BEFORE THE

NATIONAL COAL COUNCIL

UNITED STATES DEPARTMENT OF ENERGY

FEDERAL ADVISORY COMMITTEE MEETING

TRANSCRIPT OF PROCEEDINGS

12 April 2018
Washington, D.C. USA

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I N D E X

BEFORE THE

NATIONAL COAL COUNCIL

UNITED STATES DEPARTMENT OF ENERGY

FEDERAL ADVISORY COMMITTEE MEETING

Meeting was held pursuant to Invitation at the New Hampshire Conference Room, the Wink Hotel, 1143 New Hampshire Avenue, NW, D.C., USA, commencing on the 11th day of April, 2018, at 7:00 p.m. ET; adjourning at 9:18 p.m. ET; resuming on the 12th day of April, 2018, at 8:34 a.m. ET.

TRANSCRIPT OF PROCEEDINGS

MS. GALLICI: Good morning. Good morning. If you would kindly take your seats, we would greatly appreciate it.

08:34:38 Steve, I need your help. You did so well last evening.

ASSISTANT SECRETARY WINBERG: Good morning, everyone.

(Whereupon, a response was had.)

08:35:52 ASSISTANT SECRETARY WINBERG: We are now five minutes behind schedule, so if I could ask people to take their seats, or if you are getting ready to cut a deal, take it outside, outside of

the room here.

But, I'd like to get started so that we don't waste any more of your precious time.

We had an excellent, excellent dinner
08:36:19 and speaker yesterday evening. I'm eager to have a good meeting this morning, so I hereby call the spring, 2018, meeting of the National Coal Council to order.

For those of you that I haven't met that
08:36:34 weren't, that may not have been at the dinner last night, my name's Steve Winberg, and I'm the Assistant Secretary For Fossil Energy, which means that I get the honor of leading these meetings, because the ASFE is the Designated Federal Officer,
08:36:51 or DFO.

I've also served on the NCC for a couple of years, so I'm honored to again be involved with the National Coal Council, although this time from this side of the table.

08:37:05 I think you all know this, but maybe you don't. For 34 years, the National Coal Council has provided expert advice, counsel, and guidance on a broad range of coal-related policy issues,

everything from technology to energy security.

Representing the broad diversity of coal interests, the National Coal Council has always been counted on to provide solid, reliable, and
08:37:33 balanced analysis and counsel. And, because of that you have earned the respect of the industry you represent and the policymakers you advise.

So, you should be proud of the work you do. I know I am proud to be associated with you in
08:37:50 this capacity, and certainly was proud when I was on the Council for a couple of years.

Now I want to take a few minutes and acknowledge a few people that helped us immediate, immensely in keeping this organization operational.
08:38:08 On the DOE side we have Dr. Daniel Matuzak, who served as the Designated Federal Officer for about the last two years and has done a tremendous job.

Thank you Dan. Daniel, you here today?

He's back home working.

08:38:24 Also want to acknowledge Joe Giove, who is the current Deputy DFO. I wanted -- And, I want to acknowledge Joe even though he isn't here today.

It happens to be Joe's tenth wedding

anniversary, and he and his wife planned a ten-day trip to Italy about six months ago. Joe did not want to risk getting a divorce by coming here instead of going to Italy.

08:38:52 I certainly said, you know, we could change positions. No one thought that was a good idea.

We have Doug Matheney, who serves as my senior policy adviser. He's here today.

08:39:06 Doug, you want to stand up so people know who you are?

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: Thank you.

Doug has a very long history with coal,

08:39:15 and he is a valuable resource to me and the Department. And, I'm sure you're going to be seeing a lot of Doug.

Angelos Kokkinos, Angelos, please stand.

(Whereupon, applause was had.)

08:39:31 ASSISTANT SECRETARY WINBERG: Angelos is the Director of Advanced Fossil Technology Systems in FE's Coal Office, and he's also here today.

Sean Plasynski.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: Sean, where are you?

Sean is Acting Director for NETO.

08:39:47 Where am I? Jarad Daniels. I think I saw Jarad. There he is, Director for Policy for Coal.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: And Randy

08:40:00 Gentry. Randy Gentry's over here.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: Deputy Director of Science and Technology.

Also want to acknowledge our outgoing

08:40:08 Chair, Greg Workman, and Vice-Chair, Deck Slone, for their service to the NCC.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: And, of course, Janet Gallici and her team for all the work

08:40:18 that they do.

And, finally, I want to thank all the members and perspective members of the NCC that are here today. Your service to Secretary Perry and

our nation's greatly appreciated.

And, I'm grateful to see members of the public here as well. I appreciate your interest in the topics we will address today.

08:40:37 Before we conduct official business I wanted to call on the NCC incorporated legal counsel, Julia d'Hemecourt, with Hutton & Williams, to provide us with an important antitrust advisory that should be considered from the outset of our

08:40:53 activities.

MS. d'HEMECOURT: Thank you so much. Good morning.

I'm Julia d'Hemecourt, an attorney at Hunton & Williams, here in town. The National Coal

08:41:13 Council is a federal advisory committee to the Secretary of Energy.

Membership in this organization conifers no immunity from federal or state anti-trust laws. As you know, the NCC has a set of general

08:41:23 anti-trust guidelines.

If you would like a copy, one can be obtained on our web site. During this meeting we will abide by these guidelines.

If you feel at any time we've strayed from them, please interrupt and we'll seek legal counsel. Thank you.

ASSISTANT SECRETARY WINBERG: Thank you, Julie.

08:41:41

This morning, morning we'll conduct an election for the position of Chair and Vice-Chair. I'll give a keynote address, and then we'll announce the election results.

08:41:51

We'll then hear about China's work on the coal plants and coal conversion facilities from Anthony Ku, Director of Advanced Technologies at the National Institute of Clean and Low-Carbon Energy, also known as NICE.

08:42:06

And, then, following a break, we'll have additional speakers. Now, just a note.

And, we -- Janet talked about this last night. This meeting is held in accordance with the Federal Advisory Committee Act and the Regulations

08:42:19

that govern that Act.

A verbatim Transcript of this meeting is being made. Therefore, it is important that you use the microphone when you wish to speak, and that

you begin by stating your name and your affiliation.

We will also have a public comment period at the end of the meeting to ensure that 08:42:38 those not formally on the agenda are able to give us their views.

Having said that, I would like to welcome guests from the public who have joined us today, and I would like you to know that the 08:42:52 Department welcomes your view on these topics that we're being briefed on today.

Council members have been provided with a copy of the Agenda for today's meeting. I'd appreciate having a Motion for the adoption of that 08:43:07 Agenda.

Do we have a motion?

MR. BAJURA: This is Dick Bajura, as a first.

ASSISTANT SECRETARY WINBERG: Do I have 08:43:11 a second?

MS. BRADLEY: Lisa Bradley as a second. Thank you.

ASSISTANT SECRETARY WINBERG: All in

favor?

(Whereupon, a response was had.)

ASSISTANT SECRETARY WINBERG: Opposed?

(Whereupon, no response was had.)

08:43:21 ASSISTANT SECRETARY WINBERG: Thank you. The Agenda's adopted.

So, with that I think that we go right into opening remarks.

MS. GALLICI: We need to do the ballot

08:43:37 first.

ASSISTANT SECRETARY WINBERG: Okay, I think you have ballots. I'm sorry.

I think you have ballots. Members should have been given balance lots.

08:43:46 If you don't have one, could you rise your hand and we'll get one over to you. So we'll leave just a couple minutes for that.

MS. GALLICI: So, if -- This is new, so bear with us. But, I need voting members of the

08:44:16 Council who have ballots in front of them to please complete the ballots, voting for Chair and Vice-Chair.

And, if you will pass those to the

center of the room, then we have some folks here from DOE who will be collecting those. So, -- And, they will be tabulated as Steve is making his opening remarks.

08:44:39 So, if you'd kindly take care of that bit of business right now, we would appreciate it.

ASSISTANT SECRETARY WINBERG: Okay, then I think we're substantially complete. As Janet mentioned, we'll, we'll have the results right

08:45:32 after my opening remarks.

KEYNOTE PRESENTATION:

ASSISTANT SECRETARY WINBERG: So, thank you for your, for taking the time to, to vote. I want to focus the bulk of my remarks on what we're

08:45:42 doing on coal technologies, what we're doing to make our current coal fleet more efficient, and what we're doing and will need to do to make sure we're able to bring on line advanced coal plants as the current fleet retires.

08:45:58 But, first, my message to you today is that we have reason to be optimistic about coal, and that we all have a lot of work to do. No secret there.

Let me just note that I know you're doing a lot of good work, and I, as well as Secretary Perry, look forward to your white paper on coal exports.

08:46:17 In addition, I'm pleased to announce that the Secretary has just issued a letter to the NCC -- Janet mentioned this last night at the dinner. -- charging the NCC to prepare a report on optimizing existing coal fleet to ensure a reliable

08:46:35 and resilient power grid.

This report, report will take a detailed look at a broad range of issues and considerations that impact the existing fleet, including an outlook on the future generation mix, as well as

08:46:47 Policy, market, and technology opportunities for coal-fired power generation.

Given that will, it will tie into our focus on R&D to upgrade the existing fleet, while also developing technologies for plants in the

08:47:02 future, which I'll talk about in more detail in a moment, this report is most certainly most timely.

I know that it will provide the kind of insightful analysis and recommendations that have

made the Coal Council a valuable resource for six Presidents and eleven Energy Secretaries.

Now, optimism about coal was in short supply just a year and a-half ago. But, things
08:47:29 have changed.

And, the reason we can be optimistic now is that we have a president who wants to revive coal, not revile it. President Trump and this Administration truly understand the value and the
08:47:44 necessity of coal and the coal industry.

And, you can see that throughout the President's America First energy plan, which recognizes and embraces the fact that we have vast domestic energy resources in the United States,
08:47:59 including coal, and we should develop, produce, use, and support them.

And, his plan is pretty straight-forward: Boost the production of domestic energy resources, and do it in a responsible way.
08:48:16 Grow our economy, and grow jobs. Strengthen our national security, and expand global markets for America energy resources.

So, when it comes to coal, we're going

to see -- in fact, we're already seeing a new focus on Policies that level that playing field.

And, let me be clear. Leveling, leveling the playing field is not a subsidy for

08:48:38 coal, as some would argue.

Here's what it is. It's removing artificial ideologically motivated barriers to use, to the use of an abundant energy resource that remains critical to our grid and our energy

08:48:54 security, barriers that actually threaten the grid's stability and energy security, and have wreaked havoc on jobs and communities across America, and barriers that reflect a false choice between growing our economy, and caring for the

08:49:11 environment.

The fact is, by embracing innovation over regulation, we can do both. And, that's at the heart of the new energy realism that Secretary Perry has been talking about.

08:49:26 Of course, leveling the playing field for coal is not easy. We have a lot of bad policy to undo.

But, the Administration is moving on

that front because we know that domestically, parity for coal helps ensure the stability of the U.S. electric grid, and it strengthens the energy security and provides jobs in coal country.

08:49:49 But, parity also encourages a market for U.S. coal abroad. That's why the Administration has also moved to ensure that coal receives equal treatment in terms of coal exports and financing policies for overseas energy projects.

08:50:05 And, the good news is that today we're seeing a revival in U.S. coal exports. The Energy Information Administration recently noted that 2017 saw the largest year-over-year tonnage in use to coal production since 2001, driven in part by an

08:50:25 increase in demand for U.S. coal in Asia and Europe.

Overall, we saw a 58 percent increase in coal exports from 2016. And, America's coal is going to places you wouldn't have expected just a

08:50:40 couple of years ago; Ukraine, for example, which underscores the possibilities of new markets for coal.

This, again, is a key pillar of America,

of President Trump's America First energy plan. So, regulatory reform and exports, those are just a couple of ways the Administration is moving forward the president's goal for coal.

08:51:02 But, while smart policies are, themselves, technology development, the kind of innovation that reflects the new energy realism is also essential to getting us where we need to be, and that's why the President strongly supports the

08:51:17 development of technologies that will help ensure this coal's future, its next chapter, and that its next chapter will be as robust as its past.

And, this is where my office is playing a significant role. Frankly, I think this is an

08:51:34 exciting time.

We are at the beginning of the next cycle of coal technology advancements, and we have the opportunity to make great strides in efficiency and cost improvements to the existing fleet, and to

08:51:49 accelerate the development of transformational technologies that will pave the way for the coal plants of the future.

Our budget request for Fiscal Year '19

is designed to help meet these goals. And, I think it's worth taking a few minutes to highlight our priorities, and how and where we plan to focus these resources, these taxpayer dollars.

08:52:12 The overall administration request from the Office of Fossil Energy is 697 million. And, the lion's share of that, 502 million, is targeted toward fossil energy R&D, which includes funding for R&D on coal, oil, and natural gas, and the

08:52:31 national technology lab.

In addition to funding for FE, Fossil Energy R&D, we're also requesting 105 million for petroleum research. I want to point out that the president's request for Fossil Energy R&D includes

08:52:49 an additional 200 million for clean-coal R&D, made available in the recently passed bipartisan budget Act.

This is a significant bump in funding, and it speaks volumes about the president's support

08:53:00 for what we're trying to do in coal search, and his strong support for coal. So, we've requested 343 million for our coal R&D, which, again, includes that additional 200 million.

In the Budget we'll see this under a new name. It's called Advanced Coal Energy Systems, and the CCSU Program.

This program reflects our priorities on
08:53:25 R&D to improve the efficiency and reliability of existing fleet, coal fleet, while developing the advanced technologies of processes that are necessary for the next generation of coal power plants.

08:53:40 I want to take just a couple minutes and explain the new emphasis on advanced coal energy systems, which we refer to as ACE systems. As we all know, the existing fleet is aging.

We basically stopped building coal-fired
08:53:57 power plants in the 1970s. So, about 80 percent of the fleet is now around 40 years old.

And, the backbone of the fleet, those plants built in the 1970s, plants like Point Pleasant's power station, two supercritical boilers
08:54:15 which, by the way, I started up back in the late 1970s.

I was proud to cut my teeth on the start of those boilers, and I've got to tell you, I was a

little bit sad when I read in the morning clip this FirstEnergy was going to sell them and cut them down.

I spent a lot of hours on those plants; none of them wasted, by the way.

08:54:34

There's no question that low-cost natural gas hastened the retirement of, or hastened the retirement of coal units. But, in addition to that, these plants are simply getting older.

08:54:53

So, we will face challenges with both efficiency and lower capacity factors as this equipment ages. So, if you're a plant operator, you've got aging equipment, low-capacity market payments, and regulatory uncertainty.

08:55:08

It simply makes it hard to justify capital investments in these units. That's simply the way it is at this moment.

However, despite the argument from some that coal is going away, perhaps not even needed,

08:55:25

the fact is that coal continues to be a critical part of our electricity grid and energy production around the world.

Case in point: Remember the recent

spell of extreme cold, the Bomb Cyclone? It affected five independent system operators.

Coal was critical to meeting the power demand across the affected area. In fact, the

08:55:51 recent study done by NETL, -- We talked a little bit about it last night. -- found that coal provides 55 percent of the overall power generation needed to supply the six basins that NET has studied.

08:56:03 And, I would suggest that you all go on the web site and take a look at that report. It is quite well done.

I mentioned last night, I will mention again, that Peter Balash was the -- sitting right

08:56:18 over here, was one of the key authors of that. So, if you have any questions, please see Peter.

The report also warns against overestimating the Nation's ability to respond to these kinds of weather events if the current rate

08:56:32 of coal plant retirements continue.

We got through the Bomb Cyclone okay, but what happens next year or the year after if we continue to see retirement, and not only of coal

plants, but also nuclear.

So, the idea that we can take a critical generation source like coal off line doesn't make sense, and, in fact, is a fantasy. The realty is
08:56:59 that we need to upgrade or existing coal fleet to make these plants more efficient and keep them competitive, to extend their lives, and to make sure that they can operate on the grid that is accommodating more and more intermittent renewable
08:57:15 generation.

And, we need to make sure that they can operate until the next generation coal-fueled power plants are commercialized and come on line. So, while we're attending the existing coal fleet, we
08:57:29 also need to get moving on the next-generation coal plants to provide power plants for the next generation.

So, we need to focus on the technologies that are built of coal-fired power plants of the
08:57:41 future, plants that are cleaner, very efficient, and have a smaller footprint. That's what the grid needs now as it evolves with the renewables.

So, the ACE System Program springs from

the need to develop solutions where improving efficiency, reliability, and the footprint of the existing coal fleet while laying the groundwork of the coal plants of the future.

08:58:00 Under the ACE Systems Program we will target a suite of advanced processes and technologies to improve the efficiency and competitiveness of the existing coal plants. We will also prioritize the rebuilding of our power

08:58:13 generation infrastructure, focusing on technologies to stand up to next-generation coal-fueled power plants.

To be able to complete, compete with other sources of power generation, and to overcome

08:58:26 siting, operating, and logistical constraints, the constrained, the deployment o large-scale plants, these future power plants will need to be more modular, in the range of 100 to 300 megawatts; -- We're still looking at that with, to understand the

08:58:44 best size range. -- high-efficiency, more than 40-percent efficient; and nimble and flexible.

And, what I mean by that is they must be able to load follow to meet the demands of the

evolving grid.

So, under the ACE, the focus of the R&D is on power generation efficiencies, advanced systems and controls, and other novel constraints, advanced coal processing to help develop common data, common database coal combustion, on coal combustion phenomenon.

08:59:08

We're also part of the work on things like advanced materials, advanced combustion gasification R&D, including proof-of-concept and lab-scale modular gasification systems, and advanced turbine components.

08:59:20

We also want to expand our work on supercritical CO2 power production to improve efficiency, significantly reduce the size of future power plants, and reduce the costs. Right now GTI has a project underway in San Antonio to design, build, and operate a ten megawatt electric supercritical CO2 pilot plant.

08:59:40

This project will provide lessons in incubation, and we expect that additional R&D in this area will help lead the commercialization of these power cycles. And, of course, we continue to

08:59:52

work on carbon capture, storage, and utilization technologies.

The reality is that 75 percent of the cost of CCS is tied up in capital; another ten
09:00:16 percent in compression. So, the big nut to crack here is reducing the cost of capture.

We hope we can reduce it by about 50 percent -- We think we can. -- where we ultimately get the price down to about $30 a ton.

09:00:29 It's a hard goal to reach, but we're looking at advanced technologies that will have the potential to get us there. Having said that, because of the cost, retrofitting existing plants with CCS is a real challenge.

09:00:45 Now, there could be a business case if there's an opportunity to enhanced coal recovery using CO2, especially if we get the cost down, and that, combined with the tax credits. Otherwise, quite frankly, it's very difficult for others to
09:01:05 take on that cost.

So, I want to get back to what we want to do to increase efficiency of these plants. If you increase the efficiency, you reduce the

emissions.

So, higher efficiency could ultimately make these plants better candidates for CCS technologies. But, we will continue R&D on CCS technologies, which, again, can provide CO2 for enhanced oil recovery, or for feedstock for fuel, polymers, fertilizers, and other valuable products.

09:01:21

And, speaking of valuable products, the rare-earth element effort is continuing, evaluating rare earths in both coal waste and coal combustion byproducts. We want to build on that success, much of which was started by people in this room.

09:01:38

Our focus is on advancing domestic production of rare earths, and standing up critical materials, a critical-materials initiative, which would encompass related minerals.

09:01:54

By the way, I just want to note that the National Energy Technology Lab and the Oak Ridge National Laboratory recently signed an MOU to collaborate on research to expand the use of coal.

09:02:10

So, for instance, we'll be exploring ways to use coal to develop products like fibers, nanofibers, nanocarbon catalysts, and other

structural and functional materials.

So, the bottom line here is that we're looking at a lot of exciting research that could lead to a whole new prop-, value proposition for
09:02:32 coal, and to new industries and new jobs in coal country.

So, at the end of the day, new technologies need to be tested and proven, innovative processes need to be refined, advanced
09:02:44 systems to convert coal and CO2 into valuable products need to be in place, and the groundwork needs to be laid to stand up for next generation of power plants.

The ACE Systems and the CCS Program will
09:02:56 help us do just that. It will position the Department to help revitalize the coal industry, and provide utilities, rural cooperatives, and independent power producers these advanced technologies necessary to support a secure,
09:03:12 reliable, and resilient power grid.

So, that's the thrust of our coal energy program. For the next few minutes I want to talk about an exciting area that we want to spend more

time on, and that's big data.

We've got tremendous computing power across our national labs, and we have just begun to tap into that incredible asset that we have. So, there is a lot of work that we're going to be doing using big data, using machine learning so that we can do things at the Department more efficiently, quicker, with less cost.

09:03:39

And, also, these supercomputers, or these high-performance computers are going to be and already are available to industry for your use.

09:03:57

So, examples: We've got the NWRAP tool set. I think it's the most complete suite of models ever assembled to assess the geological integrity of a risk performance of CO2 storage sites related to potential ground-like activity and ground motion.

09:04:18

These tools support industry and provide technical insight to regulatory stakeholders as they design and implement geological storage, carbon storage projects to sequester large volumes of CO2.

09:04:34

We've also been working on the carbon

capture simulation initiative, or CCSI. It's a partnership with national labs, universities, and industry to develop, demonstrate, and deploy new computational tools and models to accelerate the development and scale-up of new carbon-capture technologies.

09:05:01

This initiative includes the development of data management, software engineering, code parallelization (sic), and interface development.

09:05:10

So, we've seen the value and the potential of big data in our coal program.

And, as I mentioned, there's more to do, and an increasing opportunity to use this high-performance computing capability. So, that's

09:05:27

why I think it's important to try and see over the horizon and to use all of the tools that we have within the federal government to allow us to meet the needs of what's coming in the next ten to 15 years.

09:05:47

So, now let me just circle back to what I mentioned at the beginning of my remarks, and that is that I do think there's a lot of reason to be optimistic when it comes to coal: Our president

and administration that supports coal, regulatory reform to a level playing field, increased exports, technology development to upgrade our existing coal fleet and pave the way for the plants of the
09:06:15 future.

So, in a number of ways we're seeing a comeback for coal. We still have a long way to go and a lot of work to do, but for our part we're going to be carrying out a lot of exciting and
09:06:29 important research.

But, we cannot do this alone. We will continue to need industry's help, its buy-in to secure coal's future.

The coal industry has always risen to
09:06:42 the challenge, and I know that you will do so again. And, as always, we'll ask for and welcome the National Coal Council's valuable input and partnership.

So, you can be sure that we will
09:06:55 continue to work closely with you to engage the expertise of the people in this room and outside this room that are involved in the coal space as we work to ensure that coal has a strong future.

So, on behalf of the Department of Energy, I want to thank you for your valuable and your important contributions, and I look forward to working with you. Thank you.

09:07:18 (Whereupon, applause was had.)

MS. GALLICI: Thank you, Steve. We have time for a few questions, if anyone has a, a question that they would like to, to pose to, to Steve at this time.

09:07:37 Steve, can you talk a little bit about the national labs and what's going on with some of the, the, the changes that are underway at the, at the Department for, for consolidating some of their initiatives at the, at the labs?

09:07:55 ASSISTANT SECRETARY WINBERG: Sure. We -- One of the things that, when I, I came into the, the job, having worked both with Headquarters and with NETL, and some of, and my time with Battelle working with BNNL and Oak Ridge and Sandia and

09:08:14 others, one of the things that I think we need to do is much more collaboration between Headquarters and between NETL, the NETL and the other labs.

I've mentioned that, the MOU that we

have with Oak Ridge, because that collaboration is so very important. There's so much expertise spread across our national labs, and so by working in a more collaborative way, I think we can move
09:08:42 the ball further down the field faster.

And, I came into the job thinking this. I came out of industry.

You all know, if you work together you're going to achieve more than if you stovepipe
09:08:55 yourself. One of the things that the first meeting that I had with the Secretary where he brought in the, the Management Team at DOE, he told us that -- He was very clear.

He said: To the extent that there are
09:09:12 silos within the DOE, tear them down. There's no time, there's no interest, and there's no energy in having those silos.

Now, I'm not naive enough to think that's just going, silos are just going to vaporize
09:09:30 and we're all going to be working in a very collaborative way. But, I can tell you that we are making good progress.

I'm seeing it at Headquarters. I'm

seeing it at the national labs.

And, I think it's very healthy. And, probably most importantly, it helps ensure that we are spending your taxpayer dollars in the most
09:09:50 efficient way that we can.

And, so, that's a big change, Janet, that I'm seeing. And, it's easy for me to get behind. I love it.

MR. McCONNELL: Mr. Secretary, Chuck
09:10:05 McConnell from Rice University. Can you --

ASSISTANT SECRETARY WINBERG: Yes, Mr. Secretary.

MR. McCONNELL: We all know that the growth for coal internationally is strong. And,
09:10:15 and, can you give us a sense and, as you've traveled with the Secretary, in terms of your own Department, as well as the Department of Energy, what, what are our, what's our strategy internationally to be able to get this technology
09:10:30 globally deployed to work with international companies, to work with international companies?

ASSISTANT SECRETARY WINBERG: Great question. I mentioned in my remarks we more or

less stopped building big coal-fired power plants in the early '80s.

There were a couple we built, and we built maybe half a dozen since then. The Chinese and the Japanese have taken on that market.

09:10:56

They're the ones selling new coal-fired power plants in developing countries. It's sad to say, but we simply are not.

So, they're ahead of us in that game. Rather than try and chase them to the finish line, that's why I want to move forward on modular coal-fired power plants.

09:11:15

As I mentioned, A, it's what our grids need now as they evolve with more intermittent renewables coming on line. But, to Chuck's question, more importantly, there is an export market for those small modular power plants in underdeveloped developing countries.

09:11:31

As their grids evolve they aren't going to build their grid like we did starting back in the '30s. It's going to be a different grid.

09:11:49

It's going to be a more nimble grid. Who knows what we might see.

We might see microgrids developing in underdeveloped countries. And, so, it is these small modular coal-fired power plans that I think are an opportunity for a U.S. export that we
09:12:13 haven't seen since the late '70s, quite frankly.

And, I think there's great opportunity there for us to develop and then export that technology, as well as use it here at home. Thank you for the question.

09:12:28 MR. CASSADY: Mr. Secretary, John Cassady, Vice President of Legislative Affairs with the regional Rural Electric Co-op Association. Enjoyed your remarks.

My question is: With respect to
09:12:41 Congress, with, with some recent successes in the carbon capture and sequestration space with, with the language that was championed by Senator Heitkamp that took a ride on the extender's package on the bipartisan budget bill, and then with, with
09:13:03 this week's introduction by Senator Barrasso of the USE IT Act, my question is:

How are, how are these bipartisan proposals and solutions viewed by this

Administration? Does it give the Administration hope for future successes on the Hill?

ASSISTANT SECRETARY WINBERG: I certainly hope so. I think so; yeah.

09:13:29 Any positive move forward that allows fossil energy in general to be more competitive is a positive and, and I think viewed that way by the Department and by the Administration. Absolutely.

MS. GALLICI: Other questions?

09:13:50 AN ATTENDEE: Hi. Steve Ballause (phonetic) with Advanced Resources.

With the passage of the 45Q legislation and a six-year time window in which to start breaking ground, how has that shifted some of the

09:14:07 priorities for getting demonstration plants for other technologies ready for investment?

ASSISTANT SECRETARY WINBERG: I think I can answer that qualitatively. Our focus is on early-stage research.

09:14:27 So, that, that's why when I talked about what work we're doing in CCUS, it is on reducing the cost of capture. Commercialization of CCUS for expanding that out to 45Q largely is up to Industry

to make that happen.

The DOE can support it. We can help it in certain ways, but that's Industry's responsibility and call.

09:14:59 So, what I'm hearing anecdotally is that there is a good deal of interest in 45Q, and that there are companies out there, entities, people out there that are looking to instal CCUS, primarily for DOR, but there is even some talk about

09:15:23 sequestration.

At $50 a ton is likely a little bit tight, but people are talking about it. People are looking at it.

People are doing the analysis. So, I

09:15:34 think that's -- What I'm hearing around the industry seems to be very positive.

And, hopefully that 45Q will be, will move some of these projects along, some of them that have been in the works or people have been

09:15:49 talking about them for several years now. Maybe it will get them over the finish line.

I certainly hope so. And, I -- And, I have some optimism about it.

MS. GALLICI: Steve, thank you so much. We greatly appreciate your being here and spending so much time with us, and we're looking forward to working with you on the two reports that Secretary
09:16:10 has given us.

And, I know you'll be there in support of us, and we greatly appreciate that. So, thank you.

(Whereupon, applause was had.)

09:16:25 ASSISTANT SECRETARY WINBERG: Well, all votes are in. It was a unanimous decision for both candidates, as verified by Doug Matheney, and so I am pleased to announce that Deck Slone, from Arch Coal, will be the Chair of the NCC.

09:16:52 Congratulations, Deck.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: Vice-Chair will be Danny Gray.

So, Danny.

09:17:01 (Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: So, on behalf of all of us, we thank you for your future service at the NCC. And, I think at this point I'd

like to call on the Chair to provide, the new Chair to provide us with an update of some things that NCC is working on, and then to introduce our next speaker.

09:17:34 Deck.

THE CHAIR: Well, thank you. Thank you, Steve.

I'm looking forward to telling my mother that it was an absolute landslide. I'll not show

09:17:47 her the ballot.

But, thanks, thanks, Steve, for those, those good and inspiring remarks, and really for your great visions and work in fossil energy generally, but for coal specifically. And, I speak

09:18:02 for the entire Council when I say how appreciative we are for your leadership, and how appreciative we are that you've agreed to serve as the NCC Designated Federal Officer.

It's tremendously fortunate to have a

09:18:09 past Council member and one of our own in that role. So, so, thanks for that, for all you've done for this industry, and for this cause in the past, and for what you're doing and, and seeking to do in

the future.

We really appreciate that. And, let me say thank you, the members of the NCC, for electing me to serve as Chair.

09:18:28 It is truly an honor, and I really appreciate your confidence and support. I very much look forward to working with Danny and that, and, and, and in advising Secretary Perry on coal-related issues, issues that are critically

09:18:41 important to our country's security, and to its future prosperity.

I certainly will be here to take of the mantle, Steve, on the subject of optimizing existing fleets. We'll role up our sleeves and get

09:18:50 to work.

And, I think we do have a lot to say on that subject. It really is -- It's an issue that's been much on our minds, and was very glad that the, that the Department and the Secretary and you are

09:19:02 aligned with that thinking, because there's, there's, there's really nothing more important from my perspective.

Appreciate your remarks on that as well.

Before I go ahead and introduce our next keynote event I'd like to again acknowledge our immediate past Chair, Greg Workman.

Over the past year Greg has done an absolutely superb job in leading the organization. We've sought to align our efforts with the new Administration's goals and with the new Administration's needs, and as, as, as Chair, has welcomed Secretary Perry to our spring meeting last year, which was a great thrill.

It was terrific to have the new Secretary there. He's managed a record number of NCC members.

He has overseen the NCC's recharting of the team, and he's really laid the foundation for a number of initiatives that we'll be working on here and undertaking for the Secretary in the coming year. And, he's done it all with, in his own inimitable way, calmly and, and confidently, and with great humor always intact.

Greg, we couldn't appreciate it more. You've done a fantastic job and been a great inspiration, and not just this past year, but,

really, long before that as you've guided the Finance Committee for, for years, and with all your great insights and input.

So, please, if everyone will join me in
09:20:19 thanking you.

(Whereupon, applause was had.)

THE CHAIR: One of the initiatives Greg has directed is the launching of the new NCC study for Secretary Perry on advancing U.S. coal exports,
09:20:30 as, as, as, as the Secretary has, has, has mentioned, and as we discussed earlier.

NCC members have recently been informed of that request, and to, and asked, we have asked both Justin Borak (phonetic), of Peabody, and David
09:20:50 Gloss (phonetic) of Norfolk Southern, to cochair that effort, and are looking forward to the good work on that front.

We'll be hosting an organizational meeting later this month, and plan to have the
09:20:56 report completed by the fall meeting in September in Norfolk.

Of course, one of the prime export markets for coal is the Pacific Rim. China is a

very strategic player in the coal market, but equally important, a leader on a range of coal-related issues.

And, to that end we're delighted to welcome Dr. Anthony Ku, Director of Advanced Technologies at the National Institute of Clean and Low-Carbon Energy, or NICE, to, to the National Coal Council and to our meeting.

NICE is the research division of China Energy Group. Dr. Ku is responsible for R&D and directing China Energy's strategic challenges related to carbon emissions standards, operational efficiency, and for long-term sustainability.

We won't go through the full bio, but it is available on the web site, and so I certainly recommend to you, recommend that to you. Dr. Ku will be speaking to you today on China's efforts to advance ultralow emissions coal power, a topic of great interest to everyone in this room, I suspect.

So, with that, please join me in welcoming Anthony Ku.

(Whereupon, applause was had.)

CHINA'S EFFORTS TO ADVANCE ULTRALOW EMISSIONS COAL

POWER:

DR. KU: All right. Good morning. Assistant Secretary, Greg, Deck, Janet.

Thank you for the invitation to speak today. I've really enjoyed the time that we've had.

It's been very educational for me, and I think there's a lot of common interest in coal on both sides of the Pacific. I've been asked today to speak about some of the things going on in China specifically related to technology deployment in the area of controls and also coal companies.

And, so, let me start off with a moment of disclosure. I've been in my role for about a year and a-half, so I'm very focused still on learning my job.

What I've put together are some thoughts organizing the four sections that I hope will be useful. So, I'll start off by giving you a little bit of background about China Energy and NICE, how they fit together, and what my role is in this overall picture.

I'll then talk a little bit about the

strategic landscape, kind of the priorities with respect to energy, and then specifically the coal sector.

What are some of the regulatory riders
09:22:55 that are really influence some of the things that are going on there? And, then I'll spend on two, two other topics, one going a little bit deeper value on some of the technology deployment related to air pollution controls, specifically the ry
09:23:08 primary emissions, SOx, NOx, particulate matter.

And then I'll go into a little to try to understand the impact at this point. And, then I'll wrap up with a brief overview of some of the different plants with respect to coal conversion
09:23:19 that are operating under China Energy, again where some of my team members are working to help optimize the operations there.

So, let's get started. Or not. Oops. Okay.

09:23:32 So, China Energy was formed last year through the merger of two companies, Shenhua Group, which is a mining company, virtually integrated through power. That was where NICE was originally

was organized started; and China Huadian, one of the top five electric utility companies in China.

So, China Energy Group is now the largest electric supplier in China, roughly

09:23:56 a-third. You can read about the assets on the side of the company there.

And, so, in order to calibrate these, the company, we mine about 500 million tons of coal per year. And, that's primarily, primarily from

09:24:06 the Shenhua legacy operations.

By generation capacity we have about 190 gigawatts of coal-fired power, and at the same time we're sitting on about 30-plus gigawatts of wind capacity. And, so, those are generated capacities,

09:24:22 not actual megawatt hours or kilowatt hours generated.

And, then, our other division is probably one of the largest ones in the world. It's about 15 million tons of coal-fired per year.

09:24:29 So, that helps to tolerate the fluctuations in the power supplies. It's a state-owned enterprise guided by the China Government.

But, within it there are a couple of divisions, one of which is NICE, and that's National Institute for Clean and Low-Carbon Energy. It was founded in 2009, intended to be this sort of
09:24:45 hybrid where we're looking at gas technology into the operation integrated into the group, and now it's China Energy, to help us move forward in terms of energy impact and those types of things.

Our current workforce is about 500
09:25:00 people, most of those located in Beijing. And, we have three offices: Beijing, which is where the headquarters are.

We have an office in Mountain View, California. So, I split my time between Beijing
09:25:13 and California.

And, we have a small office in Germany. That's a venture for solar power.

That's the advantage of having that here. It works well for that area.

09:25:20 The work in our organization is split into several different platforms, of which I'm one of the platform leaders. So, here are the platforms that are active.

So, catalysts, clean coal. Coal-derived materials are things that you have heard about and I think is common interest in this room.

Those are things that, that really look
09:25:36 at the existing operations. And, then we've got the thinking about the economics, energy storage, grid management, those types of things, and hydrogen energy as a, as a transportation fuel medium.

09:25:48 And, then, water treatment is primarily focused on gray water treatment and storage. And, there are other things some of the core technologies could be used for.

So, those are what my colleagues work
09:25:59 on. I do the advanced technologies, so I have responsibility for a couple of things.

And, I've listed those in vague terms here on the chart. One of the things that I think about is are the big improvements from existing
09:26:11 fossil fuels that we have.

So, it's primarily being responsible for this, but also thinking a lot of about CO2 and where that's heading. And, then, I'm also responsible

for pipelines.

So, those are other things that we should be thinking about that we already have a home for in our institute. So, I'm an incubator
09:26:29 for things like technology, incremental work, data, things that are really sort of out there that may eventually graduate to some of my colleagues in the next couple of years.

So, that's how I fit that's how it in
09:26:41 the scheme of China industry. So, hopefully that's of interest to you in terms of prologue and a context for why I'm here.

The second thing I want to talk about is to give you a sense of what the overall energy
09:26:51 needs for China. Again, this is my introspective trying to think through:

What are the big drivers in the landscape that are shaping policies, shaping industry, what are the drivers that to what's
09:27:02 important in China. And, I think the starting point of that, as some of you may be aware, are the five-year plans that are established by the Government.

So, the '13 five-year plan is available on line in Chinese and in English. And, what I've done is extracted what I think is some of the salient points from that to try to give you some
09:27:18 sense of some of these and other areas where there might be a little different.

So, I'm going to go through a few things that I think are useful and relevant in the next couple of minutes. Starting with the overall
09:27:29 energy landscape, by 2020 the goal is to have total energy use growth to about five billion tons.

So, understand, that's the first goal. So, there's a target for total energy use across the entire economy.

09:27:42 When you break that down, you now look at the different things like the fossil, nonfossil share, and CO2. Those are sort of in a combination.

And then in oil and gas there's some issues to think about, unconventional resources,
09:27:56 specifically a target around shale gas that's -- And, there's other things involved. But, again, I wanted to give you the highlights just to think about because some of the things going on around

the world also apply in China.

There's some things in China that make things not exactly transferrable technologies that we can dig into later if there's interest. In the generation mix, coal's still the big player.

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It will continue to be the big player, but there is interest in supply and quality, and around some of the other technologies. And, in Round 4 I wanted to highlight one of the targets in 2020, which is an efficiency target.

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And, that's expressed around coal, which I've translated into an LHD efficiency. And, I wanted to note that it is an efficiency which, I think is more common in the U.S., but there are drives towards efficiency making coal cleaner, but also staying very much focused on coal as being one of the primary focuses of coal as being one of the primary sources of energy in China in the years ahead.

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09:28:55

Digging a little bit deeper into coal, the area of coal mining, there's a drive towards consolidating and driving efficiency in the centers. So, there's a cap on the total output

that's, that's aspirational.

There's a drive for to be more efficient. So, the number there of inefficient capacity while also allowing the ramp-up of about 09:29:16 500 million tons of more efficient mining capability, and also consolidating industry from many, many small players, towards a medium number of relatively large players down the road.

So, those are the drivers across the 09:29:30 coal-mining sector. And, that impacts sort of the coal-mining aspect.

From a usage point of view, I've already mentioned the 300 grams per kilowatt hour for new plants. There's also an initiative to try and get 09:29:45 existing plants to about 310, although it's not all exists plants.

There's a lot more nuanced target. But, those are the targets.

"CHP" relates to "combined heating 09:29:57 power." So, thinking about permitting energy and finding ways to use it more effectively.

And, then, ULV is something I'll come back to later. ULV is ultra-low emissions value.

And, on the coal accountable side there's the aspirational goals to modernize the production and continue to build upon the successes that have been demonstrated in China with respect to large-scale coal conversion.

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And, then, there's also some specific capabilities for technical application for coal gasification, for more work investigating gasification cleanup, and, then, water treatments to the environmental impacts of gasification, as well.

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But, really, looking to maintain that total capability is giving China's energy mix and it's resource as a green country. So, emissions is something that I'd like to start to shift the focus to a little bit more.

09:30:42

We've all seen pictures, I think, of some of the, the smog that has rolled in over some of the suburban cities. It's quite striking to see on video.

09:30:54

In fact, it's more striking to see in person. And, it is something that the Government is taking very seriously.

And, so, in 2013, the State Council has issued or issued an Order driving down the particulate matter to 2.5 microns. Particulate matter of 2.5 microns is small enough to lodge into
09:31:14 the lungs and, and cause cancer.

So, there's parts where LNG refers to a specific urban region around Beijing. The parole data and industrial data all are centered around major cities.

09:31:26 So, these are additional targets that are more aggressive. And, then, Beijing, specifically, now there's a hard target that's part of their target.

And, I'll come back to these targets and
09:31:34 how they're being addressed in a moment. In terms of CO2 training, I spend a lot of time thinking about that.

I won't have time to go into that today, but right now in China they're on Phase 1 of a
09:31:41 multi-phase experiment.

So, Phase 1 involves seven targets in which we have credits of an assigned treaty. By 2020, there will be the introduction of Phase 2,

which is a national target.

And, the information that we have is that the entire country is going to be participating in that. And, our target is about 550 grams of CO2 per kilowatt hour of electricity.

09:32:04

And, just to calibrate you, right now most power plants are working at 800. You're looking at a very substantial drive towards reducing CO2, and also try to begin to address that issue. Just last month, as a consequence of the Party Congress, a new ministry within the Chinese government was announced, the Ministry of Ecology and Environment.

09:32:21

And, that's essentially now sort of an empowered environmental group which is responsible for air, land, and water quality. And, so, that's still being figured out, how, how that will occur.

09:32:34

But, that's something that will be on the landscape and that will be increasing the monitoring of energy production and its impacts to the environment.

09:32:46

Last thing I want to touch upon is some of the recent priorities that have been laid out in

the five-year plan. And, these are, again, are extracted records in the plan.

These are in the clean coal utilization space. A lot of these are relatively

09:33:08 self-explanatory.

I want to call your attention to the third one, the low- and medium-temperature properties, and the fourth one. These are the things that are most relevant to be discussed in

09:33:21 this, this meeting.

And, there is work, primarily driven by the administrative science and technology. But, those are things that, that currently are being funded within China's structure.

09:33:33 So, with the time that I have left I'd like to dig a little bit deeper into the two topics that, that are sort of the reason I was invited here, which is to talk about what's going on with respect to air pollution, and, so, on the other

09:33:51 hand, with the time I have after that, the coal-to-chemical conversion.

So, the way I'd like to do that is, rather than give you numbers or, or just general

statements, I'd like to dig a little bit deeper because this is an area where I have a team.

And, so, the acknowledgments here are for members of the team. So, let me start off with the targets.

09:34:07

So, these are numerical targets for SOx/NOx. Special areas refers to some of those urban areas that we spoke of earlier.

Referal environments are sort of the aspirational targets of what your targets should be able to do. And, for reference I've used natural gas in terms of calibrating the, the quality of these targets.

09:34:23

The installation refers to the mandate that all power plants within China by 2020 should be in compliance with these Regulations. And, so, I have quotes FOR you from 2016, which is a little bit dated, but I didn't have the 2017 numbers when I put this chart together.

09:34:37

09:34:51

So, to the percentage of the power plants where ULV retrofit has been, has been completed. And, so, the latest I have on the Shenhua side is we're close to being fully

compliant within the next year or two.

So, we'll be meeting that target of, of having ULV technologies installed on all the plants within the, the required time by the Government.

09:35:14 So, the study that I'd like to show you is, is basically a, I think a commercial question about if you're putting these technologies on power plants to reduce emissions, how well are you doing, and what's the impact ultimately on air quality?

09:35:28 That was the question posed to the teams. We have this investment capital.

We were doing something. We know that emissions are coming down, but is it making a difference?

09:35:37 So, that, that's the question that I'll now have spend a little bit on. When we did the numbers, at least we did the Shanhua numbers, we had to find out what the numbers said about what was going on.

09:35:45 So, the data is, We went to 42 specific units at 18 power plants at a variety of different types of power plants, subcritical all the way through to ultrasupercritical. And, we surveyed

the emissions coming out of those plants before and after the installation of the ULV technologies.

Let me show you -- Before I do that, let me show you the technologies. ULV technology is

09:36:09 not a single technology.

It, it's actually a suite of different technologies that can be combined into various colonies. And, over the 42 different areas of this study, we had actually eight different pieces to

09:36:16 figure in.

And, so, I've looked at some of these here. I think some of these will be very familiar to people.

The SPC refers to a proprietary

09:36:29 technology that was developed in China, which is a novel technology which, essentially, It tries to take out sulfur as well as particulate matter simultaneously.

So, it, it's something relatively new,

09:36:40 but it, it's been deployed in China. And, so far, from all we have seen, the data suggests it's pretty competitive.

So, this is a, a snapshot of raw data,

as well as stack data from one plant. So, on the top row you see three charts.

The red and the blue show you the performance before and after the ULV. The red is the power plant before ULV.

09:36:57

The blue is the power plant after ULV. The X axis is time, and the Y axis is essentially is hardware. And, the first thing that probably strikes you is that the red lines are all over the place.

09:37:09

And, part of that is that is something I think that, that it's fair to say that in China we have over-capacity. We have load following.

We have the power plants really running in fairly progressive positions. And, I think that's useful metrically to show you how problematic that can be.

09:37:19

The bottom of the chart's actually now saying: Well, can we treat it all as the same rather than ramping up and down? That actually affects the amount of emissions that are coming up.

09:37:32

So, on this bottom side you're seeing, again, data for NOx, SOx, and particulate matter,

where the X axis is tracking for the load level and the Y axis is showing actually how much load you're getting.

So, those lines, both of those lines, basically now show you the load status. If I'm running for a certain amount of power status or not, or how much are you getting out of that.

So, these emissions factors are comparable to U.S. emission factors. That's sort of the same idea, where I think it's going to 42.

We're just over the line, representing that initial spread, because there is variability in the system. It starts to get into some of the things that, that I really enjoy, but maybe I don't need to speak too much into the tech with you guys. Oops.

So, then, what we can do is now cross from a single plant to 42. And, here what I'm showing you is particulate matter data.

The left side of the board is before ULV. The right side of the board is after the ULV for all the power plants.

So, these are the averages, sort of the

emissions factor of the average. The red triangle that you see is for each power plant and what that specific power plant is expected to need from a regulatory policy.

09:38:46 So, the bottom line is you're seeing fairly good performance with respect to ULV impact. Namely you're seeing the drop in the absolute value of materials coming out, as well as a reduction in the pollution.

09:39:02 We can plot that a different way, and now what we're doing is averaging. If you think about the bar chart, a highlight is actually the factor related to how much pollution is coming out.

And, what I'm showing you is the

09:39:17 sequence of time to 2006, 2010, and our recent data used, 2016. And, what you'll notice is there's a dramatic drop in emissions.

And, again, that's something that you would expect as you deploy across the whole fleet.

09:39:36 But, I think it's interesting also that we're now able to quantitatively show in terms of quantity.

That's happening at these different plants after we put the technology on board. But,

that's not the whole story.

At the end of the day, what we care about is the quality of the air. And, so, one of the things that, as we dug into this, what we found
09:39:55 is it's not the primary emissions that's driving the smog in our area in China.

It's actually a combination of a lot of different factors that are putting it in the atmosphere. And, then, once it's in the air,
09:40:10 weather, weather happens.

Atmosphere. And, as a result, you actually have a whole lot of concrete things that occur that then will ultimately create the smog that we experience.

09:40:21 And, so, what I'm showing here is that if coal power is able to clean up its act. But, that's a question that we worked with one of the universities.

So, we brought some updated core data
09:40:37 and we asked them: Well, if you put in the reduced emissions from coal, what happens?

So, let me show you some of the work that we're doing there. So, what we're looking at

here is that exact study map that mapped that activity.

And, we mapped this specifically for areas around Beijing. Red is bad, and, then, white is, is a little bit better.

09:40:52

And, what we found in these three cases. One is what happened, happened, What happened if you replaced all the power plants that existed at these coal plants with ULV.

09:41:06

The middle one is if you didn't do anything. You just left them to run as usual.

And, the last chart is sort of the difference. How much better did you do?

And, so, it's kind of difficult to

09:41:15

interpret these if you're not used to doing it. And, so, what I put on there is we're seeing about five-percent decrease by putting on 100 percent ULV.

And, so, we didn't really understand all

09:41:25

of those results, and, so, we're digging a little bit deeper to make sure we understand all the contributions and reasons why we came to that.

But, what we were trying to do is

isolate the points, because there's a connection between the capital and the technology.

We want to make sure they're paying off. We want to also have a dialogue with the Government to make sure that regulatory burden that's put on matches. So, for example, if there are multiple contributors that are small, we want to help our government to make sure we understand what is the proper foundation for the burden you can put on coal and the other contributors.

So, it's something we're working hard on. It's something we're excited about because we think it's valuable from a capacity point of view, but more importantly, from a commercial and tax point, as well as for the environmental and air quality.

So, with the time that I have left, let me take you briefly through a few things we've been doing here. And, again, acknowledges some of the people that have done the work that maybe you'll see here.

This is a chart from one of my colleagues around different things you can do with

coal if you're not going to burn it for power. And, so, here's the, some areas that we've come up with.

Of course, direct liquefaction from

09:42:33 coal, generating liquid, primarily. And, then you're doing methanol from coal, so you're taking coal, gasifying it to syngas and taking that syngas and converting it.

And, the reason I highlighted these two

09:42:46 is that these correspond to coal power plants, or, sorry, two coal-fired chemical plants that are up and operating in China. So, let me step through each of these very briefly, and then I'll conclude.

So, the first one is the plant, it's the

09:43:05 first, I think, large-scale coal liquefaction plant. This was undertaken by Shenhua Chemical Company before I joined.

It's nice. Being a technology organization has helped various technological

09:43:20 issues along the way.

So, the basic idea is you start with coal. You gasify it, water gas shifted and produce hydrogen, and then that hydrogen is fed through a

reactor, a three-phase reactor which delivers particles, coal slurry particles, or coal particles, and then hydrogen.

And, then, the reaction occurs to
09:43:38 produce liquids. And, so, some of the technologies were developed on the fly.

But, the take-away I'd like you to, to notice was that this plant was, was started, at least on, on paper, almost three decades ago. The
09:43:51 Phase 1 commissioning, which is the eleven tons per year, started about a decade ago, and now we're starting our second decade of operation here.

And, I think, although the plant is, is operating really well, there are always, always
09:44:04 issues around technology issues. There are still issues around reliability.

And, those problems will continue to crop up. How can we increase yields?

And, one of the things I get to do is
09:44:12 look at these questions and think: How can we get in and debug these to make it a better operation?

Similar story in the methyl ammonium plant. Here, again you're doing a process diagram,

which is a little different.

You start with gasification, then moving to the syngas, and then moving to the coke reaction. And, then, ultimately, in this case, the, this plant produces a fairly high yield of polyethylene and polypropylene.

09:44:32

And, you can see the numbers there. And, again, similar story.

Plant's been operating for a period of time. Some of the initial kinks have been worked out.

09:44:41

Based on the ongoing operation, which I go is fairly standard in the industry, we can always find opportunities to do better. And, so, we've got support to try to help issues of reliability, trying to bring in some technologies that we think can target some specific issues within the plant.

09:44:53

So, let me wrap up here. I'll leave you with four take-aways.

09:45:02

One is that coal will continue to be important. It's a primary resource in China, and there's a lot of it.

We look at where we're at, it's still a dominant player that I don't think will change in the future, but I think there will be drives to try to find how we can make coal cleaner. We all need
09:45:20 technology that can make that very rapidly evolving.

And, so, the, the data leads, the, the impacts, hard for science to keep up, but I think it's important to really understand if you do
09:45:31 something together, it makes a difference in how much.

Large-scale full-coal operations are now starting to get to the phase where now we can really drive towards, towards second-generation
09:45:39 technologies. In's strategic interest within the country to move forward there.

And, for me, I kind of threw this in as a plug for some of the work that I do, is that R&D is an important piece. It's not, not the end game,
09:45:52 but it is an important regulator.

So, I want to try to make sure that we, we study the, the right phase so that it's helping to meet the energy needs with coal being in its

place.

Let me pause or stop there and, and take any questions that you may have. Thank you for your time, and thank you for the invitation to come.

09:46:07

(Whereupon, applause was had.)

MS. GALLICI: Thank you, Anthony. As I'm walking back to start the questions I just wanted to thank you for calling your, your, your institution "NICE."

09:46:20

I harken back to Steve's comment that we need to revive coal instead of revile it. So, it's nice to have something "NICE" when we refer to coal.

09:46:29

Thank you very much.

MR. PURGERT: This is Rob Purgert, President of Energy Industries of Ohio. I think the 700 joules USE, the original plan was to bring on line for 2020.

09:46:50

Is it still on track? And, second part of the question is:

What percentage of the fourteenth year plan, it's from 2014, would be going to the U.S.

technology?

DR. KU: So, the, the short answer is that's not something that I actively work on, so I don't want to give you an answer. So, so, I don't
09:47:11 personally work on it, so the work that goes on at NICE is different from that.

So, I could, I could speculate and, you know, and share chatter, but I don't think that's necessarily productive. So, with the specific
09:47:24 question, "How far along is it?" I believe there's R&D going on.

Beyond that, I don't feel I can answer that after that. The second part of your question is: How far along is the 14-year plan and how I
09:47:32 think if any of that is being made up?

I think the conversations around the 14-year plan are ongoing, but nothing official has been released, so I can't really comment on how those things are going at this time. So, again,
09:47:45 apologies to not be able to give you the right answer.

MR. PALMER: Yeah, my name is Fred Palmer. I've been involved in the U.S. coal

industry for a while, and been on the National Coal Council for a lengthy period.

I, I have had the privilege and, and honor, really, of, of traveling extensively in
09:48:06 China with Shenhua and, and many of the great companies you have there developing your coal resources, and National Coal Council, itself.

And, alternative uses for coal, we, we have done extensive studies over the years in that
09:48:22 space. Our, our shale oil and shale gas development here pulled that back.

But, with what's going on right now in the fossil markets, oil particularly, I think we're, we're going to see a resurgence of it. I am
09:48:36 chairing a subcommittee, a policy committee on new markets for coal, and we use China, as you know, as a mirror in terms of what can be done with coal, and, and applaud what you have, what you have developed there.

09:48:51 My question directly goes in the coal-to-liquids, coal-material space. Are, are -- You continue to advance the agenda there with, with respect to both, coal-to-liquids,

coal-to-materials.

And, how robust do you see that field being going forward, given what's going on in current fossil markets, oil markets?

09:49:15 DR. KU: Yes. So, thank you for the question.

I think the idea of, "What else can we do for coal besides use it for energy?" is, is one that's relevant around the world. And, within

09:49:24 China, at least within NICE, there's active R&D, both in terms of clean-coal technologies, as well as converting coals to value-added materials.

So, the whole idea of liquefaction residue, what we can do there, to fly ash, minerals

09:49:42 from, from coal. So, I know the U.S. is very interested in there.

So, I think scientifically, at least within our institute, a lot of interest on that. The bigger question is:

09:49:52 Can you convert coal into liquids and chemicals? And, I think, again, there's, there's sustained interest there.

But, at the end of the day, you have to

balance the economics. So, the price of oil there is always a driver in China, as it is in the U.S.

So, within China, the specific dynamics I think are different, but there is sustained

09:50:15 interest to continue to look at these as a strategic interest there, and also that the operations that do exist are profitable.

But, I think the question as to how to, to manage that uncertainty is something I'd refer

09:50:26 to the business people. But, from the technology point of, of view, we're looking at different things and are very interested in what's going on around the world related to coal.

MS. KRUTKA: Holly Krutka, from Peabody.

09:50:42 And, I want to thank you so much. That was, that was a great presentation.

I think your graph that showed the impact of going to ULV technologies on the Beijing area was really powerful, and it's, it's, it's

09:51:00 something that's, like, sorely needed in the States. Everyone talks about we know that a lot of emissions are from other industries, but it's really easy to target coal-fired power plants in

the absence of that, right?

So, I think you were showing 4.5 percent improvement by transitioning. And, so, shutting down those plants maybe give you -- What? -- five

09:51:22 percent improvement.

So, you spend a lot of time and energy to focus on just the tiniest sliver of the pie. So, I'm -- I think it, it's a really powerful statement that you've made with that graph.

09:51:36 And, I'm just wondering if you looked at other areas? Did you find similar results?

And, if so, do you think that there's any possibilities for changes in the, in the Policy related to closing the coal-fired power plants in

09:51:50 some of those key areas?

DR. KU: So, thank, thank you for the question. And, I think the -- I, I personally was, was kind of struggling with, with the, with, with whether there's been through that or not.

09:52:02 I think it's valuable to, to argue for a national Policy where you're assigning responsibility to all the different primary sources. And, that's one of the reasons we

undertook the study is to say:

Can we have enough science to do policy? And, and, there, I, I think the risk is that if you show people a number like 4.5, that gets stuck in people's head, and all of a sudden you move away from the discussion about what are relevant things, and it's a talking point.

09:52:22

MS. KRUTKA: Yeah.

DR. KU: So, I, I wanted to be ver careful, because we are, we are doing the research. We want to put in good science.

09:52:30

MS. KRUTKA: Yeah.

DR. KU: And, once we have the good science, I think it's then valuable to have a reasonable discussion with the Government within China. So, we're not at that stage yet.

09:52:35

We're still evaluating our results. Once we have those, we are planning to publish those so international scientists and technologists can look at those. And, then, from there I think that there's a willingness to put the data out there for you.

09:52:52

We haven't reached that stage yet. But,

again, I want to show that as sort of it's an indication that there are some of these things that, that we're specifically doing now on the ground, at least, that I've announced over to try
09:53:05 to move things forward.

So, hopefully that, that's a long-winded answer to your short question, but I think at least within the context of where I'm operating, I think starting from the technical basis and then
09:53:18 exploring the, the policy and business applications is something that I, I've got a green light to do from my CO, and also the leadership within the company.

So, that's how we're trying to approach
09:53:28 the problem.

MR. KOKKINOS: At this point I'd like to amplify -- This is Angelos Kokkinos, with the Department of Energy. I just want to amplify something that Holly said, and it's a very
09:53:43 important thing, and we're doing the right things in terms of the impact of other sources on the overall quality of air.

There's a wealth of information that was

developed in the '70s and '80s in the United States that explains the impact of, for example, hydrocarbons and emissions and sunlight, and things like that.

09:54:07 So, keep on looking at that, because that's, that's very important technology.

MS. GALLICI: Thank you. Let's --

AN ATTENDEE: May I make a comment?

MS. GALLICI: Yes.

09:54:17 DR. KU: Thank you for that comment. I think it's, if, if it didn't come across during the presentation, I think it's important to comment that we really did pay very close attention to the emissions.

09:54:26 So, the work that's been done in the U.S. on emissions has been a great part of that work again. So, -- And, part of it is that when we looked at some of those, that data, we noted that inside of China, because the situation was changing

09:54:35 so fast, the raw numbers that you put in are no longer the right numbers.

And, that was, that was one of the things that inspired the work I showed you today.

But, it is something I think is really important that both side of the Pacific have a lot to learn from each other, and so that's, this is a specific case of, of that.

09:54:55 MR. THOMPSON: John Thompson, Clean Air Task Force.

Great presentation. Could you comment about Regulations that are perhaps under development China?

09:55:03 We've heard discussion that maybe beginning in 2020, emission rates or emissions on CO2 from coal-fired power plants might go from, over some period of time, in, say, maybe 900 grams per kilowatt-hours, down to 550.

09:55:22 Can you -- Two questions. Can you comment on how those Regulations are developing? And, if they are passed, what does that mean for exports of U.S. coal to China?

And, what kind of technologies should we
09:55:36 be looking at in order to export to, to meet those kinds of restrictions?

DR. KU: Well, those are actually questions that do keep me up at night. With

respect to the CO2 side, there's been a public announcement of the target for the power companies, the 550 per kilowatt.

So, that's target put out by the
09:55:58 Government, and now it's sort of up to Industry and Regulators to work up how those happen. So, that's one transferences that I'm learning about in terms of:

How do things happen in China versus the
09:56:13 U.S.? So, it's something that's active. I can't give you more specific detail on that.

With respect to your second question, what are some of the technologies that we should be thinking about, we have collectively, being the
09:56:23 world, and specifically the U.S. Again I want to be careful, because I don't want necessarily to constrain policy recommendations.

But, I've listed some of these things for you. If you want to go deeper than the
09:56:37 five-year plan, actually I can give you. Certainly in China the Ministry has benchmarks against what's going on against the other world.

So, pay attention to things that are of

interest in DOE and U.S. and other things; not to say that there's a direct correlation to the technologies, but the core, fundamental technology, let's say, is for, for a new cycle may be
09:57:06 interesting, but the specific demands on that cycle will be different in China, and, as a result, there's some, some unique development plans that need to occur.

I've seen a lot of that in my career,
09:57:19 but, yeah, if you have a question.

MS. GALLICI: John was going to have the last question, but, among the many perks associated with being Chair of the National Coal Council is you get to have the last question.

09:57:34 THE CHAIR: So, I like this job. Sorry, John.

So, Anthony, thanks for that terrific presentation. I've got -- And, you may not want to stray to this, I realize, but, you know, obviously,
09:57:46 this level of technology has really been driven by the country's needs.

But, obviously there's, there's value in that, great value. And, whatever it is, there

clearly is value in that.

But, as, as you see progress being driven in China, and as you see emissions coming down, here's the speculation part. Can you
09:58:05 envision a time where Beijing uses its bully pulpit a little more aggressively to say, you know:

Coal has made a lot of progress. We're making great progress.

We're achieving significant things. For
09:58:18 the world to get to stabilization of carbon by 2050, we're going to have to have a low-carbon fossil solution.

We need a low-carbon solution for coal. We need to be investing in these areas.

09:58:29 Is there a scenario where -- Because I do think that would change the international dialogue in a significant way if China said, you know, with 50 percent of the world's coal production or more, in order to embrace this
09:58:45 technology, you know, embrace coal and embrace this technology, it could be a massive change, I think, in, in the way that the topic is discussed, and in terms of the momentum for near-zero emission

technology.

So, if you dare venture into that, it would be interesting.

DR. KU: Sorry, I actually don't dare. But, what I can say is I think you do see certain signals by very senior members in that regard.

There's a, you know, reduced limit to it, and if you look at the sort of fraction of coal in the energy market, I don't think you can actually reach those targets without doing something in coal.

I, I think that if you reach and start to look at the next five-year plan, as we get closer to that, you may see clearer exactly what we're talking about.

(Whereupon, applause was had.)

THE ASSISTANT SECRETARY: Well, thank you very much, Anthony. I'm sure that during the break we'll have additional questions.

So, we are now going to take a, a 30-minute break, and I would ask you, because we're about 15 minutes behind schedule, I think that's okay, but I'd ask you to be back in your seats at

10:30 so we can have a prompt 10:30 start. Thank you very much.

(Whereupon, at 10:00 a.m. ET those present took a brief recess and returned, after which, at 10:31 a.m. ET, the following occurred:)

10:00:06

ASSISTANT SECRETARY WINBERG: Ladies and Gentlemen, it is 10:30. If I could ask you to take your seats.

If I could ask people to take their seats, it's the bewitching hour.

10:31:58

Janet, I'll ask you to take over the podium and introduce our next speaker. Thank you.

MS. GALLICI: That you very much, Steve.

We're going to have a series of three industry presentations now beginning, with Randall Atkins. Randy is Chairman of the Board and Chief Executive Officer of RAMACO Coal.

10:32:32

He's been involved within the energy-related development and financing industries for over 35 years. Just a great combination with having that kind of investment experience and technology.

10:32:47

RAMACO Coal, for those of you who don't

know, is a holding company for three coal-related companies. One is RAMACO Resources, which is a publicly traded metallurgical coal operator and producer with operations in central Appalachia.

10:33:13 RAMACO Royalty is a private metallurg-, well, mineral and infrastructure company, and RAMACO Carbon owns roughly one billion tons of thermal coal in the Powder River Basin. And, that company is involved in the development, research, 10:33:28 and manufacture of, of various coal product technologies, which is what Randy will be speaking to us about today.

Randy is a brand-new member of the National Coal Council.

10:33:39 So, we're pleased to welcome you, and nice to see you jumping right in here.

And, I'd also like to thank RAMACO Coal for their sponsorship of the National Coal Council meeting, and we can thank Randy for the wine 10:33:52 service last night. So, can you please join me in welcoming Randy Atkins.

(Whereupon, applause was had.)

CARBON FROM COAL:

MR. ATKINS: If I did this right. Well, I'm delighted and honored to be here today to be able to talk to you about something which we feel has got some very positive long-range implications
10:34:16 to the coal industry.

Now, all of us in the coal industry know the concept of fear. So, fear has a wonderful ability to focus the mind.

And, several years ago we were dealing
10:34:33 with the twin demons of: How do you avoid stranding roughly a billion tons of thermal coal? And, similarly, how do you basically argue to your investors that you can justify the amount of capital to open a new thermal coal mine?

10:34:55 So, the model we have come up with is the answer to that. And, the many groups which are not quite as sophisticated as yours, we actually prepare a clip to try to briefly explain what it is we're trying to do.

10:35:11 So, Dave, if you could take it from there?

(Whereupon, a video was shown, after which the following occurred:)

MR. ATKINS: So, does coal, and thermal coal, in particular, really have a future? As someone from the investment background, we think the Jury my still out.

10:38:07 I'm not sure that thermal coal will necessarily be able, in the long run, at least, to compete against renewables and gas in a race to the bottom as the cheapest use to power. But, the quandary, of course, is the U.S. is possessed of

10:38:28 the largest and the cheapest coal reserves in the world.

The problem is that 95 percent of the coal is used strictly for power. Only five percent is used to make higher-value products, which we're

10:38:43 familiar with because we're in the met coal here, and met coal sells for a much higher price than the thermal coal.

And, indeed, in the west, it sells for probably 20 times what Powder River Basin coal

10:38:58 sells for. So, our approach is to, in essence, attempt to diversify as a coal company.

Since coal is the cheapest source of carbon, there's an opportunity. The problem is,

the carbon products today are expensive.

They're expensive because they principally are derived from petroleum. So, our solution is really simple.

10:39:24 Let's use carbon from coal. So, our objective as a company is to create high-volume, high-margin product uses for coal from carbon.

The idea is to build an innovative higher-tech future for coal that is somewhat

10:39:44 independent of power trends and environmental issues. So, coal can be, we feel, very positively disruptive.

So, carbon is becoming the dominant advanced material. We have talked about it over

10:40:00 the last day or so in various forms.

There are carbon fibers, graphites, and carbon masses. So, the trick is to make these advanced materials for a lower cost from coal.

That, if it's achieved, can be very

10:40:19 disruptive. We think that they could replace or at least enhance many basic metals like steel and aluminum, basic building materials which we'll get into in a moment.

And, carbon also, of course, has vast application in chemicals which our last speaker mentioned, as well as life scientists. All of these uses are fast growing, game changing, and we
10:40:45 feel could potentially require large volumes of coal.

In some cases, we have calculated some of these uses could use in excess of 100 million tons of coal a year, which, when we think about how
10:41:05 much coal the U.S. produces, it doesn't take a lot to create entirely new demand influxes for our industry.

So, who are we? We have quietly been around for a while.

10:41:14 I, I jokingly say last year the head of the New York Stock Exchange told me that my family has the distinction of being the only group that has had two members of the same family start separate public coal companies. I don't know
10:41:31 whether that's a distinction or basically a personality disorder.

But, 50 years ago my father was one of the founders of Arch Coal, and seven years ago my

partners and I founded RAMACO. RAMACO has become basically, as Janet mentioned, really a coal conglomerate.

We have three separate operations. Our
10:41:54 flagship is called RAMACO Resources.

It's a public met coal company. We're quite proud that we were the first new coal ITO over ten years last year.

We're also very proud that we are the
10:42:11 only coal producer that I'm aware of that has opened five new coal mines in the last 12 months. I'll put a bit of a plug.

There's a Coal Age Magazine here. We're the cover story of this month's edition that
10:42:22 describes our central Appalachian operations. We well grow to produce roughly four to five million tons of high-quality low-cost met coal.

Our other operation basically is a royalty company which owns our assets, our met
10:42:39 reserves. And, the third is what I wanted to talk to you about today, which is RAMACO Carbon, which is based in Wyoming.

So, RAMACO Carbon, we have tried to

borrow a page, frankly, from the petroleum industry. We are trying to vertically integrate a coal company into, in essence, a coal tech company.

As far as we know, we are the only
10:43:02 strategic group that's pursuing an integrated philosophy of having the resource, technology, and manufacturing integrated into one, what I would call ecosystem. We are incubating coal to products made from carbon.

10:43:19 Our components are basically a large reserve play we call the Brook Mine, which we're in the final stages of permitting. It's near a lovely town called Sheridan, Wyoming.

We're also building a research park,
10:43:37 which, candidly, we have modeled on the Research Triangle down in Carolina, and it basically will house, as was indicated, a variety of research firms, university research groups, and strategic partners where they will basically do research,
10:43:53 applied research, in essence taking carbon from coal and developing commercial products.

We intend to have bench-scale operations at the research center, which will then be, as I

call it, taken across the street to an industrial park. We call the industrial park our ICAR.

It's about a 100-acre site, and think of this as a mine-mouth industrial park where, in
10:44:24 essence, we will take coal from our mine, convey it to plants, which in many cases will be utilizing technologies developed at our research park.

So, this will, excuse me, is our trilogy of what we have, integrating the resource, the
10:44:37 research, and manufacture. We are not alone.

We have some marvelous partners that we are proud to be working with. Their names are listed here.

Some of them are in the audience. We
10:44:51 are privileged to be also, of course, working with the Department of Energy on a grant which we call affectionately "Coal to Cars."

And, it, in essence, is to take coal and use it as a low-cost precursor to make carbon fiber
10:45:08 to be used in vehicles. Our focus is basically to target those uses which we think will ultimately have both high margin propositions, as well as the possibility of using large volumes of coal.

They are three-fold: Coal to chemicals, coal to carbon fibers, and coal to building byproducts. The key, as I mentioned earlier, is to develop these products where they can basically displace petroleum as the lower-cost feedstock.

10:45:38

Coal, we feel, has an incredible displacement potential. It's basically able to be used in advanced materials which can be made stronger, lighter, and, in many cases, hopefully cheaper than with petroleum.

10:46:00

As an example, I'll use carbon fiber to demonstrate this. Carbon fiber is actually 50 percent of the weight of aluminum and four times as strong.

10:46:14

It is 25 percent of the weight of steel and twice as strong. But, the key is to use coal to create a cost advantage to make carbon fiber from coal as opposed to a petroleum precursor.

This slide demonstrates the displacement opportunities. I had our staff go back and basically do some calculations, which I've keep asking them on it, "Are you really right?"

10:46:33

But, it's kind of like the difference

between horse shoes and darts. We don't have to actually get it in the center to have a rather dramatic effect on various materials markets.

If we could use even a fraction of the
10:47:03 amount of coal that is shown there, we have something that could be very disruptive to our industry.

This is a coal-to-products tree. For those who are, who are history buffs, there are
10:47:11 even textbooks back in the 1920s which have various derivations of this.

This has been updated a little bit to some more modern products, but the interesting thing is this tree grows a branch every time we
10:47:26 turn around. It is incredible the advancement of new products that are potentially being able to be made from coal.

So, start by trying to describe a few of these. So, coal to carbon.

10:47:39 Carbon fiber's used today with reinforced plastics to displace steel and aluminum everywhere where light-weighting is important but cost is not. The simple examples are fishing rods,

golf clubs, tennis racquets.

But, they're also used in commercial aircraft. Boeing is, I think, using roughly 60 percent of the weight of the new Dreamliner from
10:48:02 carbon fiber.

And, of course, a large number of our fighter jets are made with carbon fiber. The problem, as I said, is cost.

Carbon fiber is eight times more
10:48:14 expensive than steel and twice as expensive as aluminum. The reason, again, is its precursor material is petroleum.

That today costs somewhere in the range of $15 to $25 a pound. We think, and we are
10:48:29 optimistic, that we will be able to develop that precursor to get to somewhat of a Holy Grail to below $10 a pound.

If we do, it could be a game changer as a substitute for stale and aluminum. So, our use
10:48:46 is coal to cars.

So, roughly 100 million vehicles are made each year. Less than 100,000 are made with carbon fiber.

Again, the barrier is cost. If we can solve the problem where carbon fiber becomes an affordable alternative to steel, then we can move from the niche market of carbon fiber into the mass
10:49:11 market.

This slide somewhat demonstrates our evolution where we are now. There are a few number of commercial cars, like BMWs, that are using carbon fiber, but most are not.

10:49:24 Now, since Janet has told me that what is shown at the NCC stays at the NCC, I will show you the next slide, which is our version of tomorrow's family car. Now, I'm afraid the feathers are extra, but the, it does have a lot of
10:49:45 curb appeal.

This is, indeed, an all-carbon-fiber car that's made by Mclaron. It's a bit expensive, but that is the idea if we can make carbon fiber into the mainstream.

10:50:00 Carbon fiber from coal is being used for other things than cars. Our friends who are working with us have a few more exotic forms of transportation that they're working on.

I'm not sure if that is quite as mainstream to be in a submarine, but it gives you the possibilities. In terms of possibilities, frankly the largest area that we think we may be
10:50:25 able to carbon niche is in building products.

They may well require larger amounts and volumes of coal than even carbon fiber. The possibility are endless for the product types.

We've listed three here which can kind
10:50:41 of give you a sense: Rebar, coal-based asphalt roof shingles, and the ability to wrap infrastructure to extend its life and structural integrity.

Coal-to-chemicals, our last speaker
10:50:58 articulated a lot of what they're doing in coal-to-chemicals. Our focus is really on advanced manufacturing as it relates to 3D printing, which I'll get to in a moment.

We feel 3D printing will be the next
10:51:12 main form of manufacturing. The prior speaker mentioned the olefins market and some of the other dynamics and other chemical feedstock which we think create opportunities for coal-to-chemicals,

and we're exploring them specifically with Fluor, who had have been involved with the sassal development, as well as the former Ashland H-coal operations years ago, as well as Western Research and Southern Research, who are doing work in this same area.

10:51:40

So, as I said, our focus in chemicals or chemicals from coal is advanced manufacturing. We have partnered with a very interesting group that was funded by ventures that has basically blazed a trail in high-speed 3D printing.

10:51:55

They have a patent on something that they call CLIP, which basically uses ultraviolet light, oxygen, and carbon resins to print solid materials. I'll show you in a moment.

10:52:17

We have a production partnership with Carbon 3D. We have actually taken delivery of several machines here over the summer, and we will be using those machines to make everything from horse shoes to medical sensors.

10:52:28

And, we will also be using them to help us learn how we can reverse engineer the petroleum-based polymers into coal-based resins.

And, this type of manufacturing, as I've said, we feel is the wave of the future is definitely not smokestack.

There is our manufacturing center. That
10:52:56 is what a 3D printing farm looks like.

It's more sci-fi than what you're used to seeing, but it is fascinating. These are s the printers that we'll believe using.

They're called speed-cell 3D printers,
10:53:09 and I have a slide, actually, here. So, Dave, if you could kick it off again.

This is transformers. The red is a resin.

Underneath the platform is a (sic)
10:53:24 ultraviolet light. And, you have a computer-designed mold.

So, the mixture of oxygen, light, and resins create matter. So, somewhat in summary, the way forward:

10:53:41 It has been tough for the last decade in this industry. And, I think to survive and thrive we have to think outside the box.

We have to do something perhaps a bit

different. So, our idea is to vertically integrate into a coal tech company.

We are calling it our carbon valley. And, we feel that uniquely in this country we have both the abundance of the resource as well as the abundance of the technology and prowess to basically lead the way in terms of somewhat reinventing the coal industry.

10:54:05

So, R&D obviously is critical, but R&D by itself is not going to work unless it can lead to commercial applications which can then have a widespread use for coal.

10:54:19

As I said, we are, as far as we know, the only strategic that is targeting this as a high-tech venture, but the practical effect is that unless it gets government support, you are never going to be able to scale the opportunity because you won't be able to accelerate the research.

10:54:35

So, in summary, it starts with a lump of coal, but we feel it also involves the power of carbon.

10:54:51

So, thank you very much.

(Whereupon, applause was had.)

MS. GALLICI: Do we have questions for Randy? We can -- We have a few moments to take some questions from the audience.

In the back.

10:55:15 MR. ATKINS: If they're hard I'll ask one of my cohorts.

AN ATTENDEE: Arun (inaudible), and I wanted to ask you a question. And, I assume making carbon from coal is cheaper than making carbon by

10:55:31 separating from CO2.

MR. ATKINS: So, Charlie?

I will let my inhouse chemist be able to give you the answer here.

AN ATTENDEE: Thank you very much.

10:55:51 Currently carbon fiber is primarily produced from PANacrylic microPAN, and, which is really a, a byproduct of the, after the cracking process for petroleum.

And, cost range, anywhere from $8.00 a

10:56:11 PAN to, you know, $80 a PAN in some cases. We think that by using coal-based pitch as the precursor material, that we can get the cost of carbon fiber below $5.00 a panel; maybe

considerably less than $5.00 a PAN.

And, so, to do that, one goes through the process of making isotropic pitch and mesophase pitch, and from the mesophase pitch you can spin directly in a way that's actually easier than spinning a PAN-based carbon fiber. So, we do think the cost will be considerably less.

10:56:40

With regard to the CO2 question, I don't know the answer to that question. It's, it's an interesting thought if you could convert CO2 together with other materials into PANacrylic.

10:56:55

That, that may be something that's worthy of a 45Q incentive grant. But, I don't quite know the answer to that question.

MS. GALLICI: Any other questions?

10:57:16

THE CHAIR: So, so, thanks. Thanks, Charlie.

Great presentation, and appreciate that, that vision. Very, very inspiring.

I guess the question would be --

10:57:43

MR. ATKINS: I'm Randy. That's Charlie.

THE CHAIR: Well, Charlie, he answered all the questions.

Sorry, Charlie. Sorry, Randy.

I know both of these guys.

MR. ATKINS: I used to have to pull him out of the swimming pool.

10:58:03 THE CHAIR: Thank you. So, so, I guess the question would be, you know, you pointed out that, sort of the coal tree that we, you know, as you say, dates back sort of to the 1920s.

I mean, what's the thing right now that 10:58:15 gives you the greatest sort of hope that this is the right moment to sort of do some of these things and, you know, realize these advances in sort of coal materials, coal-based materials?

Is it, is it technologies and advanced 10:58:29 technology? Is it, is it, you know, data-related in that higher costs for competing resources?

Are there, are there things that make this feel like the right moment for that vision?

MR. ATKINS: I think the moment question 10:58:40 really goes to sort of an intersection of an advanced materials and advanced manufacturing. That's why I think this intersection right now is an interesting period.

I think the feedstocks have been expensive for a long time, but I think for a variety of reasons, now is the point where we feel like there could be some, some ground-breaking
10:59:02 research to try to bring these costs down in a way that can use large volumes of coal.

MS. GALLICI: Thank you, Randy.

(Whereupon, applause was had.)

MS. GALLICI: Our next speaker this
10:59:18 morning is Dan Connell. Dan is Director of Market Strategy and Business Development for CONSOL Energy.

CONSOL, as most of you know, is a producer and exporter of thermal and metallurgical
10:59:33 coal from the North Appalachian Basin. Dan is responsible for developing new marketing opportunities and applications for CONSOL's products.

He's also worked in the company's
10:59:45 Research and Development and Strategy and Engineering Groups where he focused on the development and, and economic analysis of advanced power generation and environmental control

technologies.

He has worked on a $33 million clinical technology demonstration project sponsored by the U.S. Department of Energy. So, quite a breadth of
11:00:12 experience.

Would you please join me in welcoming Dan Connell.

(Whereupon, applause was had.)

OPPORTUNITIES FOR NEW TECHNOLOGY IN COAL MINING AND
11:00:14 BENEFICIATION:

MR. CONNELL: Well, good morning, everyone.

And, and, thank you, Janet, for that introduction and for inviting me to, to speak
11:00:23 today. It is truly a pleasure to be here with, with this diverse audience representing many facets of the industry to have a very fruitful discussion about the opportunities and challenges that we, we face going forward as an industry and, and what we
11:00:38 can do to have the path forward.

And, it's always an honor to, to share the podium with Steve Winberg, who I had the, the pleasure to work with about the first decade of my

career in CONSOLE's R&D Department. So, I think Steve is very passionate about energy in general, coal in particular, and I, I'm very confident that he'll be a great leader for us in, in, in moving us
11:01:04 forward along that path.

Before I get started, I do work for a, a publically traded company, so in full disclosure so the Record's straight. And, I promise this is the busiest slide in my talk today.

11:01:15 So, as Janet said, I work for CONSOL Energy. Many of you possibly know CONSOL is a, a company that's produced coal for more than 150 years, but we've gone through a lot of change recently, so I wanted to give you a quick update.

11:01:30 The, the culmination of that change really occurred in, in November of last year when the former CONSOL, which is now CNX Resource Corporation, spun off its coal business. And, and, that coal business retained the name CONSOL Energy,
11:01:46 and that's who I work for.

So, what does, what does it, CONSOL encompass today? Well, our primary operating asset is the Pennsylvania mine, mining complex, which is

located in the northern Appalachian region.

We run three mines, the Baily Mine, the Enlow Fork Mine, and the Hardin Mine. Produced about 26 million tons of coal last year.

11:02:10 We have five highwalls in that complex and a very large central preparation plant. And, that coal goes both to domestic end users, largely power plants located throughout the eastern United States, and then to both thermal and metallurgical

11:02:27 end users located throughout the world.

CONSOL also owns the, the Baltimore Terminal, the CONSOL Marine Terminal in the Port of Baltimore, which is one of two major coal export coal terminals in Baltimore. And, we exported

11:02:42 about 14, a little over 14 million tons of coal through that terminal last year, consisting of both our coal and other coals produced in the region.

So, my talk today is, is focused on coal mining and beneficiation technology. And, why are

11:02:59 we interested in this topic?

I know many of you are familiar with, with the information on this slide, but just to fully lay out the, the pitch here. Two important

facts.

Number one, coal remains a very valuable energy resource worldwide. I have data here from the VP Statistical Review of World Energy showing
11:03:21 that coal, in 2016, was still the world's second largest primary energy source worldwide, accounting for about 28 percent of world energy consumption.

A lot of that is driven by countries like China and India, each of which derive
11:03:41 approximately 60 percent of their energy needs from coal.

The other important fact is that the United States remains the richest country in the world from a coal reserve standpoint. So, we're
11:03:52 Number 3 the terms of production, or Number 3 in terms of consumption, Number 2 in terms of production, behind only China, and we still edge out China in terms of total proved reserves.

And, those reserves look particularly
11:04:06 impressive when you look at them in terms of remaining years of production, and when you compare them against other energy sources such as oil and natural gas.

So, this will paint the picture that, in light of the Administration's call for energy dominance, coal is a very valuable tool in our toolbox for, for achieving that goal. But, the
11:04:27 challenge to all of us in this room is to find ways to continue to not only use coal, but also produce coal cost-effectively so that we can realize that, that potential.

Talking about coal technology, I have to
11:04:43 take a look back before I look forward. And, and, the fact of the matter is that we are where we are today largely because of technology in the coal space.

So, pretty striking to look back and see
11:04:55 when we were using mules as haulage and hand-picking for operation, contrasted with today's modern mine-wall mining technology and massive service preparations.

Just to kind of throw the, some
11:05:11 statistics out, so, since 1900 we see about 15-fold improvement in, in productivity and about a 100-fold deduction in fatalities, both very, very noticeable accomplishments.

And, a lot of that was enabled by technology. When I look at this data, one of the most important things was the introduction of Schultz car, introduction of continuous miner, introduction of longwall.

11:05:34

You can see those according quite nicely with little upticks in the productivity graph. So, clearly, evidence of the role technology has played in making the coal industry what it is today.

11:05:48

But, when you zoom in and focus on the last two decades, the, the story is a little bit less impressive. So, in this graph I've plotted productivity per the hour only for active coal mines.

11:06:03

So, these are mines that actually produced coal last year, based on MSHA data. And, I've, I've broken this down into three, three subsets of operation.

So, longwall mines are in red,

11:06:17

nonlongwall mines in green, and PRB surface mines in blue. The last is differences in productivity among them.

But, look at this graph and see long

walls for activity-wise are up about three percent over that 20-year period. The other PRB models and other mines are, are actually down over that period, largely as cover has, has begun to thicken
11:06:45 in out west, and as a, the, the cap on underground mines have gotten into more and more difficult mining conditions and, and thinner seams.

So, contrast that with what, what has gone on with the competition, and if, if you look
11:07:03 at our friend in the natural-gas base, focusing on the Appalachian Basin, looking at new natural-gas well productivity per rig between 2007 and 2017. So, about a 30-fold increase in that productivity measure.

11:07:23 Now, a big piece of that was the introduction of horizontal drilling, hydraulic fracking, and the shale revolution. If I go back kind of five years to kind of take that step change out we still see almost a four-fold increase in
11:07:38 productivity in Appalachian Basin gas production.

Looking at the utility scale, they're down about 80 percent in, in the last several years as well. So, this is the pace at which technology

is developing in the energy landscape, and, and what we really are challenged on to keep up with if we want to remain a viable and sustainable industry going forward.

11:08:01 Just to give one last example, I do hold, you know, what the, what the big cell phone was in 1998, when this graph started. It was the Nokia 5110, which featured a Walkman, the ability to text, and introduced the ability to play Snake

11:08:15 on your phone.

So, obviously we've, we've made tremendous advances in certain areas technology-wise in the last couple of decades. And, and, I lay this out as a challenge to the

11:08:31 Industry to think about ways that we can innovate and accelerate the pace of technology development on the coal production side of the business.

The fact of the matter is, you know, it, you can state multiple reasons for this, but the

11:08:46 bottom line is we have not directed a lot of funding forward the upstream aspects of the coal industry in, in recent times.

In doing some research on this I found

a, a report that was published by the National Research Council in 2007, which did probably the best job that I've seen in, in really breaking down where federal funding for multiple agencies, not
11:09:09 just DOE, was being directed in terms of, of coal R&D.

And, you know, this is, this is ten-years-old data, but still very relevant in light of what we just saw. So, in 2005, about 91
11:09:24 percent of, of the funding for coal was directed for downstream applications.

That would be coal utilization, CCS, and, and transmission. The remaining nine percent that did go more toward upstream applications was,
11:09:39 was largely focused on safety, health, and the environment, certainly very noble causes, but what really stands out here is that .2 percent of the funding in 2005 went to productivity and resource optimization, you know, really finding ways to, to
11:09:59 make a step change in, in the, the cost and efficiency of, of actually extracting the coal.

So, of that $1.3 million directed toward that area, a little over 700,000 was, was in, in

the Mining Industry of the Future Program, was under the, the Energy Efficiency and Renewable Energy Office.

The rest went to the National Science
11:10:21 Foundation for, for fundamental research. So, the NRC looked at this and, and recommended in the 2007 report that there should be renewed support for coal mining and possible research and development to optimize use of the nation's coal resources.

11:10:37 And, and, at the time their argument was to increase the amount of coal that was economically minable. Today it's, it's more geared at, at keeping coal costs competitive with some of the alternative energy sources that we, we face in
11:10:48 the marketplace.

But, essentially, I'm going to stand here today and reiterate this, this very recommendation. The NRC also noted, you know, if, the, there was a lack of clarity in terms of who
11:11:00 was really leading the charge on the, the coal mining and processing front from a, a federal level.

They recommended at the time that it

should fall under Fossil Energy and, and kind of coordinate among multiple disciplines. So, I, I looked at the, the Fiscal Year 2019 budget request just to see where we are today, ten years later.

11:11:23 The good news is I, I think there is more focus now than there was then on some of the upstream applications. So, we have critical minerals showing up.

This is the rare-earth work; about nine

11:11:35 percent of the $343 million. We also have advanced coal processing, which is about three percent of the number.

That's kind of split between developing a, a coal database, looking at impacts on power

11:11:48 generation and on moisture removal for low-ranked higher-moisture coals, but, you know, still lacking anything in this, in this budget request that's focused on the mining aspects of, of the coal industry.

11:12:04 And, just to try to point out why I believe it's important to look at the mining aspects of the coal industry I've put together just some very rough illustrative economics. This is

based on existing power plants, so I looked at the average delivered coal price nationwide for the last three years, average delivered natural-gas nation-wide for the last three years, applied some
11:12:31 rough fixed and variable end-cost numbers, assumed an 80-percent capacity factor along the board, or, or, across the board, which we hope to get back to.

But, you know, first thing that stands out when you look at existing coal plants, about
11:12:46 two-thirds of this overall fixed and variable OEM cost is in that delivered-fuel price. So, that's mining cost, transportation cost, preparation cost.

Obviously the breakdown varies regionally. PRB coal has a much larger
11:13:00 transportation amount.

Eastern coal, staying locally, has a much larger mining and processing cost. When you stack that up against natural gas, and I, I look at both an existing NGCC plant with a mid-sevens heat
11:13:18 rate exchange in the report, which is what they represented is the fleet-wide tested average at 116, then a new NGCC plant which has a mid-6,000 T rate, you see that on the, on the available OEM

cost, which I'm using as a surrogate for that, so existing coal is out of the money against the new NGCC plant in this example.

When you look at the overall fixed and
11:13:45 below OEM costs, both, both the existing and new gas plants are beating out coal, with, with this traveling through our average fuel price.

So, then we say: What can we do about this?

11:13:57 Well, one thing we can do is improve the efficiency of the existing coal plant. So, if you factor in, moving over another bar to the right, a, a five-percent heat rate improvement for the existing plant, which is a pretty, pretty big move,
11:14:13 changes the game a little but, but, but leads to the same conclusion.

If you're making ha 25-percent reduction, though, in the delivered fuel cost, either through mining, processing, or
11:14:26 transportation, you see that we do, we do change the game. We guilty that coal plant into the realm of being able to compete even against a new NGCC plant.

And, I can tell you that the, the gas side of the, the power-generation industry is going to keep driving those efficiencies lower and lower. I'm assuming a 600 heat rate here.

11:14:49 We see lower than that coming down the pike. So, you know, this illustrates the role that fuel costs can play in, in trying to change the nature of, of the dispatch stack in the U.S.

I should also point out -- You know, I, 11:15:04 I focused on power generation for this example because it remains by far the largest use of, of coal produced in the United States, but a, a transformational step change in mining, leading to a, a step change in cost would also be enabling for 11:15:20 other applications, whether it's new plants for coal, whether it's the competitiveness for coals in the export market, whether it's getting a, a new fuel plant across the, the finish line in terms of, of the overall economics of that plant.

11:15:36 So, what, what does all of this lead to? Our recommendation is that, that the U.S. needs to consider investing in new technology development on the coal mining and beneficiation side of the

industry in order to fully utilize the vast coal base.

And, you know, I mentioned that that enables coal across all potential end uses. It's
11:16:02 going to continue the drive for improved safety and, and reduced work, workplace exposure for employees in the industry.

And, I think it's also important to, to, to note that it would also reengage some of the
11:16:17 best and brightest upcoming minds who don't even have the coal industry on their radar screen right now.

If you went to a college and university outside of mining engineering, it's all mechanical,
11:16:29 robotics, mechanical engineers, what are they going to be focusing on today? Probably new smart phones, self-driving cars.

I doubt if they'd be on mining right now. So, putting some funding out there would
11:16:46 entice some into entering into the mining industry.

So, I've laid out the case. I'm going to spend of the rest of my, my time just providing a few illustrative examples of areas where I think

there is opportunity.

This is not an all-inclusive list, but I wanted to at least get the creative juices flowing. So, the first area I'm going to touch on is, is

11:17:07 automation and robotics.

And, Anthony's talk I actually noticed one of the bullets was highlighting one of the, the areas that are being focused on in China talked about automating the, the mining processes, and

11:17:24 certainly pointed towards a, a drive towards automating mining process there.

So, we need to be doing similar things when, when we look at the, kind of the overall growth map for coal. There's certainly

11:17:33 opportunities for automation in both surface and underground operations.

On the surface, self-driving haul trucks would be an example. I work for an underground coal mining company, so my example is going to be

11:17:46 more, more underground focused.

And, today, when you look at models, when you look at underground mining in the United States, the longwall remains the, the state of the

art. I've showed a few slides back, you know, this is a technology that's been around since the 1970s.

It's built for high-volume, highly productive extraction of coal underground. I think
11:18:09 most of you probably know how longwall works.

If you don't, think of it kind of as a meat slicer in the deli, you know, shaving off the coal from the face of a, a large block of coal underground. You have some inverted L-shaped
11:18:24 shields that are providing temporary roof support as that shear progresses along the, the longwall panel.

So, the role of longwall mining in the U.S. coal, last year we had 40 operating long walls
11:18:37 in the United States coal industry. They've produced 62 percent of the coal that was produced in underground mines, which is about 170 million tons of coal, at a substantially better productivity than other, than the other underground
11:18:54 mines; more than, more than 85 percent more productive longwall operations than the nonlongwall operations.

In all likelihood, the nonlongwall

operations would have used longwalls if their coal seam thickness and geologic conditions enabled that to be, to be an option for them.

So, this is kind of the sexy technology in underground coal mining, and as a result, it's where the, the OEMs have focused a lot of their attention in terms of development. CONSOL right now is in the process of developing advanced shear operation across our entire longwall fleet.

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So, this is a, a technology that basically enables automated, combined with the longwall development, enables the shear to follow a very consistent cutting profile as it moves back and forth across the, the face of coal.

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Couple of advantages there. Number one, it reduces wear and tear on the equipment; reduces downtime for, for alignment cuts and what not, and that leads to a, a productivity increase.

So, Komatsu, who authored this technology, generally quotes at least a ten-percent increase in productivity when you go with advanced shear. It also helps you mine more coal and less roof rock, which means less rock that you move

11:20:09

along downstream for less preparation time.

We estimate that that's about a ten-cent-per-ton cost savings for every inch of roof that you avoid mining. So, saves 50 cents if you avoid taking five inches of, of rock from the roof.

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You can extend this automation concept by using a remote operation center where you can have the longwall operator sit in a different location from the mine underground or even on the surface, and run the equipment using cameras and, and controls.

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And, there are also automation options being developed and offered for the, the shields that support the roof, for drives, et cetera. You know, one of the big hurdles that, that we faced in, in getting this technology across the finish line has been employee acceptance.

11:21:00

But, it's generally been a positive overall outcome. People are generally reluctant to let the machine do what they do better, but in the end they realize it really improved the, the quality of their job.

11:21:12

And, when we look at this area, probably the biggest technology need on the longwall itself is really on coal seam horizon detection and control. So, right now you're still using visual observations and a person on camera to define where the possible coal seam is versus the roof; that there is a need for some improved technology to, to automate that process and avoid having a human need to take that information and make that judgment call.

11:21:37
11:21:53

So, I talked about, a lot about automation for the longwall miner itself, but when we step back and look at the overall picture, you know, the, the real need, in our view, is not the longwall miner, but actually the continuous miners which are doing the development work to enable the longwall to do its job.

11:22:04

So, here I have a schematic showing kind of the, the basic layout of, of a longwall panel. The, the white area in the middle is the block of coal that's going to be longwall mined.

11:22:21

To give you a scale, on average, in the U.S. these panels are about 1,200 feet wide, about

1,500 feet long, although they can be wider and, and much longer than that in certain mines.

And, then, you see all of this detail around the sides. This is the room-and-pillar-type mining that needs to be done to enable the panel to be mined.

11:22:44

And, right now that's all done using continuous mining machines, the same types of machines that are used in the nonlongwall mines. So, if you look at an overall typical six-panel longwall district, in order to mine these six longwalls of coal, you need to drive seven gate entries, each of which, for every foot of longwall panel to be mined, you will have three feet of entry plus 100 foot of process.

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11:23:14

So, four feet of continuous mine for every foot of longwall that need to be done. You have to drive setups and bleeders.

These are used basically for ventilation, for transporting people and materials and supplies into, into the mine, and for the belt infrastructure that takes the coal out of the mine. And, then you also have to drive mains, you know

11:23:28

which are a kind of a superhighway underground that connects the whole operation together.

So, when you do the math, in the end, as a general rule, for every foot of, of longwall
11:23:51 mining advance that, that you want to achieve, you need at least six feet of continuous miner advance to get that done.

So, we call them longwall mines, but there's a lot of continuous room-and-pilar-type
11:24:06 mining that goes on in, in these operations. What does all of that really mean?

Here I've shown, shown an illustration of kind of what's required to operate the longwall and what's required operating a continuous mine.
11:24:20 This is the type of, of CM that we use in, in northern Ap.

There's, there's also place change monitors that are used, and perhaps slightly different numbers than these. But, just to give
11:24:33 you an idea, we're looking at nine people to run the, the longwall, ten to 11 people to run one continuous mining machine.

On a consumable side, you know, in both

cases you use bits, oil, rock dust, electricity. With the continuous miners you're also using a fair number of roof and lag bolts to connect to provide support to the infrastructure that's used to
11:24:59 transport that.

Zooming down to the bottom here, if you look at the typical eight-hour shift, this longwall, in rough numbers, is going to buy, let's call it 25 feet of advance in, in round numbers.
11:25:08 That depends very much on the coal seam and the condition.

But, and produce about 350 clean tons per foot. That accounts for 8,750 tons per shift on that longwall.
11:25:25 Looking at a continuous miner, you're going to get four times the footage, 100 feet per shift. We're increasing four times the production, so that equates to about 400 clean tons per shift.

Do the math. Number of people, you're
11:25:38 looking at about a 20-fold effective difference in productivity between that continuous mining crew and that longwall crew.

And, to give you an idea, you know, at

CONSOL we operate five longwalls. We operate 15 to 17 continuous miners.

So, the vast majority of our workforce is actually running room-and-pillar-type

11:26:00 applications, as opposed to running longwalls, even though we're, we're a longwall producer.

What can we do about this? We can approach it with entire newly technology and completely out-of-the-box approach.

11:26:14 Not that this is the answer, but think tunnel boring instead of using a continuous miner as we're using today. Or, we can improve on the current process.

And, when you look at ways that you can

11:26:25 improve on the current process, there are really three things that you can do. You can increase the rates. How fast does that thing advance once it's turned on?

You can increase the mining time. How

11:26:33 many minutes of the shift are we actually mining versus sitting idle for, for other things?

Or, you can decrease the required resources, reduce the number of people that are

needed to operate the machine, or the amount of, of bolting and meshing that needs to be done.

I think there's real opportunity in this case even to improve upon the, the current process.

11:26:55 As an example, if we look at mining time, I'll tell you, it's the application.

Cutting about a foot a minute, eight-hour shift has about 480 minutes. So, in theory, you should be able to mine about 480 feet

11:27:06 per shift, using a continuous miner.

In practice, though, I, I mentioned 100 as, as a, an illustrative number. We're getting far less than that.

So, if you take that 100 feet that we

11:27:19 might mine in a shift, convert that into minutes, it says you're using basically 20 percent of your available mining time for mining. Part of the reason that number's so low is that there are things that you need to do other than mine during

11:27:33 the process.

You need to rock dust. You need to do pre-op checks.

You need to periodically remove the

machine and the cutting cycle. But, even adding that up, you have nearly half of the mining time's lost to inefficiencies and delays, mechanical breakdowns, et cetera.

11:27:52 So, if you could take even half of that unutilized kind of nonroutine time and turn it into mining time, you would double your productivity from the CM.

So, where do we go from this? We can

11:28:07 automate pieces or the entire process of the miner, itself: The bolting, the meshing, the hauling from the miner to the belt, the rock dusting.

Predictive and preventative maintenance is a big piece of this with all the downtime that I

11:28:23 just mentioned. And, then, getting these pieces of equipment to talk to each other is a big, a big need.

Challenges: I, I mentioned with longwalls, detecting the coal seam and, and the

11:28:34 horizon. That's also going to be a challenge for automating a continuous miner.

In general underground you're dealing with challenges you also have to worry about. You

have methane to worry about.

You have different floor conditions; unexpected geology, roof falls, et cetera. And, I think a big need here is actually getting the technology approved to take underground.

11:28:52

So, right now, pretty stringent rulemaking approval process through MSHA. You know, if I wanted to take this underground, number one, it wouldn't work, and number two, I wouldn't be allowed to.

11:29:05

In the U.S. I'd either need to have this in an explosion-proof case, which would make it weigh as much as a brick and probably useless, or I'd have to get it approved as a permissible device. And, by the time it got it through that process it would probably be an obsolete technology.

11:29:22

So, there's clearly a need to streamline that process. We're going to push the basic mining technology forward.

11:29:34

I'm going to run through the next couple of examples very quickly.

MS. GALLICI: Yeah.

MR. CONNELL: Very quickly. Big data is, is a big opportunity in, in the mining space.

We, we are collecting the data, but, as this graph, graphic shows, there are a number of components getting the coal from the, the mine to the end user that right now are not integrated, talking to each other.

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So, big effort. Big opportunity to integrate those data and apply technologies such as machine learning, artificial intelligence to improve decision-making, and, and, and really optimize the process.

11:30:05

Fully remote mining, out-of-the-box concepts I think are needed. This is a concept at Crazy Horse Coal presented at a DOE workshop that was held back in the fall.

11:30:19

This is a drilling company drilling in Texas. Hit a coal seam.

Realized they were able to extract the coal using the drilling technique. So, obviously a lot of considerations surrounding this; everything from permitting to drilling mud to -- You know, it would be a completely revolutionary approach.

11:30:33

But, this is the type of, of out-of-the-box thinking I think that the Industry needs in order to realize a, a true step change.

Waste coal recovery and utilization: This is an area that CONSOL is looking at. We're looking at taking our underflow coal from our prep plant, which amounts to about five percent of the, of the coal that we produce, and we're throwing away as coal fines, recovering that, turning it into a, a salable product with quality that's actually better than our, our standard Bailey coal product, and then converting what was a fine stream being disposed of in slurry impoundment into a coarse refuse stream that's easier to dispose of, or may even have alternative end-use applications.

So, we have a, a pilot plant constructed at that time at the Bailey preparation plant right now that's, that's working to test and scale up that technology. And, then, finally, we have recovered new product streams today quite a bit.

I just want to reemphasize I think what Randy mentioned about scale. You know, when, when we look at the magnitude of the coal industry

being, you know, on the order of a seven- or eight-billion ton-per-year global industry, you know, even in comparison to something like iron ore, which is certainly another commodity that
11:32:15 pales in comparison in terms of sort of the magnitude.

We definitely need to think, as we're road-mapping a path forward, about which of these technologies truly have the potential from the
11:32:26 supply side to prop up the coal production aspects of things.

So, in closing, I have listed kind of what I would recommend as, as a few next steps that we consider. I'm just going to read through these
11:32:39 quickly, but I think they say what they need to say.

Initiate focused dialogue among coal industry stakeholders, producers, equipment manufacturers, transportation providers to
11:32:49 prioritize the areas of greatest need. I've provided some examples today, but that's not all-inclusive.

Gain input from other industries that

have succeeded in implementing analogous technology solutions. Work with DOE and other Government funding agencies to define reasons for other opportunities.

11:33:07 Work with MSHA, as I mentioned, to streamline the approval process. It wants to drive the pace of technologies, testing and implementation on the ground, incorporate goals focused on productivity of the mining side into

11:33:21 road-mapping exercises for the future of coal.

And, then, finally, through funding, kind of reengage academia and innovative thinkers in, in putting our industry on their, on their radar map.

11:33:35 So, I apologize for running a little bit long, but --

MS. GALLICI: Dan, thank you for that.

You're shaking your head. Do you have any comments or questions?

11:33:50 AN ATTENDEE: No, I don't.

MS. GALLICI: You're going to see Dan afterwards, so the reason I was particularly pleased when I got a chance to review Dan's

presentation earlier was I think one of the technology advancements, we've been very focused on the consumption side, and I, I think this points to the fact that there are opportunities on, on the
11:34:09 supply and production side that, that are valuable out there.

We continue to hear from the Administration: Please find ways for us to be more cost-competitive in this coal industry.

11:34:19 And, I think Dan's presentation just kind of opened the door for us to, to start thinking about some other things. So, thank you very much.

Appreciate it. Thank you.

11:34:27 (Whereupon, applause was had.)

MS. GALLICI: All of the presentations, by the way, will be up on our web site within probably four, three or four days, so please check on our web site and you can get more detail there.

11:34:45 Our next and final presenter for this spring meeting is John Thompson, who is Technology and Market Director for the Clean Air Task Force. John promotes carbon capture and storage at power

plants and industrial facilities, as well as in the transfer of innovative low carbon coal and fossil technology between the U.S. and China.

He works to develop U.S. federal

11:35:14 Policies that enable saline injection as well as enhanced oil recovery. And, John has been very active in supporting, I know, the 45Q legislation; has been engaged in that for many years.

So, congratulations in getting that

11:35:33 done. I heard a big sigh from, from the Midwest there.

So, John has been serving with us as a member of the Council since 2012. So, will you please join me in welcoming John.

11:35:45 (Whereupon, applause was had.)

ENHANCING THE SUCCESS RATE OF TECHNOLOGY DEPLOYMENT: AN ECOSYSTEM APPROACH

MR. THOMPSON: Thank you, Janet.

Mr. Assistant Secretary, panelists, and

11:35:55 members of the National Coal Council, it's a privilege to be here with you today and talk a little bit about something I'll describe later, which is ecosystems.

And, we've heard a lot about technology innovation. We've heard a lot about how we can take and develop new technologies, and what that means.

11:36:19 What I'm going to be asking you to think about is: If we had those technologies in our hand right now, what other barriers would we see that would prevent them from being adopted in the marketplace?

11:36:31 And, that's why I'd like to talk to you about enhancing the success of technology development and ecosystem approach. And, I'll define those terms in a moment.

Oopsie, what do I do here?

11:36:47 AN ATTENDEE: The middle button.

MR. THOMPSON: The little button.

AN ATTENDEE: The middle button.

MR. THOMPSON: Middle button. Oh, what do you know.

11:36:54 I see. If you point the pointer in the other direction it becomes the middle button. Very good.

The Clean Air Task Force, we are a

nonprofit environmental organization. We work on climate change.

Our interest is in promoting solutions that address this problem. And, you've heard from us before.

11:37:10

Our Executive Director, Arnold Cohen, has addressed this group about two years ago at this meeting. I want to tell you a few things that might be a little different about us:

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That we're really interested in promoting what I would call durable climate solutions, ones that sustain when economics change, that are sustainable when politics change, and, as Janet mentioned, that's kind of one of the reasons

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we're so interested and we were so supportive of the 45Q tax credits.

It had bipartisan support. It had support from the left, from the right, from coal companies, from oil companies, from environmental

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groups, from labor groups, from farm organizations.

It was truly a bipartisan effort. That's why we support the Use It Act, which supports infrastructure on carbon capture and

storage.

And, it's especially difficult in these times, I think, to find those bipartisan solutions. It's almost as though our political parties are at
11:38:25 war with each other.

And, I, I just -- It made me -- I wanted to share an anecdote from a previous time when our parties were actually at war, the Civil War, and Abraham Lincoln was President. You know, the story
11:38:42 goes that Abraham Lincoln, that in a, prior to the Civil War, in 1863, he held a reception in the White House.

And, in the concluding remarks he referred to the Confederate soldiers and the South
11:38:57 in general as "errant human beings." And, he concluded his remarks and a Boston matron cornered him afterwards, a woman with four sons in the Union Army.

And, she said, "How can you call the
11:39:04 Confederate soldiers and the South 'errant human beings'? They are our enemies. We must destroy them."

And Abraham Lincoln said, "Madam, in

making them my friends, do I not destroy my enemies?"

Today we need to find ways of making our opponents our friends. And, so, my remarks to you today are aimed at reaching out to the left or the right, whatever side of the political spectrum that you are, to engage with you and to turn you into our friends, because ultimately, for pragmatic reasons, that is the only way that we will come up with durable climate solutions.

So, the question that I want to engage with you on is: How fast can carbon capture be scaled?

This is a topic that we are addressing in a series of reports that we'll be issuing later in 2018, and we're looking at a, a wide range of innovation policies. But, I want to focus on we'll be talking about things that deal with scale.

If you want to address climate change, it has to be done at scale, and scale is really the determining factor. If you can't reach scale, you don't have, you don't have a solution.

So, that technology that you must have

has to be globally applicable. It has to work not simply in the United States, but in the developing world.

It can't be too expensive. It has to be easy to construct and to build.

So, a modular solution that Steve talked about is very important because it embraces some of those things that are necessary to get to scale. It has to be easily financed, and it has to overcome what I would call, and what I will describe in the focus of my remarks, as bottlenecks in the ecosystem.

So, the ecosystem. Let me, let me just say a little bit about how I came across this idea and what it means.

There are some researchers from Dartmouth and the University of Pennsylvania, Adner and Kapur at the University of Pennsylvania, who have been studying technology innovation in the computer industry and in the printing of circuits, looking over the last 40 years of innovation and market adoption of those technologies.

Adner and Kapur conclude that about 48

percent of the ability to, of the market to, or the prediction of the market to take on a new technology is really only attributable to some of the traditional factors like price adjustments and performance differences, number of variety of products, how long, how old the rival technologies are.

Forty-eight percent of that predicted success comes from those factors. But, when you account for something that the authors call the ecosystem, the correlation jumps from 48 percent to about 82 percent.

So, what, what's an ecosystem? Think of it, what they studied, things like ink-jet printers and high-definition television, both technologies invented in the 1980s.

The ink-jet printer overtook the dot-matrix printer almost immediately in the 1980s, because all you had to do was plug it into your existing computer cable.

High-definition television didn't become the standard for about 30 more years, and it was because you had to have pre-processing standards.

You had to have post-production standards.

You had to have your television and, and broadcast mediums all coordinated. And, that took about 30 years.

11:42:46 And, as I looked at that I thought, you know, that sounds a lot like carbon capture. You know, we have pipelines.

We have storage sites. We have long-term care Regulations.

11:42:57 We have all these things that what Adner and Kapur call the ecosystem, the things that are necessary for an existing technology to be adopted. They are the enabling technologies that, that are there.

11:43:12 They are the standards. They are the infrastructure.

They are those sorts of things. And, I want to flag for you -- Let's see.

What did I do here? -- is, is talk

11:43:29 about what they learned about the ecosystem that I think is relevant to any of the clean energy technologies that we are talking about, whether it's carbon capture, whether it's nuclear plants,

whether it's solar, whether it's wind, whether it's geothermal.

Any of those all have ecosystem bottlenecks. So, it's important to analyze not the
11:43:52 ecosystem; not just the new technology itself.

So, in carbon capture we've got to find ways of expanding pipelines. We've got to find ways of getting EOR sites.

We've got to find ways to get more
11:44:03 saline. We've got to overcome, you know, various things.

And, these bottlenecks must be removed to advance these promising technologies. If Steve Winberg announces at the end of this month one of,
11:44:17 a new breakthrough technology that radically eliminates all of the cost barriers between a zero-carbon coal plant and one without that emission normally, I would submit to you that unless you've removed those ecosystem bottlenecks,
11:44:35 unless we have pipelines and storage sites, it will still sit on the shelf.

And, if it sits on the shelf for 30 years, like high-definition television did, it's

too late to achieve my goals, which are addressing climate change.

Another point, in terms of technology, whether that's nuclear power or solar or wind, they

11:44:56 can innovate. And, when they innovate they can extend their technologies, or they can change the ecosystem that would stall things like carbon capture, other baseload technologies.

So, we need to be looking at those kinds

11:45:11 of, of competitors and those kinds of things. And, each time a competing technology improves, it raises the bar for everyone.

So, it may be great to put out, you know, a, a, a new coal plant that is more

11:45:24 efficient, but if your customers in China who you might to want sell that have an option of a small modular nuclear reactor available to them at a much, much lower price or better emissions profile for CO2, it's too late.

11:45:43 We have to be looking also at what competing technologies are doing. So, let's talk a little bit about the ecosystem for carbon capture and storage.

You know, it can include incentives; you know, looking at current technologies. It's more expensive between putting carbon capture on for the most part in a, in an uncontrolled plant. We need
11:46:04 incentives or other mandates to overcome these cost premiums.

We need carbon-dioxide pipelines. We need storage sites.

We need safety and long-term care
11:46:17 standards enable the technology to advance with minimum uncertainty. We need to eliminate, you know, kind of location restrictions.

I mean, there are certain areas of this country that are more favorable of exposing of CO2
11:46:32 than others. We have to address financing; not just the cost of equipment, but the scale of financing the infrastructure.

And, of course, we need to address know-how. But, we're not alone in that.
11:46:43 I'd like you just to think about what Adner and Kapur say, is that the adoption of a new technology in the marketplace isn't just a function of price and performance, but how many, how much of

this ecosystem must adapt. The more elements in an ecosystem, or the stronger they are, the slower the adoption of technology.

So, let's look at two examples in this table. Carbon capture and storage, I've listed maybe seven elements.

Wind, today's wind maybe only faces a cost premium. And, as soon as we have, you know, production tax credits or those sorts of things, it moves quickly into the marketplace.

But, it's not going to stay that way. Wind at low penetration levels on the grid maybe faces one or two ecosystem bottlenecks.

Maybe it's just cost and, and transmission. But, when you get into higher and higher levels of penetration on the grid, 40, 50 percent, the ecosystem that wind faces is very similar in terms of the number of nodes as carbon capture.

You need balancing. You need grid-scale storage.

You need an advanced grid. You need a whole bunch of things that take a long time to do.

And, what I would propose and submit to you, that when you start looking at scale, and when you start looking at long-term solutions, carbon capture and nuclear power and wind and solar look
11:48:13 pretty similar in terms of the ecosystem bottlenecks that they face.

And, if we want to use all of those technologies, we have to be able to overcome those bottlenecks in each of those things, including
11:48:27 carbon capture. So, talk a little bit about what first projects do to eliminate those bottlenecks.

Usually they pick sites that remove some of them. So, a new carbon-capture project might locate more readily into the Permian Basin because
11:48:47 they can knock off, you know, maybe several of these pipeline or storage sites or other kinds of bottlenecks, and you're down to just two.

That's why new projects and new technologies tend to go where there's a lot of
11:49:00 infrastructure, but we don't see a lot of new carbon-capture projects proposed in Maine, okay? But, we see the same thing with wind.

We see the same thing with solar. We

see that they, they, they clump in areas where there's high wind and high solar resource potential.

And, so, really, the key is I'd like you
11:49:23 to think about what happens if the cost premiums disappear. And, we're probably on the verge with, in some ways with that with 45Q.

At least imagine -- Oopsie. Let's try this again.

11:49:36 Assume for a minute that we eliminate that price premium. We could have done it with 45Q, you know, to a large extent.

We will need to do it with better technology. And, when that happens -- Let's see.

11:49:49 You know, you eliminate those cost premiums, and imagine them for all of these different technologies. You're still left with about six elements in the bottle-, in the ecosystem bottleneck.

11:50:00 We need Policies that address those bottlenecks, and that's why, for those that say, "Well, all we need to do is focus on getting R&D to get projects to commercial stage," I say look at

the ecosystem.

It is insufficient to stop there. The market will not take those technologies and push them to higher levels of adoption if we've still got these ecosystem bottlenecks.

11:50:24

So, we've got to eliminate the remaining bottlenecks. And, I'd like to just sort of discuss that in the implications with 45Q and carbon tax.

You know, it's our view that 45Q tax cuts make some coal plants near the Permian Basin attractive carbon-capture retrofit because we've already reduced some of the key barriers and we've got easy access to EOR.

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But, we need other policies. We need capital; probably Policies that help with, you know, forming capital in these deregulated d electricity markets.

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Very tough to put a power plant or a capture unit in a deregulated market in Texas. Maybe we need some support there.

11:51:09

Maybe we need pipeline legislation that extends the ability for EOR operators to take their pipelines into areas where CO2 is, is coming from

industrial sources. That's why we're so excited about the Use It legislation.

So, I'm going to offer a few concluding thoughts, and hopefully -- Oops, a little bit
11:51:34 running late here. You know, although -- Here's what I would just say, is that although renewables have made impressive gains over the past decade, have higher levels of penetration on the electricity grid, you add more ecosystem
11:51:52 bottlenecks which will appear and will likely hinder their development.

And, then, although carbon capture has started more slowly, the ecosystem bottlenecks don't appear to be any more challenging than
11:52:02 renewables reach as they reach higher levels of penetration.

But, for -- However, for CCS to significantly scale to really hit a climate mitigation level, it's not enough to focus just on
11:52:16 cost reduction. We have to address these other policies that also address the ecosystem; things, ready opportunities right now, you know, in this Congress, pipeline buildup, and maybe trying to

address the ability to reduce risk and find more capital for multi-billion-dollar project, projects.

And, what I would also just say, finally, that the ecosystem for the current
11:52:42 electricity system is not static. Gas prices are low.

That favors gas, CCS, or gas, natural gas combined cycle, and it may also help with CCS on gas plants, too. And, in the short-term, 45Q
11:53:00 tax cuts are going to help carbon capture on industrial and power sources.

And, these early projects may bring us down the learning curve to actually transform the technology into much lower costs than what we've
11:53:13 experienced in recent years. Changes to the advanced grid may favor some technologies over others, like intermittent renewables and baseload generation.

So, we need to make sure that our grid
11:53:25 works for everybody. And, in the medium term, capture and storage applications are going to depend on enhanced oil recovery.

But, EOR also competes with other ways

of producing oil. Every advance in unconventional oil development has an impact on EOR as a business model.

So, with that I'd just like to wrap up
11:53:49 my remarks and thank you for your time this morning.

(Whereupon, applause was had.)

I think we're doing questions, not just maybe for me, but for other panelists, too?

11:54:03 MS. GALLICI: Just for you.

MR. THOMPSON: Oh, just for me? Okay.

MS. GALLICI: I have one. So, John, thank you very much for your presentation.

You have alluded to this a number of
11:54:15 months ago, and I thought it was a fascinating idea. But, it seems to suggest maybe a transition kind of piecemeal legislation; so, more wholistic kind of approach.

The mind boggles to, you know, just, how
11:54:29 we, we get there. But, is that kind of the vision that you see going forward?

MR. THOMPSON: Exactly. I think that our focus for all technology innovation hasn't, has

to be not just on particular projects, but at programs that bring, in little of a kind plants into being.

We have to overcome those first barriers

11:54:54 of, of, of the, that, that, that build risk into that first project, because usually the commercial sector has difficulty also building two, three, and four. So, there's a government role, I think, to reduce those things.

11:55:16 And, it's also, I think it, it lends in, you know, it, it -- Scale raises interesting implications for research and development. We have to think about manufacturability at the beginning of R&D.

11:55:22 You know, can we make these solutions and factor? Can we make them modular?

Can we, if we deal direct, how much of the equipment can we do in modular ways? There are many implications, and the policies have to start

11:55:38 by first thinking about the scale.

MS. KRUTKA: Holly Krutka, from Peabody.

Janet, I think you used an excellent word when you said "wholistic," because that kind

of big-picture thinking kind of brings it all together. And, I love your analogy with your comparison to wind.

I think you're spot on. But, my
11:56:03 question is kind of at one higher level than that because in ecosystem you're missing one thing, and that is, like, a fundamental opposition to coal from some parties.

And, that costs real money, right? So,
11:56:15 how -- I think you and Brad and a couple others have, like, this unique view where you can see these entrenched camps.

And, I saw this incredible passion that was so negative when I spoke at COP 23. And, it
11:56:30 wasn't a fun, you know, experience, but it was eye-opening.

And, I'm just wondering if you can comment on how can we get past that kind of rhetoric and you think of things wholistically so
11:56:42 we can actually find places to work together. I think 45Q is a great example of success, but now we realize, you know, that there are all these other pieces.

Or, we always knew there were these other pieces, and we have to work on those as well. I mean, there could be real opposition to CO2 pipelines from opposition groups.

11:57:05 And, I'm wondering, from your viewpoint, which is really powerful and unique, what do you think we can do about that?

MR. THOMPSON: I give that same speech, whether it, I'm on left audience or right audience.

11:57:19 And, I will usually begin with something like, over the last 30 years the level of fossil fuel use has been pretty constant, around 80 percent of the total energy requirements of the planet, and the best estimates are maybe by 2050 that might drop to

11:57:34 75 or 70 percent, but it's not zero.

So, what do you do with the rest? And, I think that when it comes to thinking about carbon capture, it's, it's not just a coal technology.

It is a pollution-control technology.

11:57:50 We need it for the industrial sector.

We need it for gas plants. We need it for oil.

And, I think the biggest thing that

changes is when we actually have projects in the field that are working. Petronova that is in, in operation, changes the, the, the dynamic of public relations.

11:58:13 So, we've been in a position where there's been few coal CCS projects and few coal success stories. That, I think, is going to change.

And, as that changes, your average

11:58:26 person is going to start thinking more and more about: What are the pragmatic options?

And, I think that I'm, I'm not, I'm not worried about that as a, as a, as a long-term, you know, challenge. I think pragmatic solutions

11:58:43 change the way people think about the options before them.

MS. GALLICI: One more question.

MR. CRABTREE: Brad Crabtree, Great Plains Institute.

11:58:55 John, that was a great presentation, and I just wanted to note that Governor Meade, in Wyoming, has recently reached out to 17 other Governors in extending an invitation for them to

participate on a retail basis to develop deployment initiatives. Now that the 4Q has passed at the federal level, we have a unique moment.

11:59:22 And, as, as, as the fellow said, a six-year window to get as much deployment as possible while that tax credit is authorized. And, this kind of ecosystem approach to these resource deployment issues can be a laboratory for trying to, in a wholistically way, pull all these pieces

11:59:38 together and getting beyond this chicken and egg problem which has bedeviled us now for years.

And, I wasn't going to, but I'll pick up on, on Holly's point and your response. I really agree with that in putting together the coalition

11:59:53 and keeping the coalition together that ultimately got 45Q done, we didn't try to get everybody to agree on climate change.

We didn't try to get everybody to agree on the future of coal, but, rather, the core

12:00:07 outcome, which is if you capture the CO2 that would otherwise go up a stack at a power plant or industrial facility, put it in the ground, produce more oil, store that CO2 in the process, that's a

good thing that everybody can agree on.

And, I guess the last question, and you raise a very good point, is there will be some opposition to CO2 pipelines. But, I think when we
12:00:31 focus on outcomes, we have a large middle in this country that really almost aches to solve some problems, and we'll be speaking to that large middle.

And, we will be diminishing the extreme
12:00:41 voices that say climate change isn't real or that coal is bad, and, instead, focusing on whether it it's 80 percent or 70 percent, or whatever that big middle is, and empowering them to work on the solutions.

12:00:55 But, you have to focus on the outcomes and get past that high-level debate, because that's where people don't agree.

MR. THOMPSON: So, I'll just make one conclusion. Since I introduced Lincoln in the
12:01:09 beginning of my talk, let me end with him.

Lincoln was asked how it was that both sides of the Civil War could invoke God as being on their side. And, he was asked you know, whose side

is God on?

Lincoln said, well, God is on the side of truth. And, the question is: Are we on God's side?

12:01:26 So, I always think that the challenge ahead of us is to try to figure out how we can get closer to the side of truth, and to find those solutions that I think work the best from an economic standpoint, from a political standpoint to

12:01:38 appeal to that large swath of the middle.

Thank you.

(Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: Let's -- I think we've had tremendous speakers, starting with

12:01:57 Thomas Pyle last night, Anthony, Randy, Dan, and Tom. Thank you.

Interesting thoughts, and provocative thoughts, and I think we all gained by it. So, round of applause.

12:02:12 (Whereupon, applause was had.)

ASSISTANT SECRETARY WINBERG: As is the NCC requirements, we now have time for a public comment period. We posted in the Federal Register

announcement several weeks ago asking if anyone had any written Statements, and we did not get any.

There was a signup sheet outside for anyone from the public that wanted to speak. No one signed up for that, but we have always opened it up for anyone, any guests with us that want to speak.

12:02:41

And, if you do, we will bring a microphone over to you. I'd ask you to raise your hand, let us know your name, your affiliation, and if you will keep your comments to within five minutes I would appreciate it.

12:02:58

So, do we have anyone in the audience that would like to speak?

12:03:11

(Whereupon, no response was had.)

ASSISTANT SECRETARY WINBERG: Okay. Seeing no one, I think we are very close to being on time once again.

So, what I'd like to do is turn the podium over to Janet. I think she has some closing remarks.

12:03:26

And, then we will end the spring meeting of the NCC for 2018.

MS. GALLICI: So, I will echo Steve's comments and compliments to our speakers. I think we had a great roster of presenters, and quite a variety of presentations.

12:03:52 They will be -- Again, the PowerPoints will be up on the web site in a few days. We also have a contact list for the speakers posted on our web site, and so that you will be able to follow up with these folks if you have questions or comments.

12:04:07 So, I also wanted to take a moment to thank our sponsors. We really and truly appreciate the folks that have contributed to the event the last day and a-half.

Our dinner sponsors, RAMACO, RAMACO,

12:04:22 TriState, and Jupiter Oxygen, thank you for your support of the dinner event last night.

It was the first time that we had done a dinner event, and I think it was quite a success. So, we'll see more of that in the future.

12:04:36 For our meeting again, today, again RAMACO, thank you for your support, Peabody, Arch, CHARA, Western Research Institution, ABA, Clare Back (phonetic) and SynFuels America, represented

by the folks here in this audience. Thank you for your support.

Orinthia, who has conveniently left the room now when I wanted to thank her, but if you
12:05:03 will thank her on your way out, there are just two people in the office, and running a meeting for 130-some people is challenging. We love a challenge.

And, Dottie, thank you very much for
12:05:14 your support on the tech stuff.

So if you'll thank her. I'd like to just acknowledge our Executive Committee members.

They're the ones that come in a day earlier and, and get on phone calls during the year
12:05:26 and really support the operational running of this organization. So, would the folks that are on the Executive Committee please stand so that we can let folks know who you are and, and we can acknowledge your support.

12:05:42 (Whereupon, applause was had.)

MS. GALLICI: Glad -- Thanks. Appreciate that very much.

Hey, yes, sir. Guy in the wreak. Deck,

Danny, you will not be hearing from me tomorrow, but Monday morning first thing, we've got work to do.

There are evaluation forms that are at
12:06:07 your seats. If you will kindly complete those or get them to Orinthia.

We'll also be sending you electronic version if you prefer. We're next going to be meeting September twelfth through the thirteenth in
12:06:22 Norfolk.

Dave Lawson, with Norfolk Southern, is going to be sponsoring most of our group down there.

Thank you very much for that.

12:06:31 Lunch, if you have purchased a lunch there should be a ticket on the back of your name tag. If you've lost it, Tom, you can seem Orinthia.

But, we'll be meeting for lunch in the
12:06:46 City Center 1 room, which is just outside the doors here. And, finally, I'm going to give it back to Steve for any closing remarks.

But, I realize I've been referring to

you as "Steve," and not to "Mr. Secretary" the entire time. So, it's difficult to make that transition.

No disrespect for a lot any means. I
12:07:13 think a lot of us have been knowing Steve for a long time.

But, with all due respect, Mr. Secretary, I'll turn the program back over to you.

ASSISTANT SECRETARY WINBERG: "Steve" is
12:07:15 much more comfortable. Thank you again.

So, it's now time to conclude our meeting. Certainly I want to thank everyone that came, some of you a very long distance, to get here to be with us today.

12:07:30 Again, I think we had a great program. Your cooperation, your input have been and will continue to be invaluable in the work that the NCC does.

And, again, on behalf of Secretary Perry
12:07:43 I want to thank you for all the time and effort that you've put into this important work. Again, we look forward to seeing you all in Norfolk.

And, this meeting is now officially

adjourned. That you.

(Whereupon, at 12:08 p.m. ET the above meeting was adjourned.)

I certify the foregoing to be a true transcript from my notes.

E-signature: D. I. Bunn

CSR CP RPR

CERTIFICATION

I, D. I. Bunn, a Registered Professional Reporter, Certified Conference Reporter, and Notary Public, do hereby certify that the foregoing testimony was duly taken and reduced to writing before me at the place and time therein mentioned. I further certify that I am neither related to any of the parties by blood or marriage, nor do I have any interest in the outcome of the above matter.

In witness whereof, I have hereunto set my hand and affixed my official seal, at Chadron, Nebraska, USA, this 18th day of April, 2018.

E-signature: D. I. Bunn

Notary Public

My Commission expires January 5, 2020.