National Coal Council

2015 Annual Spring Meeting

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P R O C E E D I N G S

MR. WALLACE: If everybody could grab their seats, we will begin. Well, good morning, ladies and gentlemen. My name is Jeff Wallace. I'm the Chairman of the National Coal Council. The Spring 2015 Meeting of the National Coal Council is hereby called to order.

This morning we have a full agenda, and we will proceed. We're pleased to have Dr. Friedman's successor with us today, David Mohler, Deputy Assistant Secretary for Clean Coal and Carbon Management. We'll hear from Mr. Mohler in a few minutes. Congratulations on your appointment. We certainly look forward to working with you.

I'm also pleased to recognize Robert Wright as Senior Advisor in the DOE Office of Fossil Energy as the Federal Designated Officer. Welcome, Bob. It's good to have you with us here today.

We have other exceptional speakers on today's agenda. Following Mr. Mohler's opening keynote, we'll have a keynote presentation from Mike Marsh, acting President and CEO with SaskPower.

Following a program break, we'll hear from three industry experts. Dr. Larry Makovich, with IHC CERA, will discuss opportunities for grid-scale energy and storage for coal power plants.

We'll then hear from Patrick Falwell with Center for Climate and Energy Solutions on the topic of opportunities for financing CCS projects and the impact of oil prices on CO2 for projects.

Finally, we'll hear from Jonny Sultoon with Wood Mackenzie, who will provide us with an international coal market outlook.

We'll conclude our program today with some council business.

This meeting is being held in accordance with Federal Advisory Committee Act and Regulations that govern that Act. Our meeting is open to the public. I would like to welcome guests from the public who have joined us today.

An opportunity will be provided for guests to make comments at the end of this meeting.

A verbatim transcript of the meeting is being made; therefore, it's important that you use the microphone when you wish to ask a question and that you begin by stating your name and affiliation.

Council members have been provided copies of the agenda for today's meeting. I'd appreciate having a motion for the adoption of the agenda.

MR. NARULA: So moved.

MR. WALLACE: Do we have a second?

MR. ALI: Second.

MS. GELLICI Ram Narula was the first; who was the second? Sy Ali second.

MR. WALLACE: All in favor?

(Chorus of "Aye.")

MR. WALLACE: Opposed?

(No audible response.)

MR. WALLACE: Thank you.

Now I'd call to the podium our National

Coal Counsel legal counsel, Karen Bennett, with Hunton and Williams, who will provide us an anti-trust advisory.

MS. BENNETT: Thank you, Jeff, and good morning, everyone. It's at this time that we pause for a moment before we embark on the meeting today.

And it's my role to remind everyone that your participation in the Federal Advisory Committee meetings today is subject to federal anti-trust laws, and that these laws preclude any discussion of agreements or concerted actions that may be construed as restraining competition.

This would include discussions in the meeting, in the hallway, in the restrooms about prices, about market practices, or any other competitive aspect of your company or business or the industry.

We all have a shared responsibility for ensuring all discussion associated with today's meetings are consistent with these restraints. If you want further information, we have the council's anti-trust policy in your packet for reference. And I will be here throughout the course of the meeting today and happy to answer any questions you might have.

With that, Jeff, thank you.

MR. WALLACE: It's now my pleasure to introduce our opening keynote speaker, David Mohler. Please note detailed bios for our speakers are included in your package. I'll highlight a few of David's previous experience.

He is Deputy Assistant Secretary for Clean Coal and Carbon Management with the Office of Fossil Energy at the U.S. Department of Energy. In this capacity, he's responsible for the DOE's R-and-D program in advanced fossil energy systems, large demonstration projects, carbon capture, utilization and storage, and clean coal technology deployment.

Previously, Mr. Mohler served as Senior Vice President and Chief Technology Officer for Duke Energy, where he was responsible for the development and application of technologies in support of Duke Energy's strategic objectives. He also served as vice president of strategic planning for Duke Energy. Prior to the merger between Duke Energy and Cinergy, he served in the same role for Cinergy.

Mr. Mohler has operational experience in both nuclear and fossil power generation, as well as experience in corporate marketing, human resources, and business development.

He earned a B.A. from Indiana University, a B.S. from the University of the State of New York at Albany, an M.A. from Xavier University of Cincinnati and an M.S. from the University of Pennsylvania. He completed the Columbia University marketing management program and the Penn State University executive development program.

Join me in welcoming Mr. Mohler.

(Applause.)

MR. MOHLER: Well, Jeff, thank you very much for that introduction. I'm happy to be here this morning with all of you. It's, I think, a good opportunity to get together and for me to meet some people that I have met before again, and to meet some new people. So I appreciate the opportunity very much.

I want to try to do three things. One is I'd like to sort of extend Jeff's introduction a little bit and answer a question that I've been asked many times in the past three weeks, which is, why did I join DOE? So I want to talk to that.

And I'd also like to talk a little bit about what's going on at -- what I see going on at DOE today and what I see kind of in the future as some major kinds of topical areas that we'll be exploring there.

So, the reason I joined DOE is really the combination of what I would call a set of inflection points and a Bruce Cockburn song. I don't know how many of you are of my generation and like Bruce Cockburn, but I'll try to link that in here in a minute.

So, in terms of inflection points, I've

been in the industry for 40 years and, you know, had a terrific career. Really, I've gotten to do a little bit of everything.

But I reached the point last year where I was very retirement-eligible and where my team in the technology group at Duke -- you know, I've always gone into new jobs with the idea that I wanted to build an organization that could do without me. And they were at a point where they were ready to fly without me. So it seemed like an ideal opportunity for me to kind of enter the next adventure, and so I took it.

The reason that I think the timing is very right for being at DOE has to do also with the number of inflection points, not personal in this case, but more industry and political. In the industry landscape, as I'm sure most of you are aware, we're in an era where we're replacing aging plant. So we've got some key decisions to make around, what do we replace with? And as we do that, how do we maintain a balanced portfolio and how do we actually improve our ability to manage our water, our air, and our climate as we do that upgrading of facilities on the generation side?

We're also in an era where the developing world is energizing. And they're consuming more and more energy, burning more and more fuel. So there are great opportunities, in my opinion, on a global basis, to begin some very serious and significant partnerships that actually were, I think, very much accelerated by President Obama and President Xi's agreement on climate just a few months ago. So some exciting things are going on there.

Of course, we're in an era where there's continuing focus on modernizing the grid and bringing new resources into the mix both on the supply side and the demand side as it relates to the grid. And we have a number of changing business models out there today. You know, shale gas, I think, for many of us, me at least, was a huge curveball. I didn't see it coming in advance. And now that it's here, it really has the potential to continue, I think, over time to change a number of business models in the energy industry.

So, those all make it kind of a prime time, an exciting time, I think, to be involved in an arena that enables us to do some really groundbreaking work around energy, and fossil energy in particular.

Political landscape, I was really, really pleased after Secretary Moniz began speaking publicly as Secretary, that he continuously articulated and continues to articulate an emphasis on "all of the above" as kind of an approach to the energy challenges we face. And I couldn't agree more, you know, with that approach.

I think there are some in the public arena who think all-renewable is an approach. There are others who might think all-natural-gas is an approach. But really, all-of-the-above is what it's going to take. So it's really compelling to have a leader who articulates that as forcefully as the Secretary does.

I mentioned the agreement between President Obama and President Xi. I think that really puts a stake in the ground as we move toward Paris. And I think international partnerships are going to be an area ripe for advancing the technologies that we need into the future.

I'm also really, really impressed by the people that have been assembled at DOE today. So I've spent -- this is the third day of my third week, which is good for me, because if you guys ask me questions I don't know I'll be able to say, "Wait. I'm too new. I don’t know that yet." But that escape aside, there's just a terrific group of people at DOE.

I spent yesterday at the National Energy Technology Lab, and I was equally impressed, continue to be impressed by the quality of the fundamental research going on in the national labs and how it all is being pulled together via DOE.

I think we have an opportunity to lay the groundwork for the future. So, I'm a political appointee, and I think I have a sense for what that means in terms of how much time I have to really accomplish something. But I really think that we're in a wonderful window right now, one I believe that we can lay a significant foundation that will continue into the future.

And to bring it back to Bruce Cockburn, a friend of mine asked me that question, why was I choosing to go to DOE? And there's a Bruce Cockburn song; maybe you know it as well. It's called "The Broken Wheel." And one of the lyrics that's always stuck in my mind is, "No adult of sound mind can be an innocent bystander." And I think that applies. It certainly does for me.

So, in terms of what's going on at DOE today, there's a very compelling landmark that we're about to achieve and we will achieve by the end of the week. And that is we will have safely injected 10 million tons of CO_2 in deep geological formations across the U.S. in CCS projects and regional partnerships and demonstration partnerships that have all been supported by DOE.

That's a huge landmark, in my mind. I was aware when I was with Duke, of course, and participated in the Midwest sequestration partnership, and we even had a small sequestration project at our East Bend site in Northern Kentucky, where we injected 3,000 pounds of CO_2. So, my headset was kind of, "okay, thousands of pounds." Well, we're at millions of tons. So I think that's very significant and really lays a good groundwork going forward.

That, by the say, is the equivalent of removing 2 million cars from the roads for a year, which is another way to put it into context. There is continuing work, I think, to figure out how to extend and expand and really enable that kind of management of CO_2 to continue and expand.

But another number that I ran into just the other day that impressed me was, today roughly 5 percent of U.S. oil production is a result of enhanced oil recovery. That's significant.

And I think that as we continue to look for more opportunities for that -- enhanced oil recovery, in my mind, is one of the real opportunities as a bridge between where we are today and where we need to go in the future with ultimate storage of CO2. So I was thrilled to see that number.

I want to mention some of the major projects that are either in operation or soon to be in operation that there are really some good things to say about. One is the Petra Nova project that went from 60 megawatts to 240 megawatts based on project economics alone. The 60 megawatts was DOE supported; the 240 megawatts was a business decision. So that is a terrific kind of example of how things are moving forward.

As is the air products project in Port Arthur, Texas, where they're capturing greater than 90 percent of the CO2 from hydrogen production and have stored about 1.8 million tons.

And the Archer Daniels Midland project, and the storage and saline aquifer in the Illinois basin from ethanol production is another example of, they have kind of a robust project that in this case is not ER-related and not directly power-generation related.

(Pause.)

MR. MOHLER: I apologize. I have tree pollen allergies, and Washington seems to have a number of flowering trees right now.

(Laughter.)

MR. MOHLER: On the global front, there are a number of very interesting and robust activities in the CCUS, carbon capture, utilization, and storage arena, and a number of countries that are either already engaged with DOE or in discussion with DOE on the potential for significant projects.

Some of those countries include Norway, Canada, China, Japan, the United Kingdom, and

Algeria, who already are engaged with DOE in some ways. And there are discussions, continuing discussions with the United Arab Emirates, Saudi Arabia, and about to be with Indonesia, where I'm going in about a week-and-a-half. So I think there are some really wonderful opportunities there.

What I see there -- and I don't know how many of you know this. But when I was at Duke, one of my missions at Duke was in fact to lay down a set of international relationships for technology development. And it made sense in the private sector; I think it makes sense in the public sector because in this country we're kind of built out. We're in a replacement mode, I think, in the U.S. for the foreseeable future.

But in some of the other countries such as China and even some of the countries in the Middle East, we're really in a more groundbreaking green field situation. And particularly in China, so much energy infrastructure is being built so quickly, you know, at such scale, really, that there's just this huge opportunity to learn from observation how best to scale some of these technologies. So I think huge opportunities there.

So, I'm going to let my allergies die down and stop speaking for a minute and see if you have any questions.

MS. GELLICI: Thank you.

Questions for David?

(Pause.)

MS. GELLICI: David, on the international partnership front, what do you see as some of the major challenges to facilitating more partnerships? It's something that we've addressed in our NCC studies about the need that DOE has been doing wonderful things at this point. But more is better. Just curious about what you see as maybe some of the challenges to overcome at facilitating more of those partnerships.

MR. MOHLER: Well, let me give you two cuts at it. One is kind of my pre-DOE experience, and then the second is my thoughts from, you know, a DOE perspective.

So, some of the things that I've run into already in my international work are what I would call, in essence, cultural differences. But they move beyond what you would normally think about as culture. So when we've worked, in particular with Chinese counterparties, on specific projects under the U.S.-China Clean Energy Research Center, for example, what we find is it's very difficult to understand what is meant by cost to capital, sometimes. You know, for the Chinese, what is the cost to capital?

There can also be some real differences in kind of what the boundaries around a project might be. So, when you're looking at a project and you're looking at a project cost, are you talking about -- you know, what are the boundaries? Are you just talking about a gasification skid? Are you talking about the entire plant? Are you talking about the entire plant and the retrofit to the generation facility attendant to it? What are those boundaries?

Sometimes, that can be kind of difficult to get to. So that's kind of one set of issues that have already been encountered.

Another set of issues, I think, has to do with intellectual property, and how do you make sure that intellectual property is protected and dealt with the right way? So that's kind of my private-sector experience.

When I look at the DOE side and kind of what I'm already familiar with, one of the questions that I want to make sure we can very clearly answer is, as we engage in those international partnerships, what value do we bring back for customers and stakeholders here in the U.S.? And to me, that needs to be very clear as we engage in those projects.

MS. GELLICI: Thank you.

MR. BIBB: Bob Bibb.

I'll throw you a softball. What is the status of the loan guarantee program, especially as it impacts projects in our industry?

MR. MOHLER: Well, that's one where I don't have all the information. So it may have seemed like a softball, but it's not.

(Laughter.)

MR. MOHLER: So, Bob, do you have any information? Can we just capture that, and we'll get back to you on it?

MS. GELLICI: Thank you.

MR. ALI: Sy Ali.

I'm familiar with your background at Duke. Is EPA also accompanying you on these international visits?

MR. MOHLER: No. No one from EPA will be on the trip with me.

MR. ALI: It might be a good opportunity to educate them on this.

MR. MOHLER: Interesting thought.

(Laughter.)

MR. BAJURA: Dick Bajura, WVU.

We're looking at a lot of plant closures in the next couple of years. What role could DOE play in helping to preserve those sites for future use in power generation?

MR. MOHLER: Well, that's a very good question, too. And it's another one where I don't have a well-thought-out answer. So I'm not going to speculate off the top of my head. But I do appreciate the question, and I will capture it and get back to you.

MR. SLONE: Thank you. Deck Slone with Arch Coal. I'll ask a big-picture question, and perhaps you can opine on this a little bit.

When you think about what we're doing globally on the climate front, there's certainly meaningful expenditure going on in renewables. But until we have large-scale storage, that can only take us so far.

I think everybody acknowledges that, until they're dispatchable, you know, that can be something, but it certainly can't -- you know, there's a limit, whether that limit is -- I mean, 20 percent would seem like audacious. But maybe you could get to that, at least another 80 percent.

If you think about nuclear, you know, there was certainly talk of a nuclear renaissance, but there have been a few cautionary tales on a cost perspective. And so, I'm not sure that's taken off. I think investment in advanced nuclear is fairly limited.

We're certainly not doing nearly, I would argue, what we need to be doing on coal with CCS. And we're not doing what I would argue we need to be doing on natural gas with CCS. So, in effect, we're kind of dabbling around the edges when we need to get the stabilization by mid-century.

And yet, this story of the need for CCS and advanced nuclear to get us there, there is no path to stabilization without those. It seems like it's still viewed in policy circles as kind of, "Oh, yeah, and then we need to do that." But it really is the main event.

Why haven't we been able to break through with that message? How do we do that? How do we engage organizations who continue to be reluctant?

MR. MOHLER: Well, I think that's an excellent question. I think that a couple of things come to mind for me. One is I don't think we've done a great job of really explaining the line-of-sight-to-value creation from CO_2. And I think there are ways to anticipate creating significant value with it.

So, EOR comes to mind as kind of an early example, and of course, that's not the entire answer. But we need to really articulate, you know, what kind of value we're going to be creating. And that's something that we're working on.

I think another thing in my mind is we really have to shepherd through more major demonstration projects and projects at a scale -- I know from my experience in industry, you know, in the electric utility industry, the focus really is, very appropriately, on reliable 24-7-365 production of electricity in a way that's safe and affordable. That's the focus. So it's not on taking a lot of risk.

So, the companies that are engaged in major power generation activities today from coal are not going to really want to take serial-number-one of anything, including sequestration. So somehow, we've got to get those demonstrations in place so that it's not serial-number-one, so that it's proven, demonstrated and people can move forward with confidence.

The rest really is an issue of economics, in my mind. So I think those are the areas where I think we've got to really dig in and go to work.

MR. WILLIAMS: Bob Williams, Princeton University.

First of all, I would like to congratulate you on your new position, and I'm very pleased that our country is able to have you in this position.

Question that I want to raise relates to one of the major recommendations of the 2012 NCC report to Energy Secretary Chu, which was that the NCC recommended that the Secretary and the coal industries work together to find ways to build, finance, and demonstrate coal to liquids, plus electricity, and coal biomass to liquids, plus electricity plants with CCS and captured CO2 used for EOR.

As far as I can tell, the DOE did not respond to that recommendation, and I wonder if you could say what DOE is thinking about in that area.

MR. MOHLER: Well, Bob, it's good to see you again, first of all, outside of Princeton. So that's great.

I don't know if there's been any kind of formal response. I really can't address that. What I can tell you is I am aware of research in that area, NETL among other places, that is ongoing in that arena. And I also know that there are at least discussions with international entities who are pursuing that work.

MR. PALMER: David, Fred Palmer, Peabody.

We totally agree and actually did a study, I think what, two years ago, on EOR as a low-hanging fruit and a real opportunity. But there are other forms of carbon capture utilization and storage, and some of the more promising ones haven't panned out. But when Calera was going to go into the cement business and ran into unanticipated cost problems.

But do you see any promise in the non-EOR utilization field, CO_2 to solids, aggregates, things like that that you could comment on?

MR. MOHLER: You know, it's an area that I've really been very interested in for awhile. And you know, one of the reasons, once again, for my utility background is, if you're in the kind of position I was in, where you're going to go in to a CFO and say, "Hey, I need X million dollars to work on CO_2," the response, rightly so, really, is, "Well, why should I give you that money? It's only going to increase the cost to our customers, and there's nothing really in it for the shareholder."

So, at least to address that second complaint -- there's nothing in it for our shareholder -- you'd like to be able to say, "Well, here's a line of sight to potential value creation."

So, in the absence of any kind of a price on carbon, I think that we need to look toward some forms of utilization as, once again, a bridge. Some of the work that I'm familiar with, I think there is some very interesting work going on in algae, the use of flue gas for algae production. That's become a longer putt commercially because of the price of oil falling as it has. But I think progress continues there.

There are a couple of entities out there that I'm familiar with who are using CO2 for things like, you know, making different kinds of chemical derivatives and solids. And I think the long putt is really finding a way to create those usable byproducts without totally saturating markets, frankly, which is easy to do, given the volumes that we have to deal with.

MR. PALMER: Just as a follow-on, you talked about a, quote, "price on carbon," which people have talked about forever. And usually it's -- always it's in the context of negatives, whether a carbon tax, and of course, the Waxman-Markey effort, which failed. And the CO_2 cap bill, cap and trade bill.

We talk about a price on carbon. We talk about a positive price on carbon. Solar and wind get a positive price on carbon in the context of tax credits

And in the latest study, the Fossil Forward study that we just came out with, which we're very proud of that, we talk about -- the very first recommendation in there is policy parity. And policy parity, in our world, means tax credits, regulatory certainty, and insurance for deep saline, and then tax credits in other arenas.

And, you know, having been in this industry for awhile and been engaged in the arguments over energy taxes and carbon taxes and things like that and coming from a co-op consumer background, which has always been anathema to people who care about electric consumers, and of course, you work for Duke and you were in that space -- I've never understood, ever why it is we demonize this technology because it's related to coal and CO_2 and exalt this because it's a windmill or a solar panel, when the goal is supposed to be low-cost, available, affordable electricity on a sustainable basis.

We have embraced in our 2009 study President Obama's greenhouse gas goal of an 80 percent reduction by 2050. We did that. But you need to put positive signals. You can't demonize something and expect people to put money in it, which was Waxman-Markey and which is a carbon tax.

So, you know, one of our ambitions is to change the dialog to a positive price on carbon and to encourage an industry which could be a fabulous industry. But absent that kind of an approach, we're not going to have that industry, ever. And you know, politically, it's tough. It's tough right now with the Democratic Party because of the total focus on renewables, and it's tough with the Republican Party because of the total focus on tax reform and budget issues and things like that.

But hope springs eternal. And if no other thing can be accomplished this morning, it's to emphasize to DOE how strongly we feel about the need for policy parity and a positive price on carbon to get this industry going.

MR. MOHLER: Well, message received. And I do think that that is just a really -- that merits a whole lot more thought and consideration than perhaps it's received so far.

But just to qualify what I said earlier, what I was feeding back to you was the kind of challenge I got from my CFO, not my personal belief.

(Laughter.)

MR. MOHLER: Just so you know that.

(Inaudible interjection and laughter.)

MR. NEMETH: David, Ken Nemeth, with Southern States Energy Board.

This summer, EPA will conclude its regulatory work on new and existing power plants. And as you well recognize, that's caused quite a bit of havoc in the states. You know, we have the Senate Majority Leader saying, "Don't do anything until the rule comes out." We have state regulators that are very concerned about where that's going to go and what they should do in preparation for the rule.

And we even have some states that have just passed legislation that say, once a state plan is developed, the governor and the Speaker of the House and the Senate president must all approve before this plan can go forward.

What can DOE do to help the states at a time when they're looking at an environmental problem on an energy issue? And I ask this question because, having engaged the EPA administrator on this several times, her point has always been, "You are the energy guys. We're the environmental guys. You worry about what happens on energy."

And so, I just wanted to know how engaged you are on this and if there are plans within DOE to help the states once we know what the parameters of this are going to be.

MR. MOHLER: Yeah. Well, at DOE, actually, and in fossil energy, we do have what I would call an action plan to continue engagement with the states. And clearly, your organization is a part of that.

In terms of interface with the EPA, you know, I've been busy trying to understand what's going on in my own shop as opposed to what's going on in somebody else's shop. But I would be perfectly willing and eager to entertain more conversation about that, going forward.

MS. GELLICI: We'll take one more question.

MR. BIBB: Bob Bibb. I'll try again.

We're starting to build some number of really large LNG export terminals. And do you think, from a strategic point of view at the department, there's concern of us gradually transitioning towards a world market sort of clearing price for gas, and we'll see significant increase in gas costs in the U.S. and lower costs worldwide where there's not indigenous gas?

MR. MOHLER: You know, I can't articulate a DOE position on that. What I could tell you personally is I see that as not a near-term problem. It seems to me like that is into the future. So, could it happen? I suppose. Is it a necessary outcome? Not clear to me. So, sorry. If that was another softball, I still couldn't hit it.

(Laughter.)

MR. MOHLER: Bob.

MR. WRIGHT: Bob Wright, from the Department of Energy.

For each terminal that comes in, usually it's a change. There is a study done by DOE, not our particular office, that looks at the impact on the country. Each time a new application comes in, the study has come back addressing that question.

And the answer they're giving is that they don't see an impact immediately or far into the future, that there's going to be enough supply to keep the price not necessarily at two dollars, but maybe five or six dollars, not the twelve or fifteen that happened at one time.

MS. GELLICI: Thank you, Bob.

David, thank you so much. It's very gracious of you to join us so early in your tenure. We look forward to working with you in the future, going forward. Thank you.

MR. MOHLER: Thank you.

(Applause.)

MR. WALLACE: Thank you, David.

Now we'll turn over the program to Vice Chair Mike Durham, who will introduce our next keynote speaker. Mike.

MR. DURHAM: Thank you, Jeff. I appreciate the opportunity to be here this morning and introduce our next speaker, Mike Marsh, who is the acting President and CEO of SaskPower.

Mr. Marsh was previously Vice President and COO since October 2012. In this position, he had responsibility for all operational issues, for power productions, transmission, and distribution services.

He has over 35 years of experience and joined SaskPower in 1991, where he spent nine years in engineering and maintenance supervisory positions at the Boundary Dam Power Station before serving as the manager of business and financial planning in Corporate and Financial Services for six years.

He attended the University of Saskatchewan, where he earned a bachelor of science degree in mechanical engineering and later studied at Queen's School of Business and earned an MBA.

So, please join me in welcoming Mike Marsh.

(Applause.)

MR. MARSH: Good morning, everybody. I'm very happy to be here. And just like Mr. Mohler, I have allergies as well, and I've been in this lovely city for the last three-four days, and it's really starting to hit me now. So, please bear with me as we go through this today.

I'm here today to tell a story about what we've done in the Province of Saskatchewan and Canada, and we're going to tell a good story about how we've been able to convert a coal-fired power station at a production scale and extract the CO_2 out of the exhaust gas and actually do something with it.

We're very proud of this facility, and it's really been a journey over the last probably 15 years since we began to contemplate what the art of the possible was and bring it to reality. So with that, we'll see if the technology works here.

(A video presentation was given.)

MR. MARSH: So, that's a great little intro-video that our communications department put together just before we opened our facility last fall.

The person who actually has spearheaded this program since 2008 is Mike Monea. Now, Mike Monea and I have the same initials. He's a little bit taller than I am, and he's certainly attended a lot of conferences, and many of you have probably met Mike over the last few years.

Mike has really -- you know, he has a passion for this project, and he has really brought it home. And he's carried the message about our Boundary Dam 3 project around the world.

But for those who are not familiar with Saskatchewan or SaskPower, just a little bit of background. We're the province that sits right over North Dakota and Montana. Montana is just under the southwest corner, and North Dakota is under the southeast corner.

Our province is the size, roughly, of Texas, just so you know. But we only have a little over 1 million people in the province. So we have more -- we like to say we have more power poles than people in our province.

(Laughter.)

MR. MARSH: And most of the population is in the lower half of the province. We tend to think of the prairie provinces as big grain producers. Half the province is really agriculture and potash mining in the south and the north. It's forest and rock, and hard-rock mining, uranium, gold, and forestry products in the north.

We're a little over 4,000 megawatts of total installed capacity. We say 151,000 kilometers of transmission line; I'm going to have to talk to my communication people. That's really 14,000 of high-voltage transmission line and about 135,000 of distribution line, so 25,000 volts and below.

We have about a half-million customers in the province. And we're experiencing probably something different than a lot of states and a lot of provinces are experiencing right now. We are in a significant growth period. We have had year-over-year growth, two years ago a 6.4

percent and last year a little over 3 percent. So we've had about 10 percent growth in energy consumption over the last two years.

Now, our supply mix is diversified. And as Mr. Mohler said, we have a portfolio of generation options available to us. We're not blessed with abundant hydro facilities like our neighbors in British Columbia or further east in Ontario and Quebec. And in the past, our percentage of coal generation was over 60 percent.

But as time goes on and we add more gas generation and more renewables and the load continues to grow, our percentage of coal is actually coming down. It's now about 44 percent. Gas is about 29 percent, hydro 20, wind about 3 percent right now, and other would be imports and small generators provide about 4 percent of our energy.

Now, we have -- one of the topics in Mr. Mohler's speech this morning was about renewables, and a couple of questions about renewables. We have about 25 percent renewables. So if you include hydro and wind, our percentage right now is about 25 percent. We continue to add more additional wind to our fleet. We're putting in another almost 200 megawatts of wind right now. And we'll be putting out more requests for additional wind over the next few years.

So, what we have here is just a picture of a dragline in operation. We have a mine mouth operation for our coal facilities, which makes it very handy.

We have three coal-fired stations in the province. The Boundary Dam station currently about 650 megawatts; our Poplar River station, about 600 megawatts; and just a little to the east of the Boundary Dam station is our Shand power station, which was the most environmentally advanced station of its time when it went into production in 1992.

Now, for those who are interested in the coal aspects of our facility, coal mining in

Saskatchewan, probably just like Montana and North Dakota, dates back to 1857. It was one of the earliest commodities to be mined in the province. The coal we burn is Western Canadian Lignite, which has a very low heating value and a low percentage of sulfur.

Our coal comes from a different number of seams that vary, but typically, there's 40 to 50 feet of overburden, which gets pulled off. And the coal seams are anywhere from three feet to fifteen feet in depth.

Now, our heating value, just so you know, varies between about 5,400 to 6,200 BTU's per pound. So it's very, very low. It requires us to build big boilers in order to convert that coal energy into heat energy and then into electrical energy. The moisture content of our coal is 34 to 38 percent; ash content, 12 to 14 percent; sulfur, between 0.5 and 1 percent, depending on the seam that we're mining.

Now, the coal for our three power stations currently is mined by Westmoreland Coal, which operates throughout Canada and the U.S. There's a picture of our 75-cubic-meter bucket, for those that haven't been up close and personal to a dragline before.

Now, with respect to the regulations that we currently have to work in in Canada, we started the construction on the carbon capture facility prior to federal regulations coming into effect. So we began construction in May of 2011. And on September 5th, 2012, the Canadian Federal Greenhouse Gas Regulations on Coal-Fired Plants became a reality.

These regulations are actually coming into effect this year on July 1st, 2015. And essentially, the regulation requires new and existing facilities to operate as clean as natural gas facilities. The regulation is 420 tons of CO_2 per gigawatt hour.

Boundary Dam's unit 3 was 1,100 tons, but today, with 90 percent capture with our carbon-capture facility, will operate at full capacity and emit only 140 tons of CO_2 -- essentially three times cleaner than a natural gas facility.

It's a little snapshot of the regulations in both Canada and the U.S. -- 420 in Canada for modified and refurbished coal units, which is what we did. We refurbished an existing nominal 150-megawatt generator. And it was nearing the end of life, and we had to make that decision.

For new coal or natural gas units, the target is still the same in Canada, slightly lower in the U.S. And I'm sure many of you are familiar with these targets.

Now, I said before that we have a mixed portfolio in Saskatchewan. We have coal, we have gas. The base load at cost for natural gas is represented on the slide here, capital investment being fairly small, but the fuel cost and the fuel risk over the long term is something that most utilities are certainly concerned about.

Retrofitting the Boundary Dam 3 with a carbon-capture facility attached to it provides what I think everybody in this room is looking for -- long-term, stable price for the coal, for the fuel, much higher capital cost in the beginning. But over the life of that plant, we see a very good economic case being made.

We also have another very valuable benefit in Saskatchewan. In the part of the province where Boundary is situated, there's also oil and gas reserves. And we are able to use that CO2 and make it commercially available to an oil and gas company.

So, Boundary Dam -- the name is a bit of a misnomer. When you say "Boundary Dam," people think, "Oh, there's a hydro facility down there." But the name "Boundary" actually comes from the U.S.-Canada border, the boundary. And the dam is the reservoir that you see behind. There's just to the left of the screen, there's a dam that holds back the water in that reservoir for cooling water for that power station. And it's called Boundary, Boundary Dam.

I worked there for many years. I know the place intimately. All hours of the day and night when you're working in a power station and in a utility makes you very familiar.

Units -- it was originally a six-unit station. We retired two of the units. Unit 1 and unit 2 were retired in 2013 and 2014. They were 62-megawatt units apiece, built in 1958. And they were on the very left-hand side of the screen where the roof is a little bit lower there. And then units 3, 4, 5, and 6 are the four stacks that you see there.

Units 3, 4, and 5 are each 150-megawatt units. And unit 6 on the right-hand side is a 300-megawatt boiler and generator set.

Now, what you see at the right, to the right of the power station, is the carbon-capture facility. And you can see -- let me try to use this -- right here, you'll see this is ductwork that's coming from the back of the power station. Where the exhaust gas was going up the stack, we installed a set of big dampers.

This ductwork right here, you can imagine, is probably 16 feet high and about 12 feet wide, pulls that exhaust gas from the back of this unit over here all the way around to the back of the power station and over into the carbon-capture facility.

Now, for constructing this facility, we used over 60 companies. Our prime engineering contractor was SNC-Lavalin. We had about 1,700 workers onsite at the max, and we clocked about 5 million man-hours on the construction if this facility, with no loss-time injuries. So, we're very, very proud of that.

And we launched this facility in October of last year. And we had over 20 countries represented at the opening ceremony.

Now, here's a snapshot of what Boundary Dam looked like prior to carbon capture and post carbon capture. Megawatts, this is net megawatts here, 139. It was a nominal 150 megawatts gross, so you take station service off and you're down to 139. Post carbon capture, we retrofitted the boiler and the turbine. When we're not extracting CO2 out of the exhaust, we can now generate 160 megawatts gross. So that would work out to about 149-150 net without, if we weren't using the CCS facility.

And with the SO2 extraction and the carbon dioxide extraction, the parasitic load actually takes the net down to about 120.

Carbon dioxide -- a million tons here. We put the K in there. I wish they would have put something different. Post carbon capture, 112, reducing the output of carbon dioxide by 90 percent.

Sulfur dioxide has been reduced to essentially zero. Through the process, we extract all the sulfur dioxides. We put it through a sulfuric acid plant and manufacture sulfuric acid, which we have contracts now for and are selling.

Nitrous oxides, again, cutting by more than half. And this is particulate matter here. PM's, this is 10 micron size, 2.5 micron size. So you can see that we've certainly reduced all the harmful stuff, as well as the particulate matter coming out of that stack by a significant amount.

So, 150,000 tons have been captured since October. This was as of about two weeks ago. Minimum of 80 percent of CO_2 captured, so accounting for the performance of the plant up to this point in time, the operating hours, and ramping up the facility in the first few weeks of operation, we are still working towards the 90 percent captured at full efficiency. But we are achieving the 80 percent target today.

One hundred and twenty megawatts net to the grid. When we designed this facility, we based it on a net output of 110 megawatt hours. That's what our economic calculations were based on. We're getting less parasitic load than what we originally had estimated, which is a very, very good thing. It's going to help make the economics much more positive as we look to the next decision.

And the quality of the CO_2 that we're producing, using the technology that we've installed at this carbon-capture facility, which is an amine technology, so it's a post-combustion amine technology, very familiar to the oil and gas industry. We're producing actually 99 percent pure CO2, very close to food grade.

We're looking at actually now installing a slipstream process and taking out whatever is left there in order to make it food-grade quality. And then we would sell that product at a premium price and earn a little more revenue than we're earning today.

So, to do the math, a million tons a year -- that's like taking all the cars off the road in Regina. And there's about -- our population of our city, which is the capital city of the province, is about 220,000. We estimate, as Mr. Mohler said earlier, 10 million tons is about 2 million cars. We saved 250,000 automobiles off the road.

Capturing all the CO2 from the heating and cooling of every home, we use natural gas in the wintertime. And we need air conditioning in the summer. It doesn't snow up there all year-round, just so you know.

(Laughter.)

MR. MARSH: We experience 100 degrees in the summertime and minus-40 in the wintertime. So we have high extremes in the province. And also, keeping the lights on in half the city, so it's a phenomenal achievement. And I think it demonstrates what is possible when a facility like this is actually installed in an operating electrical system. And the benefits accrue to everybody.

Now, the big question people want to know is about, okay, how much did this cost? And how much is it continuing to cost? At this point in time, I can say that we are achieving better-than-expected operation out of the plant. But we're still in the first six months of operation. We haven't quite reached full capacity yet, as we work out -- you know, just like any other power station that goes in, it takes several months to work out a lot of the issues. And we continue to work on that. And we expect to be in full capacity by about June this year.

But based on the price of natural gas in Canada at the time, and these figures are from '09 to '10, so this is about the time we were putting together our business case for this one, the price of traditional coal-fired generation in $55 to $60 megawatt hour coal with carbon capture was priced in between the 90 and just under 110 at the time.

Natural gas, of course, wide range there. That goes from simple cycle to combined-cycle gas, from 50 up to about 80.

Nuclear, which we don't have any in our province, but there's a few facilities in Canada, and of course, biomass and wind having the highest cost per installed megawatt at the time.

The argument for coal with carbon capture in our system, in the Province of Saskatchewan, really was helped by the location of that facility, as I said earlier, in the southeast corner of the province where we have large oil and gas reserves. And we're able to, with the additional revenue, we're able to pull that number even lower, using the revenue from the CO_2 to help offset the installed cost of that facility.

Now, because of the nature of the contract we have with Cenovus, who is the off-taker of CO_2, and they're buying all 1 million tons a year from us, you know, I can't divulge the exact figure.

But we're just going to paint this picture that helps illustrate that with the proper utilization of carbon capture technology, the proximity of oil and gas reserves, and our ability to enter into a contract to sell that CO_2, we now have an economic case that we were able to take to our board of directors and we were able to get this project approved.

And with the performance that we're seeing now, which is better than we've expected, you know, it will help us as we look towards the next decision point that we have to make on units 4 and 5. So again, two more 150-megawatt units slated for retirement in 2019.

We want to have a full year of operation at full load performance design criteria in order to really prove out the economics of this plant and to be able to build a proper economic case. We expect to have that decision at the end of 2016, beginning of 2017, and make that decision on whether we are going to go ahead with retrofitting two more units in our fleet.

So, we've got a few slides on the actual carbon-capture facility, brand-new facility. For those of you that have been in a coal-fired power station, things don't usually look this clean. There's usually kind of a gray-black smudge over everything. But this facility is brand new.

The structures that you see on the left, there are the SO_2 and the CO_2 absorber towers. And I'll get into that shortly. And coming out of the top part of the stack here, that's clean exhaust coming out of there. So, 90 percent of the CO_2 has been scrubbed out of the exhaust stream right here.

On this part of the facility, that's the CO_2 stripper. So, the amine captures the carbon dioxide in the process. We put it through the plant, which is essentially a chemical plant, not a utility plant; it's a chemical plant. We strip out the carbon dioxide in the CO_2 stripper and recycle the amines in the process.

So, the process has been working, been working well, and the consumption of amines is very low right now, which is promising, as well, because you don't want to have to start replenishing amines in this process because that will, again, tip the balance on the cost of the plant.

Now, just to the right of the plant, just off the screen here is the compressor building. So where we take the CO_2 out of the exhaust gas, we then compress it to just about 1,800 PSI and put it in the pipeline and ship it to Cenovus. And they take it about eight kilometers from this facility. That's their takeoff point. And it goes into their pipeline system.

Now, this project has cost, to date, a little under $1.5 billion. This is a production-scale facility. The initial estimate on this particular project was about $1.24 billion. We received 240 million from the Federal Government of Canada, which contributed to this project. And that occurred, you know, from 2011 up until last year.

We do know, based on our experience and some of the issues we had that developed during the construction of this facility, we do firmly believe that we could build another facility like this for 20 -- some of my engineers are saying maybe up to 30 -- percent less than we currently experienced here, which is very, very promising.

So, together with the good operating performance and the ability to construct this facility at a lower capital cost will help make the economics look even brighter.

So, this is a picture of the carbon dioxide and sulfur dioxide absorbers. Just a couple of little facts -- the CO2 absorber is 14 stories high. The smaller tower is the CO_2 -- or pardon me, the SO_2 absorber, right here. This is the CO_2 absorber, 14 stories high.

They were built, they were constructed of brick, so they went up kind of one foot at a time when they were being built. To eliminate degradation of the walls on the inside, over 70,000 ceramic tiles were used to make up the interior. Industrial ceramic tile is known for its durability and chemical resiliency. And the absorber can withstand temperatures of up to 1,000 degrees Fahrenheit.

Now, this is the CO_2 stripper, which is the larger of the two vessels. And you're only seeing the part that's actually sticking out of the roof here. It actually goes another 100 feet down into the building. The SO_2 stripper is found within the facility itself, so you can't see it here.

And the reason the CO_2 stripper is much larger is because there are several times the amount of amine is used in the carbon dioxide stripping process than the SO2 stripping and slightly different amine solutions.

Large vessels also add additional heat to the amine solution, and this stripper separates the carbon dioxide gas from the amine solvent to be recycled back to the system. This vessel was fabricated in Alberta, Canada, and this was the largest piece of equipment hauled on highways in our province to date.

And just to note, as I said earlier, amine technology has been used in the oil and gas industry and the LNG industry for over 50 years. But we chose the technology when we designed and built this facility.

This picture is actually of the SO2 stripper found inside the carbon-capture facility. This particular shot is taken on about the third floor. So, you have two workers here. There's one fellow in behind here, another fellow here. The SO2 stripper follows the same process to remove SO2 as the previous CO2 stripper that was shown, but using far less of a completely different amine solvent solution.

Now, the amine technology was provided by Cansolv. They own the technology, the amine technology. And as I said earlier, SNC-Lavalin was the prime EPC contractor on this site. One hundred percent of our produced sulfur dioxide is captured using this process.

Now, this is the sulfuric acid plants. It's the first of its kind to have been integrated into any form of chemical carbon capture and storage facility. It's especially unique because it's vertically built, so it's higher than it is wide. And they stack the components vertically to save space.

The job of the acid plant is to facilitate the chemical process that transforms captured SO2 into commercial-grade sulfuric acid, which we then sell. Our sulfuric acid is 96 percent pure, and we produce about 1.5 semi-loads a day of sulfuric acid. So, sulfuric acid, just so you know, is used for fertilizer, agricultural pesticides, and other industrial uses and other chemical processes.

And after compression, this is the pipeline that is just before it exits the plant and hits the pipeline to go to the off-taker. We use -- now, you can't see it in this particular photograph. But there's a dehydrator and an eight-stage compressor. The compressor is a German-built multi-stage compressor, 18,000 horsepower. The CO_2 compressor first eliminates moisture, then compresses the carbon dioxide to transform it into a very dense state. And as I said, it goes to the pipeline to Cenovus Energy. They use it for enhanced oil recovery.

Now, in addition to the off-taker Cenovus taking, right now, 100 percent of the CO_2 that's produced, we also have a deep underground storage facility, which we call Aquistore. It's a saline reservoir that's about 10,000 feet underground, so a little over 3,000 meters.

That facility right now is just being charged, so they are starting to charge that Aquistore facility. And they're beginning the process to inject carbon dioxide into that saline reservoir 10,000 feet underground. It's the deepest well in the province.

A lot of interest on the part of the academic community for the geology of underground carbon dioxide storage. The University of Regina, the petroleum technology research center that we have in Regina, are doing the measurements and monitoring and verification of the process itself.

And over the next few years, we hope to be able to have a lot of data that would be very much of interest, I think, to the academic community.

So, securing off-takers for the products out of this facility certainly helped to make the business case of the sale of carbon dioxide for enhanced oil recovery, sale of sulfuric acid out of that plant. And there's about 600,000 pounds a year being produced of sulfuric acid, and of course, fly ash. We do have precips that take a lot of the heavy particulate out of the exhaust before it goes into the amine process. And we sell that fly ash product as well.

Now, the storage, as I was just mentioning earlier, pure CO_2 storage goes to a deep well that we call Aquistore. Ten thousand feet down is the saline aquifer down here, so it's going to be injected down here.

Through this entire layer, there are several different geologic formations which provide hard-cap. So there's many different aquifers as you go down, but the deep one is down here where the CO_2 is going to be injected. So many, many different layers.

And I'm not a geologist, so I won't be able to answer any of those kind of questions if there are. But we're very optimistic that we're going to have a very good solution here. In the event that we can't sell the CO_2, for whatever reason, the off-taker might not need it, we can then inject that into the saline reservoir. But the predominant use of that carbon dioxide is going to be for enhanced oil recovery.

So, with the Boundary Dam facility, add one power station, and just about 10 kilometers away, we have another power station, the 300-megawatt Shand facility. We've also constructed a carbon-capture test facility. It's the first-of-its-kind facility, and it will allow international partners to try out new technologies and methods in carbon capture.

We currently have a partnership with Hitachi Power Systems, for when the facility opens this June. We also have a brand-new world-leading amine chemical lab that we're going to be using to test the effectiveness of new amine-based solvents and other chemical processes. So we're developing labs to really perfect the technology and the processes around carbon capture from coal-fired stations.

In addition to that, we've formulated a global consortium to share our knowledge with private sector, government institutions, universities, and nonprofit organizations who want to learn more about our expertise in carbon capture and storage. Now, this consortium will share information we've uncovered in the way of significant cost reductions, training.

Some of the learnings that we have through the construction and commissioning process, and certainly as we gather information on the performance of this plant, that information will become available as well.

We also provide tours. If you're ever able to get up to Saskatchewan, we're only a couple of hours north of the U.S. border. The plant itself is only about 20 miles north of the U.S. border, so it's not that far. We've had representatives from 30 companies and probably well over 1,000 people have toured this facility over the last year.

We welcome anyone who wants to come and visit this facility. We will provide a guided tour for people, delegates from this conference. I extend that invitation to come to Saskatchewan and see this facility firsthand.

And if you can't make it to Estevan, we

have another way for you to tour this facility. You can do it online. Go to the website saskpowerccs.com-slash-tour for a virtual tour of Boundary Dam, which provides a little more information on our process and viewing of the critical components that make up this project.

So, just a little piece of trivia. I was introduced as the acting president. I was just formally appointed as president last week. So I'm new to this role on a permanent position, as well. So I just corrected the slide here for you today.

With this project being the first of its kind in the world, we're definitely going to be learning a lot and we're going to be answering a lot of questions as we go. This is a world's first, and we're very proud of it. As global power production increases, and countries like China and Germany look to continue developing coal power, they are looking to us to see how they can do it in a more environmentally sustainable way.

So with the knowledge-sharing consortium, where we're inviting world governments and companies to learn from our experience so that carbon capture and storage deployment can move forward.

It's just one of the answers to climate change. It's not going to be the only one. We call it another tool in the toolbox. With our portfolio of generation, we're going to continue to add more wind. We're looking at biomass projects. To the extent we can add additional hydro into our fleet, we will do that as well.

So, this provides that tool that allows countries like Canada and the U.S. to provide energy from a source that we have on the ground that we know the cost of. It's a very stable fuel, and the process to convert that to electricity has been known for a long, long time.

We're very proud of what we've been able to achieve at Boundary, and we certainly look forward to the opportunity to share our success with you. And with that, I'll end my presentation, and I'll take any questions you might have. Thank you.

(Applause.)

MS. GELLICI: Thank you.

MR. WRIGHT: Bob Wright, U.S. Department of Energy.

Again, congratulations on a showcase project. Many meetings that I'm at people talk about Boundary Dam worldwide. And I'm pleased that you're willing to accept visitors and tourists. I know in the United States, Southern Company has been very gracious in letting people go to see the Kemper project. So be prepared for all those people who want to come.

I do have a question on all this, which is, you thought your net power was going to be 110 MW_e, but it turned out to be 120 MW_e. Could you comment more on where that 10 extra megawatts came from?

MR. MARSH: There wasn't any one single place. I think in the design process, because this was a first-of-its-kind facility, I think the conservative estimates of our engineering team, through all the processes, all the amine loops, and all the pumps that are used inside this facility, we didn't exactly know. So I think we took a very cautious and conservative approach.

And, you know, we built the business case based on the 110 MW_e. So, just as we got this plant up and running, we found that we were just consuming less energy in every part of the process.

The compression plant, you know, the biggest single user of electricity, with that 18,000 horsepower compressor, came in pretty close to design. So it wasn't that facility at all. It was just an accumulation of everything that was happening in that power station.

MR. SLONE: Yeah, Mike. Deck Slone with Arch Coal.

You're probably getting tired of being congratulated, but congratulations. Really, I've seen this, I guess, three times since the grand opening. And I'm amazed anew each time. And you guys do a brilliant job of telling the story, and kudos for getting out there and telling the story.

I guess I would ask this. You know, as you think about Boundary Dam 4 and 5 and the potential there and you think about what the reaction is going to be, is there an evolution in the way the environmental community -- and I know that's not monolithic, but environmental groups are reacting and thinking about this? I mean, this is a world-changing event. You know, is there growing recognition of that fact?

And I guess I would even go beyond that and say, would it be difficult today, given that, you know, you're getting performance on CO_2 that's three times better than natural gas -- would it be difficult in Saskatchewan to build an uncontrolled natural gas plant? Are there those who say, "No, no. We want this"? So is there anything on that front that you'd like to comment on?

And I guess, finally, I'd ask the question, you know, great stuff on the consortium. Is there something that SaskPower can do with all this learning? Because obviously, you guys are getting really good and really smart at this. So, is there a way you're thinking about sort of using this from a business perspective?

MR. MARSH: Okay. Well, first of all, you know, with respect to environmental groups that are looking at this project and, you know, challenging why we're not taking the money and putting it into wind, for example, and trying to develop more wind and renewables, I think this is a journey. I think we've only just begun.

And as we prove out the operation of these types of facilities on a production scale, we're going to be able to actually have some concrete evidence to say, "Yes, this can be done, and this can be done in a clean way." Up to now, it's been really just textbook. It's been theory.

We have to be able to operate this plant. We have to be able to demonstrate that we can do it economically. We have to be able to do it in a way that doesn't affect the rates to our customers, as well.

Remember, we're a utility, a Crown-owned utility in the Province of Saskatchewan. Any huge capital burden, of course, has the knock-on effect in future years to depreciation and finance costs. And that's not insignificant.

So, we have to balance our investment decisions just like Duke Energy and every other utility as we go forward. And we have to prove the technology so that we can answer those questions from the community that may be challenging, carbon capture as still being a dirty energy source. We view it as certainly a clean one.

We have the unique ability, I think, in the province to be able to use our captured CO2 in enhanced oil recovery. And that is probably the single biggest thing that has helped make this project certainly viable. And there's those that would say, "Well, that CO_2 is being used to pull oil and gas out of the ground and you're going to be extracting more CO_2 out of the ground and, you know, the cycle is going to be open."

But, you know, enhanced oil recovery -- and I'm not the expert there, but that CO_2 is recycled time and time again for many, many years. And I think the success rate and EOR fields around the world have proven that that technology can work very well.

So, we expect that it's going to be awhile before we're able to convince people that this technology is the right one. We are going to learn. We're going to share our learnings. And to the extent that we can build a case for the next two units, we will build that case. But it's going to be certainly something that we're going to take a long, hard look at.

Because again, we're a 4,000-megawatt power utility. One and a half billion dollars is a significant capital investment. And certainly, we have to be mindful of keeping the rates affordable, keeping that energy reliable, and certainly building a sustainable fleet over the long term.

And I just lost the last part of your question.

MR. SLONE: Well, for Sask, could you extend this beyond Boundary Dam? Are there business opportunities

MR. MARSH: That's a good question. Are there business opportunities for us? We've certainly looked at that in Canada. Remember the technology, the amine capture technology is owned by CanSolv. The engineering was provided by SNC-Lavalin on the carbon-capture facility.

We have, I think our learnings are really on, how do you attach it to an existing power station? So, power utilities, you know, can learn from us. And I think that's probably where our knowledge will be most valued. How you can actually integrate it into an operating coal-fired power station, build a facility, and then do something with that carbon dioxide. That's a pretty specialized market.

But I think when you look at, on a world scale, if there's opportunities around the world, we'd be happy to share, and we'd be more than happy to sell that if we could.

MR. JONES: Thank you, Mike, for that very interesting presentation. Mike Jones with the Lignite Energy Council, and I have a couple of questions.

First of all, you said that your success with CO_2 removal brings you significantly below the regulation. Are you able to take advantage of that to look at the whole station? And then, secondarily, would you look at 4 and 5, would you look again at 90 percent? Or would you go for a lower level?

And then, finally, you are storing in Aquistore. Is this something you could retrieve during an outage or something like that to allow for a continuous supply of CO_2?

MR. MARSH: Okay. I'll answer the last

one first. No. Once the CO_2 goes into the Aquistore facility and down into the brine -- essentially, it's a very, very toxic brine down there -- we can't extract it. It just goes in there, and it becomes mixable with that brine solution. So, no, we cannot.

And it's only going to be a relatively small component of the CO_2 that we're extracting. So, again, putting it into the pipeline and selling it to the oil and gas companies is where most of that CO_2 is going to go.

On units 4 and 5, we are going to be looking at how the regulations develop right now. In Canada, the regulations are for specific units of generation. So, we have to meet that 420 target on every individual unit of generation that we have. We are looking right now at ways that that can be adopted across the coal fleet entirely.

And if that happens, we would be able to take advantage of, perhaps, not having to extract 90 percent, but extract equivalent to gas, to meet the regulation.

So, looking at how the regulations unfold in the next little while, and certainly working to help those regulations meet an equivalency standard for fleets, generation fleets, will probably allow us to build a station much less expensive than we were able to do on BD 3.

Right now, we still believe that, you know, pulling the 90 percent of the CO2 out of the exhaust stream for BD 3 today, we can build an equivalent facility 20 percent less for units 4 and 5. And that's just based on the learnings that we have and the recent history that we have. So we're very optimistic that the next units will be more economic than this one.

MR. FLANNERY: Mike, I'm Dave Flannery with Steptoe and Johnson out of West Virginia.

Beyond the obvious technological accomplishments here, were there policy or regulatory or legal accommodations that had to be made for your project to deal with environmental regulatory issues or landowner rights, not so much for EOR but for the storage and environmental liabilities of any kind that you had to accommodate?

MR. MARSH: The environment -- the Ministry of Environment in our province had to permit the Aquistore facility. So the injection well received its operating permits from our Ministry of Environment in the province before we could do any deep underground injection into that saline aquifer.

As far as getting an operating permit for constructing this facility to meet the best CO2 capture in the world, there was not really a huge hurdle there. We met all the tests that were required, both federal and provincially. And certainly, you know, because of the very good environmental performance of this station, it was -- I wouldn't say it was a slam-dunk. But it was a fairly easy path for us to do that.

MS. SULLIVAN: Congratulations on a great project. I'm Vicky Sullivan with the American Coalition for Clean Coal Electricity.

You mentioned changes that were made to the existing Boundary Dam unit 3. Could you talk about those changes that were necessary to that unit? What portion of the project cost did those represent? And do you see those being needed in future projects, like for Boundary Dam 4 and 5?

MR. MARSH: Okay. Yeah. To start with, you know, we looked at increasing the overall gross capacity. So we went from 150 gross to 160. We wanted to make sure we could extract as much energy out of that coal as we could. So we replaced the entire turbine generator set.

We also increased the size of the boilers. So we added a little more surface area to the boiler, replaced some of the super-heater and re-heater sections in that boiler. Basically, improved the design and efficiency of that boiler to extract the energy out of that coal by using the same amount of coal.

So, we were just able to make a more efficient boiler, a more efficient steam path, a new turbine generator set. It probably -- that portion of the plant probably cost a little less than half of the $1.5 billion that I spoke of earlier. So about 60 percent was for the carbon-capture facility, and 40-45 percent was for the boiler and the turbine generator set.

MR. PALMER: Hey, Mike. Fred Palmer. Great job, great project.

I was looking at one of your presentations online. And there's reference there -- maybe you had it and I didn't notice it. But the government put in $240 million towards this?

MR. MARSH: Correct.

MR. PALMER: On your units 3 and 4, would that pertain -- would you need that, as well, or could you go ahead and do it without them?

MR. MARSH: No. We are not anticipating any more federal money being available to us. So we will have to make a much more solid business case without that $240 million.

Being the first of its kind, it was certainly a big demonstration project for the country. And that's the reason why the federal money was available. But we're not going to be seeing that for units 4 and 5.

MR. PALMER: And in this context, the enhanced oil recovery, obviously, was a major driver to do this?

MR. MARSH: Absolutely

MR. PALMER: In the parasitic load situation, this document I saw said it was at 21 percent. Is that accurate? And what's an nth plant look like, do you think? Where can this technology lead us on the amine solution scrubbing?

MR. MARSH: Well, you know, I believe that based on the results we're seeing in the first few months of operation, there is always room for improvement. There's always a way to make your operating plants a little more efficient, both starting in the power house and ending up in the carbon-capture facility.

So just like any boiler and turbine generator set, you continually look for ways to improve your cycle efficiencies and extract as much energy as you can. So that's what we need to work on over the next year, year-and-a-half as we prove the performance.

So we're going to be looking at everything to try to fine-tune this facility and to make it as efficient as we possibly can, and then take those learnings, you know, as we look at laying out a design for 4 and 5.

We don't have a number quite yet, because we haven't reached our peak performance yet. As I said, we'll probably reach that in June. Once we're able to operate at our design parameters, then we're going to work on that for the next year, year-and-a-half and really see where we can drive some efficiency out of that plant.

(Applause.)

MR. DURHAM: Thank you, Mike, for sharing your experience with us here this morning. And before taking a break, I'd like to turn it over to Janet Gellici for a special presentation.

MS. GELLICI: Thank you, Mike.

I wanted to take a few minutes today to acknowledge one of our members who has served as a guiding light for the NCC for many years and is transitioning to a new role in his company.

Fred Palmer has been a member of the National Coal Council since 1990, when he was Director of Western Fuels Association. Fred, I think you took a couple of years off of your NCC service, but you were reappointed in 2002, when you joined Peabody Energy.

For many years, Fred has served as Chair of the NCC's Coal Policy Committee, guiding our study efforts through many and various journeys. Fred has most recently served as Peabody's Senior Vice President of Government Relations. He's stepping down from that role this summer and has been named as a special advisor to the Office of the Executive Chairman at Peabody.

Fred, because you are such a guide to the NCC, we thought it would be appropriate to acknowledge your years of service with a compass to help guide you in your future endeavors at

Peabody and beyond. The inscription on this reads, "To Fred Palmer in appreciation for National Coal Council guidance since 1990."

You'll notice, Fred, that the inscription does not specify an end date. I said "since 1990." Fred has assured me that he is not retiring from the NCC and will continue to support and help guide our group, going forward.

Fred, please join me up here. And would you all please join me in showing our appreciation for Fred Palmer.

(Applause.)

MS. GELLICI: There you go.

MR. PALMER: Thank you.

MS. GELLICI: And there's also, at the break -- I'll let Fred say a few words because I know he always likes to say a few words.

(Laughter.)

MS. GELLICI: But at the break, there's also a book that we'll have available if anybody would like to just jot down your thoughts and appreciation for Fred. I'll have that available.

So, there you go, Fred.

MR. PALMER: This makes me feel very happy and good, and it is indeed a surprise. And I deeply appreciate it and the relationship that I've had with this fabulous National Coal Council for -- 1990. Don Odell (phonetic), my God.

Anyway, there are two books that I believe in, and one is called "Passages." And I'm sure many of you have read that. And I guess I'm in that time in my life. And the other is "Younger Next Year," which has 10 rules. And the first rule is, have a cause.

And I noticed on this compass that it's pointing towards coal. So I'm not withdrawing from coal. Thank you very much.

(Applause.)

MS. GELLICI: Okay. We're going to take a break now. Again, let's reconvene at about 10 to 11:00 for the remainder of our program. Thank you.

(Whereupon, at 10:35 a.m., a recess was taken, to reconvene at 10:52 a.m.)

MS. GELLICI: We're going to get started with our next session. If you can kindly make your way to your seats, I'd appreciate it. Thank you. I'd appreciate it if you could kindly take your seats.

(Pause.)

MS. GELLICI: You're all seasoned presenters. Thank you. We'd like to get started with our session. Thank you very much for finding your seats.

Welcome back, everyone. I wanted to take a moment to thank Hiranthie Stanford for her assistance in managing logistics for this meeting. Of course, she's not in the room because she's out doing something right now.

But she is our NCC Membership and Meetings Manager. She's actually been with us for a year now. I wanted to make sure that you all knew who she was. So if you haven't had a chance to introduce yourself to her, she is out at the registration table.

Also, before proceeding with our program, I'd like to acknowledge some folks for their extraordinary efforts in preparing our most recent study for Secretary Moniz, entitled "Fossil Forward: Revitalizing CCS." Our study was chaired by Amy Ericson, with ALSTOM. Amy, would you please stand?

And would you please all join me in acknowledging and thanking Amy for her great support that she gave on the project.

(Applause.)

MS. GELLICI: And, Amy, if you'll let Carl know that we're thinking of him, as well.

MS. ERICSON: And thanks to everyone in the room for the fuel effort and their contributions.

MS. GELLICI: Right. And I did want to acknowledge Carl Buzzuto also with ALSTOM as the lead author on that. Many, many others in this room contributed to the Fossil Forward study.

I'd like to ask those of you who participated in the study, whether writing sections for the report or reviewing or writing fact sheets, to please stand at this time. Those of you who worked on the Fossil Forward study, please.

Thank you. And would you, the rest of us, please join in in acknowledging the fine effort of these individuals. Thank you very much.

(Applause.)

MS. GELLICI: We have three exceptional speakers to round out our program this morning. We'll begin with the presentation from Dr. Lawrence Makovich, who is Vice President and Senior Advisor with IHS CERA. Larry has more than 33 years of experience in the electric power industry. He is an authority on electricity markets, regulation, economics, and strategy.

His current research focus is on electric power market structure, demand and supply fundamentals, wholesale and retail power markets, emerging technologies, and asset valuations and strategies.

Larry has been a lecturer on managerial

economics at Northeastern University's Graduate School of Business. He holds a B.A. from Boston College, an M.A. from the University of Chicago, and a Ph.D. from the University of Massachusetts.

We're delighted, Larry, that you're able to join us and come down from up North and enjoy some of our thawed-out weather here, a little bit, for you. But would you please join me in welcoming Larry Makovich. Larry?

(Applause.)

DR. MAKOVICH: Thanks very much, and it's a pleasure to be with you here today. In fact, I was a little bit surprised when I had the invitation to talk about grid storage and coal-fired power plants. And the reason I was surprised is because I think most people don't appreciate or they underestimate, really, the potential that's out there for innovation in electric storage to benefit coal-fired generation.

I've got another event that I was invited to speak at next month that I wasn't surprised at getting the invitation. And it's to talk about storage and how that's going to affect renewable power.

And the reason I mention that is I think the conventional wisdom is that energy storage, electric storage, really is an enabling technology to address the primary shortfall of intermittent renewables. And so people, I think most people, think that if we have breakthrough in storage technologies, it will really enable renewables to displace conventional generating technologies.

But I say that the conventional wisdom maybe even goes further than that, that I hear a lot of people think that energy storage is really going to enable, you know, an upending of the traditional utility model, grid-based, large central power stations and that storage will enable us to move to this distributed generation future.

So, I wanted to share with you a different perspective that we've gained from our research into electricity storage and what that would mean for the future. I've given you my major takeaways here. And rather than repeat them, let me just try to build them up for you here.

But first of all, I wanted to just get a grounding in reality here. Where are we when we talk about electricity storage? And right now, the power business operates with very little inventory. All right? And just to give you a sense of that, I just wanted to put together -- look at the supply that we have in the United States right now.

And if you try to characterize storage -- and I didn't use hydro-reservoir as electricity storage, because it really isn't -- it is really a storage of energy, but it's not really what we're talking about here, like a pump storage plant.

But the majority of what we've got out there right now is pump storage. And of course, that is hugely dependent on, you know, your natural endowments from geography. And we've got really very little of storage technologies that people are talking about, going forward.

What most people are focusing on and where the enthusiasm is on grid-based storage is for these larger projects where we're talking about these new, innovative, cutting-edge kind of battery technologies that people are focusing on. And I gave you a sense here of what's going on.

And again, when you look at the scale of the power business, this is really small-scale activity. But it is kind of the leading edge of this hope that, you know, we can come up a learning curve and demonstrate the viability and the economics of storage.

But what's important in this graphic is to look at, you know, the different experiments that are going on, the different kind of battery technologies, storage technologies, and in particular to note the kind of discharge capacity and duration of that discharge that's associated with the charging and discharging cycle.

And what you'll see if you look at the spread of stuff that's going on right now, you know, we're talking about these kind of four, five, up to twenty-five megawatt kind of projects here, with this discharge capability that's spanning hours when we look at where the experimentation is. And there is a lot of enthusiasm to advance this technology.

And you can look at this historical pattern of experimentation and investment here, and you can see that we are on the upswing. So it's an area, it's a technology that people are really focusing on because they can see it as a way to solve a lot of problems.

So, you know, as I look at my notes here, I was putting together, to make some points about that there's economics that affect inventory. And then I thought, well, I'm talking to a coal crowd. And if anybody knows about inventory economics, it's probably the coal business.

So I won't go into, you know, the basics here, other than to say that, look. You're always evaluating the benefits versus the cost in order to figure out what kind of inventory makes sense. And so, if you're in the electric power business, and you're looking at the ups and downs of the demand for electricity -- and so I give you the example here of Texas.

And you ask yourself the question, you know, how much inventory could make sense? You can see that, you know, storage would be quite valuable because you have quite a substantial variation in use here.

For example, if you had the ability to push inventory to the limit here, you'd build enough power plants to produce all your energy in Texas, you'd need maybe 40,000 megawatts rather than, you know, 70,000 to be able to meet that peak. So you could substantially reduce the amount of capacity you have in place if you had inventory there to meet your ups and downs.

And what's interesting, too, here, is there's kind of two variations here. One is this hourly stuff within a day. And you can see the kind of range there. You can see, you know, it's a little bit wider in the summer than it is in the spring and the fall. And then you've got this seasonal kind of variation where, in the extreme, you'd have inventory where you'd be charging up in the spring and discharging in the summer.

And of course, that is what essentially happens for things like hydro-reservoir in the Pacific Northwest and so forth. We actually do have kind of seasonal storage.

But just to give you a sense of what kind of challenge you're up against in the power business, why would inventory be valuable? And in analyzing this and looking at that kind of discharge, term that I showed you earlier, if you can only discharge for a few hours, up to four hours or so, you're not really reducing the need for capacity. This is the example that I ran for that Texas case.

So if you can discharge for under four hours or so, what you're really substituting for is not so much capacity as it is things like automatic generator control and kind of predictive software that people use for wind and solar output.

But if you can store power and then discharge at capacity for this kind of four-to-twelve-hour period, this is where you can really start to level that load, increase the load factor. And so that's really kind of the sweet spot on what you want the performance characteristics of these technologies to look at.

So, you know, when you look at what's out there right now, you know, pump storage plants do that for you. They'll give you this kind of 12-hour charge, 12-hour discharge kind of situation. When you look at things like solar thermal power plants that are using molten salts to store heat and then produce electricity later, they're into this four-hour-plus kind of discharge range.

And so that looks like it's the sweet spot. If you get there, what you're going to be displacing in a power system are not your base-load plants. It's your peaking and cycling plants that are getting displaced if you can build in this kind of storage capacity.

Now, when we think about the technologies that are out there and the ones that I showed you people are investing in, if you look at their kind of cycles of charging and discharging, most of what you see out there, with all these new battery technologies, are in this range where most of the benefits are not going to be to displace the generation.

That's all the way at the right-hand side where you've got things like compressed air energy storage and the pump hydro and a little bit of the battery technology.

But most of these current applications are really going, their primary benefits to justify their costs are the kind of grid-management things, about voltage stabilization and automatic generator control, transmission flow management, and so forth, much less on this question of being able to displace capacity.

And the only other thing about the technology that I wanted to say is, in analyzing technology, I think a lot of people pride themselves on being optimists. And I think that when behavioral economists study human nature, they come up with this characteristic that we have as human beings, that we tend to be optimistic.

And when you apply that to technology, I think you need to be careful that I see far too many people being optimistic and unrealistic about how quickly we can advance technology in general. I think the example of the carbon capture and sequestration is an example of, it takes a lot of time to do the research, do the demonstration, commercialization, wide-scale application.

And all too often, people are assuming things like Moore's law is going to apply to batteries and in a very quick time frame, we're going to have this revolution in power storage.

Remember, batteries are an old

technology. This is not something new. I mean, this goes back to Volta in the early 1800s and, you know, Gaston Plante, who made the first rechargeable battery in the mid-1800s. So, this isn't a new technology. I think we have to be careful of assuming we're on the verge of these dramatic breakthroughs and cost declines.

But in trying to think it through, if you think about what we're likely to see, I think it drives you to a very interesting conclusion. What has always been the case and what remains the case is that the lowest-cost way to give people the electricity they want when they want it is to build enough capacity to produce the energy when they need it.

That's been the longstanding engineering economics of power supply, which is why you see so little inventory in the mix. It's not that you can't store electricity; it's just that it's far more expensive to build electric inventory than it is to just build the additional production plant.

And so, I think that we have to realize that, given the current state of storage technologies, the current level of deployment, we're still a long way off before we're going to see the cost in performance of batteries really up-ending the central-station grid-based power and utility business model.

But I also think that there's a bit of a storage paradox here that people don't appreciate. So, let's assume the breakthrough. Let's assume that batteries are some kind of electric storage technology, beat the cost benchmark. They're cheaper to put in place than it is to build peaking-and-cycling plants. Let's assume the breakthrough, that we're there.

Now, think of the effect on the power generation system. So think about wind and solar. Wind and solar technologies generate at a utilization rate a plant factor of 20 to 30 percent. Think about their coincidence to time of peak demand. So, typically, you can count on about 10 percent of the capacity for wind or solar being there when you've got that peak demand for electricity.

Now, compare that to the characteristics of thermal generating plants, conventional generation, including a coal-fired power plant. So you're talking about something that you can depend on 90 percent of its capacity, you know, on average to be there at time of peak. And you can run these things, you know, at 70 percent or better of plant factors.

So it gives rise to what I call this storage paradox. I showed you the Texas example there. The average load compared to the peak load, what people call the load factor, is about 57 percent. So, in this example, I say, all right, let's suppose you've got an increase in demand of one megawatt. With a load of 57 percent, you're going to need about 5,000 megawatt-hours. So there's an increase in demand for power like the pattern we saw in Texas.

Let's think about serving that now if storage technologies are cheaper than peaking and cycling units. So, one option is, let's build a wind technology plus storage. All right. So, if the load factor is around 57 percent, I have to build two megawatts of wind if it's running at 30 percent plant factor to give me all the energy I need.

And since I can only count on the wind capacity, about 10 percent of it, to be there at peak, in order to meet that one megawatt I need about 0.8 megawatts of battery. So if I wanted to meet the increment of demand and produce all the energy that people want, if I use wind plus this new storage technology, I need to build about 2 megawatts of wind and 0.8 megawatts of storage.

Now, let's look at a conventional technology. So let's look at a coal-fired power plant with carbon capture and sequestration. So when you think about a plant like that, you can run a plant like that at, you know, 80-90 percent load factor. So, since I can run this thing close to flat-out, I only need to build about 0.6

megawatt, and I run it flat-out base-load.

I can produce all the energy that I need. And since I can count on it to be there at time of peak, I only need about half as much storage.

So the interesting thing about this paradox, as you look at it, is it is true that what people think is if we have a breakthrough in storage technologies, it's going to improve the economics of intermittent wind and solar.

What people fail to appreciate is it's likely to improve the economics of high-utilization power plants even more, the paradox being a breakthrough in power storage technology is likely to advantage base-load generation versus renewables, which is not something that most people are anticipating.

So, why is it that we look at the engineering economics of storage and come to a completely different kind of expectation for how this might play out in the future than what most people think?

So, I'm going to end with just some

reasons why I think that might be the case. I think one is it depends on what your objective is. If your objective is to maximize renewables, then your focus is that, yes, breakthroughs and lower-cost batteries are going to help the performance characteristics of renewables.

If your objective is to give people electricity at the lowest cost when they want it in the amounts that they want, it does shift your perspective and your conclusion.

And then the other thing is, I think we also have to look -- you know, why is this so different from the conventional wisdom? There are a lot of people that want to believe that the future is a distributed, small-scale, small-is-beautiful kind of world that this will enable.

And that strong kind of belief that that's the vision that we need to move to is why people will say, "You know, we can count on Moore's law. We're on the verge of this breakthrough" and why there's so much optimism, because people want to invent this very different future.

So, my predictions are, I expect continued enthusiasm for the potential for innovation and advances in battery technologies. I expect most of the traction will come from the benefits they deliver to grid operations. I do expect tension, going forward. I think it's going to take longer than most people expect for battery technologies to get to where they're a widespread application in power systems.

And I think that when people do their integrated resources planning and when they do their simulations, what they're going to be finding is this underlying storage paradox is true, and there's going to be a tension here that, you know, the economics are going to be pushing you in a direction different from the vision that many people have that we're moving to a distributed world.

So, I'd watch that tension to see how that's going to play out in energy policy, which I think is kind of geared towards delivering the vision and may have some misalignments with some of these basic economics.

So with that, I think we've got time for a few questions.

(Pause.)

MR. DURHAM: Good morning. Mike Durham, Advanced Mission Solutions.

So, if you look at integrating storage with like solar, wind, they're producing electricity. So you have to store electricity and then turn it back. If you look at storage at a fossil plant, you're producing heat and then you turn that heat to electricity. And so you have options of not just storing energy in the form of storing electricity, but storing heat and then using it.

So, I wonder if you'd just contrast that with inside the plant as other opportunities.

DR. MAKOVICH: Sure. Yeah. And I mentioned the technology there of solar thermal plants. There's a handful of those in the U.S. There's a couple of dozen worldwide. And that is, essentially, the storage medium is a heat storage.

So, you know, I think it actually was -- there was one of these adventure movies where they had this fight scene on the top of one of these towers, if people remember that. But you know, it's where they've got all those mirrors that focus up on a tower. It's got molten salts. It stores the heat. And then when you want to generate the electricity, that heat is then used.

So, yes. The way that electricity can be stored doesn't necessarily have to be battery technology. That's where a lot of the focus, the excitement is right now. But you're right. There's heat storage.

I noticed -- and I showed you, compressed air storage, the pump storage is you're using water across, you know, different hydro head heights as the medium.

So, yes, power generation is fundamentally the process of turning one form of energy into another. And you're right. It could be the medium here is heat different from chemical batteries and so forth. So, your storage is a much broader set of technologies. And heat storage is certainly something that we're seeing activity in right now.

The major focus right now, though, is on these battery technologies I showed you.

MS. SULLIVAN: Hi, there. Vicky Sullivan, American Coalition for Clean Coal Electricity.

Yesterday, there was an announcement by some researchers at Stanford about yet another breakthrough in battery technology, aluminum ion, I believe. Could you comment on that?

DR. MAKOVICH: Well, that's why I wanted to mention kind of this Moore's law idea. And you know, I was introduced that I've been analyzing this business for over 30 years. And I think one of the advantages of doing research in an industry over a long period of time is you do get some perspective. And that's why I caution people on this technology optimism.

And I'll just give you a couple of other examples. You know, the world that people wanted to create -- well, technology optimism, the thing that you hear oftentimes is that, "Look. If we can put a man on the moon, we can" -- and then you fill in the blank, right?

And so, it took about eight years between when President Kennedy said we're going to put a man on the moon, even though we don't know how, and the Eagle landed. So when the first investment tax credits for renewable energy were put in place, they were put in place for eight years.

And I think there's a connection there. I think the idea was, look. If you subsidize something for eight years, you'll get people to do some of it. You'll get scale. You'll get innovation. Costs will come down. And then you've got this disruptive technology that's going to change the world.

And instead of the invention we wanted, changing the world, the biggest technological innovation over that time frame was shale gas. So instead of inventing the cheap, renewable future that everybody was hoping for, innovation and technology delivered a fossil fuel revolution, which was not what people were trying to move towards.

So I think you have to be very cautious. People tend to overestimate the control they have over shaping the future. I think we see that in technology all the time. And I caution people on the battery side. It's not a new technology. The batteries in your car are the same thing that were in cars 100 years ago.

And so, I think that the emphasis is certainly there. We're seeing a ramp-up. We are seeing innovation. But I think we have to be much more realistic on the time scale that we're looking at. So, yes. There's always headline stuff.

The other thing I remind people of -- 10 years ago, if I were standing here today, people would probably have asked me, "How are fuel cells going to change the business?" Because if you'll remember, we were all going to have little fuel cells in our backyards and that was going to be completely disruptive. And the optimism there was separate from the reality, and it never played out.

So those are the lessons I think you have to take away when you're trying to follow what's happening here on the power storage technology side.

MS. SANTOIANNI: Dawn Santoianni with Tau Technical.

Can you comment on what you see as far as the role of short-term dischargeable energy storage like batteries for grid regulation services, compared with something that is a quick ramping, dispatchable, thermal unit?

Particularly, I'm thinking, you know, there are units that are coal units now that, especially in Europe, are very quick-ramping units and so, can not just follow a load, but can really get up to meet peak demand, uncertain demand in a quick time frame?

DR. MAKOVICH: Right. Right. So, yes. As I mentioned, the power system is a really complicated machine. And a lot of generating plants are as much a source of electric energy as they are a source of transmission control.

So when I mentioned, there's a subset of power plants that are under automatic generator control. The people in the control rooms there, they're speeding up and slowing down these plants to govern the flow of electricity around the grid.

And then there's these problems of reactive power, which, so when you've got loads of electric machinery and so forth, they create a reactive power that throws the cycles of the power running through the system out of phase with itself, so that you need to manage the reactive power.

That's what these battery technologies are going to be very effective at doing. Just put in the grid in the right places, they can help manage voltage. And one of the challenges that's cropped up with wind and solar is that not only are they intermittent, but that they can change very rapidly.

So, all of a sudden, you know, a weather front comes in. And, you know, we've seen this in Texas and so forth. So, a weather front comes in across all of Texas. All of the wind drops rapidly, or speeds up and has to cut out because it's too fast. But either way, the system has to adjust very quickly to this change in sources of electricity in the grid.

And that's where these technologies can be very, very helpful in managing the power flows. So, I think that, although a lot of people hope or think that the killer app of storage is going to be the intermittency of wind and solar, I think it's going to get its traction first in these other, very technical aspects of grid management.

And that, of course, means if the major benefit is to improve the operation of the grid, that's a good thing for grid-based power supply.

MR. SLONE: Deck Slone, with Arch Coal. Great non-intuitive conclusions, as always, and really interesting stuff.

I guess I want to ask you -- we started this conversation last night a little bit at the reception. But the knock-on CCS, CCUS is that, you know, it's just too hard and too expensive. And I wanted to get your thoughts on, understanding that it's not knowable, as you've pointed out, technology does, you know, things happen at different speeds and it's not entirely knowable.

DR. MAKOVICH: Right.

MR. SLONE: But when you think about where CCS, CCUS is today, and maybe in light of the Boundary Dam discussion earlier versus large-scale storage, what's harder? What's more expensive? What's further out, from your perspective? Understanding there's a scale question.

And then I guess the second part of the

question would be, when you think about what build-out really looks like, if we really know what storage is going to look like, if these are, you know, large-scale battery systems, chemical reactions, what do you think the reaction is going to be to that? Is that the future that's being envisioned?

Because these are obviously going to be very large, industrial-type facilities. So, interested in your thoughts on either of those, both of those.

DR. MAKOVICH: Okay, good. Let me start with the last one first, which is the large scale versus small scale. I think it's interesting to note that when you look at the technologies we use to produce electricity and distribute it, there's enormous economies of scale in just about every part of the power business.

So, for example, when you look at wind, wind power has demonstrated dramatic economies of scale. The towers are taller, the blades are longer, and the generation is greater because there's enormous economies of scale. There are economies of scale in solar. Utility-scale solar farms are about 50 percent less expensive than the same amount of capacity distributed around on a lot of people's rooftops.

So, if -- and I think my bet would be it is far more likely that battery technology innovations are going to demonstrate economies of scale than not, which would mean that if we get breakthroughs in battery technologies, that the economics are going to drive towards bigger grid-based storage rather than a lot of small distributed storage in people's homes that are allowing them to unplug because they've got PV on the roof and a battery in the basement.

So, I think economies of scale would tend to suggest we're going to stick with a grid-based power.

And on the cost side, what this example illustrates is you want to be comparing apples to apples. And what this says is that if we say, "Look. For power supply, you've got to meet not just kilowatt hours whenever the sun shines or the wind blows, but it's when people need them," then you need to take the time dimension into account in a cost assessment.

And what this says is, if you have, instead of a battery, if we're talking about peaking units to integrate the renewables, you can do the same kind of analysis. If you look on an integrated basis, what is the cost of wind and solar integrated with natural gas-fired generation? And compare that, so that can do the same thing that your dispatchable coal-fired power plant with carbon capture and sequestration.

What's interesting about that cost comparison is wind and solar integrated with gas has a carbon footprint, the natural gas-fired generation that's necessary to fill in and back up for it.

So we can look at, what is the additional cost of building wind, integrated by gas, from just building gas alone? And I can look at the difference in the carbon footprint, and I can come up with a cost per ton of CO_2 reduced. And I can compare that to the cost per ton of CO_2 reduced from a coal-fired unit with capture and sequestration.

And it will be -- it's very interesting, because what it really does show you is that -- and I've done this for nuclear that, for example, nuclear power is far more competitive when we're thinking about ways to reduce CO_2 cost-effectively, than wind and solar integrated by gas. But people don't do that kind of calculation.

But if you do, because of the high removal percentage of carbon capture and sequestration, I think you'd be pleasantly surprised at how good something like that looks on a dollar-per-ton-of-CO_2-reduced basis. You'd be, I think, pleasantly surprised at the relative economics.

And really, that's the whole point. Why do we have mandates to build wind and solar?

Because we want to address CO_2 emissions. And if that is the whole purpose, then let's use a metric cost-per-ton-reduced to judge the best ways to approach this.

Okay. Thanks.

(Applause.)

MS. GELLICI: Thank you, Larry. I appreciate your being here today.

Our next presenter is Patrick Falwell. He was a Solutions Fellow with the Center for Climate and Energy Solutions. Patrick analyzes clean energy and climate change policy at both the state and federal level.

He previously worked as a research analyst for the U.S. Bureau of Statistics and the Consumer Price Index. He holds a Master's of Arts in International Economics and Energy from Johns Hopkins School of Advanced International Studies, as well as a bachelor's degree from Georgetown University.

Would you please join me in welcoming Patrick Falwell? Patrick.

(Applause.)

MR. FALWELL: Good morning, and thanks, Janet, for that introduction. My name is Patrick Falwell, and I'm a Solutions Fellow with the Center for Climate and Energy Solutions, or C2ES. My colleague, Jeff Hopkins, our Vice President for Policy and Analysis, is actually a member of the Coal Council.

Just a little bit about C2ES. We're an independent, non-partisan, nonprofit environmental organization dedicated to finding practical and effective solutions to our twin climate and energy challenges. You may have previously known us as the Pew Center on Global Climate Change, and we were rebranded as C2ES in 2011.

Bob Perciasepe, the former acting administrator of the EPA, is our new president. And we work with a 30-member business environmental leadership council of major Fortune 500 companies that want to help us identify practical solutions to dealing with climate change, though the views that I represent here today are purely those of C2ES.

You may also know us for our work with the National Enhanced Oil Recovery Initiative. And this is a project that we've been convening with the Great Plains Institute since 2011. The short acronym for this is NEORI.

NEORI brings together a group of companies, environmental groups, labor organizations, and state officials who don't always see eye to eye on climate and energy policy, but they do agree that capturing CO2 from power plants and industrial facilities and using it for enhanced oil recovery is a good thing. And it's something that can address our joint energy, security, environmental, and economic challenges within the United States.

This group issued a set of consensus policy recommendations for federal and state actions. And in the last two Congresses, these recommendations were incorporated into legislation that was introduced. And I'll go into a little bit more detail on this later on.

Just a quick overview of what I'll cover today, just give some thoughts about what C2ES thinks about CCS. And then I'll also get into the economics of carbon capture and storage and what role enhanced oil recovery can play. And also, how incentives can likely make up the difference between what EOR provides in terms of economic value and what's needed to actually get more projects up and running.

Just briefly, on where C2ES sees CCS. We acknowledge that the entire world is dependent on fossil fuels to meet 80 percent of its energy needs. This will likely continue well into the future. And while we're using these fossil fuels, we need to figure out a way to deal with their emissions to meet global climate objectives.

This is the International Energy Agency's estimate for how much we'll need CCS between now and 2050. The IEA estimates that we'll need CCS to provide about 14 percent of cumulative emissions reductions between now and 2050 to meet a 2 degree objective. That's along with various other clean and renewable energy technologies.

In 2050 itself, I believe the IEA estimate is that we'll need CCS to provide one-sixth of what's needed in terms of reducing emissions, which is the equivalent of eight gigatons of carbon capture per year. However, the reality is that we're only about 20 million tons of CO2 capture per year, so we have a long ways to go.

Just one thing I also want to point out about IEA's estimates and the PCC, is that CCS is not just a coal power plant story. A number of other industrial processes and natural gas will ultimately have to consider this technology as well to make a true dent into their global emissions.

And just on the chart here, the gray area represents coal with CCS, and it's obviously the biggest part. But you can see there's several other colors representing industries and other power-generation opportunities where CCS is needed.

Overall, CCS development is not on track. We need a number of additional commercial-scale facilities up and running today to truly drive the cost down and to make it a more economic technology. As you know, we only have one power sector project up and running right now. And there's two more under construction in Mississippi and Texas.

There's been a little bit more success on the industrial side, applying CCS to natural gas processing, fertilizer and ethanol production, and even hydrogen production at a refinery. To get more projects up and running, I think it requires taking a look at the economics of an individual CCS project and how we cover the incremental cost of investing in capture and in transportation technology.

Certainly, the ability to sell captured CO2 for revenue is a big economic driver for getting more projects up and running. And I think the best example of selling CO2 and creating a value is selling it for use in enhanced oil recovery, or CO2 EOR.

And this is just a representation of what's needed to be done. Even when you are able to monetize captured CO2 and sell it, there is still expected to be a cost gap between the cost of capture and transport of a ton of CO2 and the revenue you derive from selling the CO2. And I think this is where a variety of federal incentives will probably come in to bridge what we call the cost gap.

And I'll go in -- the second half of my presentation will cover a little bit more about what federal incentives can do and how various approaches will address the economics of carbon capture.

But just briefly, how does CO2 EOR work? It's usually tertiary oil production, which means it follows other primary methods that extract anywhere between 30 to 50 percent of the original oil in place in a well. Given that there's perhaps up to 50 percent of what was there before still in the ground after these initial production techniques, there are other methods to recover the oil in place.

And carbon dioxide has the unique property of being able to bond to oil. It bonds with it, makes it flow through a reservoir more easily, and gets at the hard-to-reach oil that wasn't recovered by earlier production techniques.

Just in general, the experience with the Permian Basin of Texas is that, if you inject a ton of CO_2, you'll get 2.5 barrels of oil recovered from that.

Just also in terms of potential environmental benefits of EOR, you're going into an existing well. You're accessing light, sweet crude that maybe has a lower carbon intensity than other oil production. And if you assume that EOR may have the ability to displace another barrel of oil from the market that does not store any CO_2, you're doing a little bit better from a carbon perspective.

Just some quick statistics about where CO_2 EOR is currently. It accounts for about 300,000 barrels of oil production per day. That's the equivalent of 4 to 5 percent of total U.S. production. But that's shifting with how much oil we're producing by other methods.

There's over 4,000 miles of CO_2 pipelines in place. Some of these pipelines span hundreds of miles and even cross international borders with Canada.

Annually, there's about 65 million tons of CO_2 injection. But only about 20 percent of this derives from a manmade source. It's not well known that the majority of the CO_2 that's used in EOR actually comes from natural formations of underground CO_2. It's usually a surprising fact for folks.

We've been doing this for about 40 years in the United States. History suggests that EOR has the potential to permanently sequester large volumes of CO_2 from the atmosphere. Research has been done by international researchers to confirm that, once injected in the ground and cycled through several times, CO_2 does remain in place and permanently stored.

Overall, there is significant potential to expand EOR production and address both energy security and environmental challenges. This is just a quick summary of the work of Advanced Resources International and the National Energy Technology Laboratory. They estimate that between 20 and 60 billion barrels of oil is economically recoverable via CO_2 EOR That's equivalent to at least our current reserves, if not double that.

The recovering of this oil at the same time would involve the utilization of anywhere between 8 and 16 billion tons of CO_2, which is an extraordinary amount.

This is just a map of where most EOR projects are located today. The Permian Basin of West Texas is, obviously, the heart of EOR production. But there are additional opportunities in the Gulf Coast stretching from Mississippi all the way to East Texas.

Also, in the West, where Wyoming is pretty much the heart of EOR opportunities up there, but the opportunities stretch into North Dakota, Montana, Colorado. I'll just highlight that EOR opportunity is also present in California, which is in the process of figuring out how to document CCS projects and enhanced oil recovery for meeting its state climate goals.

And the industrial Midwest also has EOR opportunity as well. And most people don't associate that as an energy-producing region anymore, but there's a lot of oil development there in the last century that's slowed. But the potential remains because the oil is still there. So, we find CO2 EOR to be a pretty compelling story.

But as you know, recently, the oil prices have had a bit of a tumble. We've gone from three or four years or so where the value of a barrel of oil was above $90. That rapidly declined in the last couple of months of 2014 to about $40 to $50.

IEA has forecasted a slight rebound in where those prices will be, potentially getting it back up into the $50-$60 range. But the general sense is that we're not going to get back up to $90 or $100 a barrel, barring some unforeseen global geopolitical challenge.

At the same time, IEA also forecasts that existing production will actually continue to increase for the remainder of 2015 before plateauing in 2016. It's not exactly clear when the low oil prices will cause producers to cut back production or otherwise slow what they're doing already.

And the question becomes, how does EOR factor into what the market is experiencing right now? And the story that we've been -- the story that's been explained to us by those working in the EOR industry is that CO_2 EOR actually does pretty well during periods of volatile oil price changes.

You can see here in this graph that EOR production has steadily increased over time, maintaining its existing production volume even when prices have swung wildly. It hasn't increased either when prices have rapidly increased as well. But in general, we've slowly seen the gradual increase of EOR over time.

What is it about EOR that makes it somewhat resistant to oil price changes? Well, it's just the actual profile of an EOR project. It takes anywhere between zero and five years to actually hit peak production.

As I understand other oil production opportunities, within a year you get a high and quick return for your investment. But that production eventually subsides and you have to move on to the next place.

EOR is much different, because you will actually produce potentially for decades. The first year, you do a cycle of continuous CO2 injection. That may not produce oil. But eventually, within the first year or two, you do get some oil out of the ground. Between the next three to four years, you slowly build production that is sustained for at least a 10-year period.

And then the expectation is that production volumes decline gradually over time, but potentially lasting 30-40 years. Knowing this, EOR operators do not expect to have high and immediate returns often witnessed with other oil production opportunities. Given the long-range production forecast for their projects, they expect oil price volatility. They build it into the economic case for deciding whether to produce or not.

Once they are up and running, they have actually a pretty low marginal cost to produce, meaning that they can ride out the bad times and maintain their existing production and remain steady until oil prices increase again.

I would say that the challenge for them, though, is that low oil prices mean that it's hard to initiate new floods and increase production beyond where it is already. The lower oil prices, obviously, constrain how much of the capital budget they have.

I don't think there's a certain level that they need to begin production. However, $40, $40 or $50 is probably low for anybody. The biggest constraint on EOR expansion is also the availability of CO2 supply. And how much -- getting a new supply of CO2, whether from a manmade or natural source, is challenging, challenges an EOR operator's willingness to pay.

Their ability to pay for CO2 is usually tied to the sales price of a barrel of oil. So, if you have $100 -- for example, a $100 barrel of oil, they may be willing to pay $35, which is representative of 2 percent of the total cost of the sales price of a barrel of oil, adjusted for a ton of CO2.

How does this -- so, we may not see an increase in EOR production as the result of these lower oil prices. But I think there's additional implications for policy makers and those studying this issue. First, that the states that are very worried about where their oil revenue is going to go once we -- if for an extended period of low oil prices, EOR presents some stability.

Obviously, royalties and what-not are tied to the price of oil. But the hope is that EOR can continue to produce in times of austerity. The other important implication is that, as I just explained, the willingness of oil producers to pay for CO2 is tied to the price of oil. That impacts how much a capture project can expect to receive for selling its CO2.

The variability of the revenue that a capture project will receive from the CO2 sales is an inherent economic risk when an investor or financier looks at the project finance case for a project. And if there's no compelling way to address this uncertainty, then that remains an ever-present risk and makes the final investment decision pretty hard.

So, moving back out, I just gave an overview of what EOR can do to influence the economics of a capture project. I think the expectation is that we'll still have a cost gap even after the revenue from selling captured CO2 is considered. And this is where federal incentives have a role to play.

To date, this is a quick summary of what has been available at the federal level in terms of economic incentives for carbon capture.

Grants, mostly provided through the Department of Energy, have been the primary driver for getting commercial-scale capture projects up and running. Given that billions of dollars were devoted to these grants, it's a pretty high fiscal cost, and it's not clear if similar support will be available in the future.

Tax incentives have been another incentive available federally. There have been the 48-A and 48-B ITC's that have been allocated through an application process. The projects that were awarded these credits have still struggled to move forward.

There is also a 45-Q production tax credit for carbon sequestration. This is the tax credit that our NEORI group has taken the closest look at. It was only authorized for 75 million tons of CO_2. We expect it to be completely exhausted within the next couple of years, just based on the capture capacities of existing projects.

Just the way that the credit was written, there's limited certainty. There was no way to reserve the credit, and that created a barrier for projects hoping to utilize it once they're up and running and present the certainty of receiving the credit when they're seeking private-sector finance.

However, without that ability, it's been difficult for the private sector to use. Also, at $10 per ton of CO_2, it may have been insufficient to drive the most innovative carbon-capture projects.

DOE has also had a loan guarantee program in place, though to my knowledge no projects have been able to apply for it and successfully get that benefit.

There has, I would say, been significant political interest in addressing the economics of carbon capture and storage. And this is just a list of what's been done in the last Congress or so.

Last year, Senator Rockefeller introduced the entirety of our NEORI group's recommendations to expand and reform the existing 45-Q tax credit. It reflects our consensus approach, and it would provide an incentive to support the broad deployment of capture technologies beyond the existing 45-Q.

Senator Heitkamp of North Dakota eventually cosponsored this bill as well. She also introduced her own legislation to provide an investment tax credit and a competitively awarded subsidy for CO2 capture at coal-based projects.

Incentives for CCS have also been considered as part of larger clean energy and renewable energy strategies. The bipartisan Master Limited Partnership bills in the House and Senate are one example of this. And Senator

Wyden's comprehensive tax energy reform would have provided eligibility for carbon capture for the benefits that that would have established.

Finally, just this year President Obama introduced his 2016 budget. That includes two incentives that would be directed towards carbon capture. They would be authorized for billions of dollars, but it remains to be seen whether the President's budget will advance all that quickly through Congress.

Just in what our NEORI coalition has looked at in terms of what the priorities are when designing new incentives, how can incentives actually address capture project economics? First, are they on the sufficient level to address the cost gap?

Second, what happens if a carbon-capture project has no tax appetite? It's very likely that most of these projects early on will have high debt burdens.

A high burden means you can write off your interest payments on your tax return. Given that, you may not have a tax appetite to properly utilize the variable tax incentives. If that's the case, can tax credits be refundable? Can they be assigned to other parties that do have tax appetite?

Again, I mentioned the inherent risk of CO2 revenues derived from selling the CO2 for use in EOR. If oil prices are very volatile, then that revenue is going to be volatile as well. And is there any way incentive can be ramped up or ramped down to address the uncertainty that exists there?

Also, is there any way to make this a more -- less complicated and clearer process for the private sector? As I mentioned, several of the credits that have been awarded to date have been through pretty cumbersome application and allocation processes. Additional uncertainties in the tax code have just made it difficult for projects to actually be able to claim credits.

And finally, if incentives are offered for capturing carbon dioxide, that CO2 is used to produce oil. That oil is taxed by the Federal Government under existing tax treatment; there's no changes that we recommend. But the sum of those royalties have the potential to finance the costs of the incentives themselves.

This is probably not how congressional scorekeepers see things. But we think it's an important thing to consider, moving forward.

And just quickly, our NEORI coalition recommended an expanded and reformed 45-Q. We're very cognizant of the potential fiscal costs of such a thing. We recommended that credits be allocated competitively and that separate tranches be reserved for power plant and industrial sources of CO2.

Reform would also have the Treasury look at the sum of incentives to see if the entire program was meeting its cost-competitiveness goals.

Another option that our group has endorsed is private activity bonds. These sorts of bonds have been long available for environmental technologies and have helped speed their deployment. They would address the up-front costs of addressing CO_2 capture economics.

And finally, Master Limited Partnerships -- that was incorporated into a bill introduced in the House and Senate. They're an innovative company structure that has long been available for other resource extraction opportunities. And carbon capture could easily qualify for them as well.

And I'll just wrap up here, just saying, to recap what I've said so far, EOR does pretty well even during periods of lower oil prices. CO_2 capture projects can be enabled by a combination of EOR incentive support, and there is significant political interest in figuring out how we can do this and meet a variety of public interest goals.

(Applause.)

MR. SCHOENFIELD: Mark Schoenfield, Jupiter Oxygen.

In addition to the problem of incentives, as I'm sure you know, one major barrier to CCUS EOR is the EPA's scientifically erroneous decision to classify wells, to reclassify sequestration EOR wells from class 2 to class 6, which drives up costs tremendously.

And the reason is Melzer Consulting and others have shown that it's scientifically erroneous is because they use data from empty pour space to predict what would happen with pour space that has been under pressure for long periods of time with oil.

So I think it's important that we recognize one of the barriers here is the EPA's erroneous regulation, which is under scrutiny and attack in various places.

MR. FALWELL: I can comment on that real quickly. C2ES doesn't take a position on that, and that's not a point of consensus within our coalition. The EPA does recognize one pathway for recognizing permit CO2 storage through EOR, and that's the combination of a class 2 well with subpart RR monitoring.

(Pause.)

MS. GELLICI: Please join me in thanking Patrick again for his presentation. Thank you so much, Pat.

(Applause.)

MS. GELLICI: There was a lot of good information in that presentation that we didn't get to fully in detail, but the presentations will be posted up on the NCC website. So, please look for that here in the next week or so.

Our concluding presenter this morning is Jonny Sultoon, who is Research Director of Global Coal Markets with Mackenzie. Jonny has 14 years of experience analyzing energy markets. And his areas of expertise include short- and long-term demand forecasting for international coal markets, as well as competition between multi-fuels in the power generation sector, corporation analysis of major producers and utilities, and fundamentals-based price forecasting for the coal market. Jonny holds a B.A. and an M.A. in Physics from the University of Oxford in the U.K.

Please join me in welcoming Jonny Sultoon. Jonny?

(Applause.)

MR. SULTOON: Thanks, Janet. Good morning, everyone. It's a pleasure to speak at the NCC event this morning. We've heard a lot of very interesting presentations. It's clear there's a lot of passion for the coal industry here amongst all the members and the talks and the representations that people have given and spoken to me so far.

Just a brief introduction about Wood Mackenzie. We're one of the leading commercial research advisory firms in the energy and mining space. We have been around for over 150 years, really over the last 40 years, though, in the commodities sector. We have about 1,000 employees. We've recently been acquired by Verisk Analytics last month.

In the coal space, we cover both the supply side and the market side. We have about 35 analysts dedicated purely to coal. They monitor, you know, all the individual assets from around the world.

What are the quality types of different coal that come from both the domestic producing, but also the seaborne-facing markets? Looking at production costs, quality reserve, marketable production characteristics, financial acquisition, MNA in that sense as well.

We have people working on the market side as well, looking into fuel competition, where every coal country that -- well, every country that consumes coal, we have analytics and practices built around the way that coal demand and price is formed. And that's the part of the industry that I represent.

So, what I wanted to talk to you about today -- well, Janet kindly asked me to talk about the future for global coal. I could just say there isn't one and walk away, which is what the mainstream media want you to believe. But we actually have quite a different thesis on that. And, yes, times are very tough on the international coal space, as they are in the U.S. domestic coal space. But there are some nuanced points that need to be represented.

So, I'll give you a brief history of time, or the last 15 years in global coal markets, talk about some of the developments in China and India, which are really the principal driving forces for coal markets around the world, and then wrap up with our commentary on demand and price and costs and how those will evolve over the next five, ten, and fifteen years.

So, to start with, on coal, coal prices and coal costs. And this is a picture that we put together very frequently, just showing the evolution of coal prices, international coal prices for thermal and for metallurgical coal versus the marginal cost of production.

And you know, the marginal cost of production is a proprietary piece of Wood Mackenzie's research gathered together from all the assets that we cover.

And what we mean by the marginal cost of production, we talk about the 90th percentile cost contribution to the seaborne market. Roughly, where has that cost moved over time? Thermal coal on the left-hand side and metallurgical coal on the right-hand side.

And you can see that coal prices have been exceptionally volatile. You know, you've got the boom-and-bust commodity price cycle in 2008 and '09. You have the once-in-a-generation flooding in Queensland, Australia, in 2010-11, which had more of an impact on the metallurgical side, but very much a price impact on thermal coal.

And then, since then you've had pretty much collapsing coal prices since 2012 from an elevated price in 2011-2012. And all the way through the 15-year evolution of coal prices and coal costs. When you've been in these down cycles, the prices generally bounce back from the marginal cost of production, as it did in the early 2000s, as it did in 2007-08, as it did in 2009, as it kind of did in 2011-12.

But the last two years, almost three years now, we've been in quite nontraditional market times and nontraditional market dynamics. And prices have been significantly below costs, although costs have retreated, for, you know, 18 months to 24 months.

And that's quite a unique feature about the coal market versus other commodities markets. It talks to the nature of the globalized coal market, whereas in 2007 and 2008, you didn't have this behemoth called China sucking up one in four of every tons on the thermal coal market, for example.

You've had the production on the producer environment very much focusing on these Chinese net growth as the new form of demand, rather than the Japanese and Korean markets, which have been driving forces over the previous 10 to 15 years.

But you have also nontraditional market imperfections, things like take-or-pay structures in Australia, where you have very expensive infrastructure contracts that were put together back in the 2010-11 time frame when prices were expected to be at much higher levels.

And that's implied producers both and small to keep coal running to avoid paying a large take-or-pay penalty. And at the same time, they can work on trying to maximize those synergies at the mine site and reduce costs.

And then you also have things like, you know, the integrated miners. You know, they are a larger set than they used to be, less so in metallurgical coal, but absolutely in thermal coal. You have, you know, maybe a Glencore or a Rio announcing a production cut. But then you look at the world, and there's 100 million tons of Russian thermal coal, and the producers there aren't looking at cutting production.

You have very different motivation factors from new entrants. You have the U.S. producers, who have a very different, unique set of domestic markets and looking for the international market for an export valve, or an export relief valve.

So, that fragmentation means, you know, this coalescing of producer behavior doesn't really work like it used to. And hence, you have quite a fragmented market.

So, you know, where are we in 2014? Well, in terms of the seaborne trade of thermal coal and metallurgical coal, in 2014 there was essentially no growth whatsoever -- you know, 0.5 percent. After the glory years of 3, 4, 5 percent and principally driven by China, but also India, from 2008 to 2012-13, that evaporated in 2014.

China representing, you know, 225 million tons of thermal coal. In terms of imports, that's probably going to drop down to the 175-million-ton level this year. You're not seeing that being absorbed by any new countries.

You have a staggering amount of oversupply in terms of supply capacity in the system. Producers themselves, this is just looking at thermal coal, for example -- but producers themselves have talked about production cuts. Some are materializing, but we think there's still a ways to go on that.

You have people like Glencore talking about 15 million tons of production cuts from Australia. In reality, we might not see that as 15 million tons less of exports, but it might come off the top of the capacity.

You can see maybe that, you know, that amount of publicly listed cuts, production cuts is kind of growing into that 35-to-40 million ton range, but there's still a lot of excess. And that excess is only going to get bigger in this year and into next year when you have the participation of existing projects.

But there's also the brownfield capacity that's coming on stream, on stream from the time of a lot of these commitments in terms of supply expansion around 2010-2011 when prices were supporting those kind of supply projects.

So, there is this, would you say, wave of supply over capacity that needs to be wound out of the system. Indonesia is the greatest, in terms of volume, exporter in thermal coal. And the Indonesians are looking at trying to rein in illegal production and illegal exports, and that's quite sizable. You might see quite a big reduction from the capacity side there.

But still, we feel that the market is not really balanced at the moment, from a supply-and-demand perspective.

So, let's just talk about China. And what are the fundamental shifts going on in China? You know, China is very regional. There are areas in China that are exporting coal, there are areas in China that are importing coal. As a whole, you know, it imports around 200 million tons of thermal coal and 55 million tons of metallurgical coal.

But there is an overarching change in focus and shift on the environment, on market-driven policies, on anti-corruption as well, and that's bleeding through into all the different industry effects.

We've seen quite a lot of growth in terms of environmental protection, so the Air Pollution Control and Action Plan that was announced at the end of September 2013. That's evolved slightly and taken a different turn. But broadly speaking, that's going to take away a little bit of coal's market share in the power sector.

We've seen a big focus on ultra-low emissions. And I'll get to that in a point. And that's an area of positivity in China. I think there's a very good article I was reading just before in the Cornerstone magazine on Shenhua's push at the Gouhua -- if you'll excuse my pronunciation -- plants that they have, where they and others are looking at incredible low emissions of SO_2, of PM, and of NO_x.

They've really put what looked like an order of magnitude lower than the best available targets that are being pushed in Europe and North America. So that's an area of strategic interest, I think, for coal markets.

But really over the last six to twelve months, there's been a staggering amount of policy changes, either policy implementation, evolution of existing policy, or specifically edicts that have been targeted at the coal market, that have been hard for industry to catch up.

So, you know, we put together what we think are the top six. And they're coming through on quite a regular basis. Some of them are geared specifically at environmental policy.

So, for example, the Air Pollution Control Action Plan that, first of all, looked at rapid coal-to-gas switching in heavy industrialized and urban areas. And it's kind of moved a little bit in terms of now trying to -- because that gas dispatch isn't there. You know, the gas pipeline availability isn't there.

And now the movement is more kind of an evolution towards ultra-low emissions, which is being rolled out on a regional perspective.

But the vast majority of these edicts are more in the domestic protectionist kind of pocket, if you like. And that's things like the

NRDC ordering Chinese generators to lower their imports by 40 to 50 million tons at the end of September-October. That's absolutely playing into those imports that we're seeing in January, February, and March.

A big thorn in the side of the exporters who look to sell coal into China has been this issue around trace elements. Trace elements testing is not really widely used in the global market. When you look at coal, you're looking at sulfur ash and heat content primarily, but trace elements testing around phosphorous, around fluorine, arsenic -- it isn't really a global standardized testing that people adhere to.

But the trace elements testing that was introduced 1st of January 2015 and that will tighten up into July aimed only at the import market and not the domestic market, where there's quite a lot of impurities in Chinese domestic coal as well.

That's been, I think, a bugbear for a lot of prospective exporters into the Chinese market, where they've had to rely on coal sitting at ports two to three weeks, waiting to get tested, not a clear homogeneity of those test results, and waiting perhaps to pay a big fine or be rejected outright. And that's ground the market to a standstill.

So, at the heart, you know, why is there a lot of domestic protectionism edicts or those that are kind of masquerading as environmental policy? It's because of the competitiveness of the Chinese coal industry. So, you know, people often come to us and say, "You've got all these fancy cost curves. What does the global markets' competitiveness look like?"

And we say, "You know, it's a moving target." But roughly, you're talking about 15 to 20 percent of seaborne coal is cash-negative at the moment. If you turn that around and then look at the Chinese domestic industry, it looks more like 50-60, possibly even 70 percent.

So, any kind of safeguarding or support that the domestic miners can get from the NRDC and the NEA is really helpful. And that's what we've seen in policy over the last six to twelve months.

So, just moving tack a little bit, onto the steel industry and, you know, the hot-metal production, which really drives coke and coal demand. Absolutely, there's a problem with steel overcapacity in the Chinese industry, and that's been driving a lot of the growth in coke and coal demand.

You know, we do see that returning, you know, the rate of coke and coal imports on a global nature softening over the next two to three years. But we do not see -- people are talking about peak steel in China. That's not our perspective. We think peak steel in China, there's still a long way to go, perhaps in the late 2020s -- 2025-2026 time frame.

We feel that the big area of growth will be in India, which is a less mature market for coke and coal and for steel, the steel industry, and doesn't have the same level of quality or domestic market in terms of volume of coke and coal.

And that will drive this kind of growth in hot metal production and, hence, coke and coal imports over the late part of this decade. But we do see, you know, the start of a kind of peaking and falling of coke and coal demand in China as the development of the scrap industry really gathers pace.

And that's kind of started a little bit now. You've had a lot of, actually, scrap steel prices plummeting. The only thing that really saved the Chinese steel industry last year was this movement to shift a lot of steel into the export market when the domestic market consumption was actually quite low.

So, if we're going to see an acceleration of the scrap steel industry, that might bring that time horizon a little bit forward. But we're still, you know, bullishly forecasting hot metal production and coke and coal imports to grow into next decade. And that will be supported by supply from both existing projects and also greenfield projects.

Shifting to just looking at this, exploring a little bit more on the Chinese new energy policy, one thing that we've certainly seen, and actually a lot of this has already happened, has been this movement for both thermal and metallurgical coal demand led industries away from coastal provinces and into the interior.

I mean, these just show a few statistics from 2005 to 2013, where you've had growth in plastics, in fertilizer, in smelting, in cement production, away from eastern provinces and northeastern provinces into the interior. That's going to accelerate. You know, China has kind of dedicated this kind of go-West policy of trying to produce a commodity superhighway, if you like, from Zhejiang all the way through to the central provinces.

And we're going to see more of that, this -- you know, we talk about saturation of coastal China. And that's a lot of where all the policy on air quality is aimed at, you know, coastal China. But we feel that there's still a lot of growth to be had in interior provinces.

And, you know, when you're looking then just at the thermal power side, this is always a good bone of contention when we describe this to people in industry about the makeup of Chinese electricity demand, first of all noting that coastal Chinese generation is effectively flat or flattish over the next 15 to 20 years. We feel that there is a saturation there.

But the growth? And this includes all the assumptions around ultra-high-voltage distribution lines. It includes all the very great steps that are being made on the nuclear industry, on hydro. You know, hydro growth in 2014 and 2015 was exceptionally high in China, and that's displaced a lot of coal demand, notwithstanding also that China had very mild weather in 2015 and the overall power generation growth had slowed.

But, you know, it's hard to get away from the big number in terms of coal's makeup in the sector. So, you know, although coal's share does fall from the 75 percent level to maybe the low 60s, possibly 55 percent by 2035, that still seems an enormous amount of contribution from non-coal and non-fossil fuels.

And just to put that in perspective, you know, when you're talking about all this big roll-out, nuclear has to grow fivefold. And in this new nuclear environment, post Fukushima, yes, the Chinese have kind of committed to nuclear growth.

That's still a staggering amount of investment. To even achieve these kind of levels of support in terms of capacity, you're looking at the equivalent of a Three Gorges Dam every 18 months to two years for the next twenty years. And the amount of social difficulty that the Three Gorges Dam had in terms of the displacement of population, the moving of population, that's still a big ask, we say.

So, you know, coal is deeply embedded

within the power sector. Yes, there are moves to move it away from coastal generation and move towards ultra-low emissions, where you have companies like Shenergy, have sold technology transfer agreements to the big Chinese generating companies who are trying to prove ultra-low emissions.

As I said before, orders of magnitude less for SO2, NOx, and PM than what's currently in regulations for the mercury in their toxics legislation, what's currently in legislation for the European Industrial Emissions Directive, which starts next year, which is the broad analog with IMAT's (phonetic) here in the U.S. that's driving power plant retirements.

And if that can be proved, if you can look at other plants around the world, like the Isogo generating station in Japan, which achieves those low emissions targets, then there's a positive bit of environment, I think, there for coal-fired power in China.

Then the next big question comes, okay,

well, China -- well, if you believe this story on Chinese demand growth or still coal-for-power demand growth, where is it going to come from? Is it all embedded to the domestic industry? Or will there still be room for imports?

And we still feel that there's going to be room for imports. There is, of course, a lot of de-bottlenecking in the Chinese industry that's occurred, being able to bring coal from Shanxi, AA Shanxi and inner Mongolia out to coastal provinces and then down. There's been a lot of de-bottlenecking on the rail side.

But even if you look at the rate of growth of domestic production that we are seeing, or at the moment -- and this is coming from a very difficult start, given the financial state of the domestic industry, there's obviously an amount of protection there -- there's still room for imports.

And we feel those imports are falling into 2015 and 2016, but we do feel imports could push through, you know, the 400 or 500 million ton mark by the end of 2025-2030.

Now, India -- as China has gone through this raft of domestic protectionism over the last 12 months, India has been the market where people are naturally more interested in. I think there's been a couple of things going on in India.

First of all, the amount of ebullience and enthusiasm for India as an investment sector since Modi's elections last year and the way that he had turned around Gujarat state, people thinking that that can now be applied pan-India in terms of power sector reforms, power demand growth.

And there is a huge amount of latent capacity for power demand growth in India. But then there's still a lot of questions to be asked about domestic coal, and on two fronts -- how domestic coal will attract private investment, external foreign investment; and how the coal blocs that were cancelled by the supreme court last year will be rebid out.

Now, I don't know how much you follow that. But the supreme court cancelled about 250 coal blocs for a very opaque and nontransparent allocation process over the last 20 years. And those have been cancelled. They've gone through a three-part auction process. I think we're in the midst of the third auction.

The auction prices are very high. And, you know, there's a sense that, although there's a lot of captive coal in the northeast that is being bid out, some of that will support domestic coal demand. And our sense is that that has the potential to be handled quite -- not badly, but it will take some time to handle that coal reallocation process.

And in such time, there is very much an upside for imports. Imports surprised to the upside again last year. A lot of commentators were thinking, as ourselves, you know, we might hit thermal imports around the 140-145 million ton level. They turned out to be 155 million tons. So, growing into this year, we could almost see India at a parity level with Chinese imports if Chinese imports are pushed down to 175.

So, there's certainly a lot of short-term growth perspective in the Indian market. I still think there needs to be a large amount of concentration on the transportation story. Coal India and, you know, the government will have you believe that Coal India will grow to 1 billion tons within the next five years. We feel that's a very aggressive scenario.

And in looking at that, what use is that when it's quite stranded as well? There's no transportation that will be able to bring coal to market effectively in India just yet. And on top of that, you have a problem with Indian coal, unlike Chinese coal, where you have literally no washing capacity. So, you know, ash levels of Indian coal can be typically 35-40 percent.

So, it's not just the production side. It's the production side plus the prep and the washing side, and it's the transportation side.

And it's an aggressive target. So we feel those are providing quite a lot of upside for the imports into India.

Okay. So, I'll skip through Europe pretty quickly. I mean, Europe and the Middle East, North Africa, isn't a very positive place for new coal-fired capacity. The industrial emissions directive is going to push 40, at least 40 gigawatts of coal plant retirement over the next five years.

The new additions are all centered pretty much in Poland and Turkey, where there's a lot of domestic support for coal. And there are a lot of projects being proposed in Turkey; not all of them will be built.

But coal's capacity in the European market really falls to below 10 percent, although we've seen this bump in the last two to three years, based on very competitive priced coal and very low carbon prices, whilst gas prices have been high.

Now, as oil prices come down in Europe,

those gas index contracts will lower as well, and there will be a switch back to gas-fired capacity in places like the U.K. and Germany. But overall, the story of thermal coal in Europe isn't particularly positive outside two or three countries.

So, in our view, we see a lot of the upside in terms of supply coming from three nations. There's still a lot of risk around export terminals in the U.S. and how you get, you know, this big latent capacity of the Powder River basin out into the international market.

That's very challenging, I think, in this environment from a price perspective, from a permitting perspective, from an opposition perspective. But when you're looking around the world, there isn't a lot of sub-bituminous coal elsewhere.

In Indonesia, there's more of a pivot towards lignite. We know the Japanese and the Koreans are very dedicated to try and reduce their reliance on Australian coal. But that is only a small portion of that sub-bituminous market. If it eventually gets off the ground, it will have to come from China and India.

Australia provides a lot of high growth in bituminous coal. Australia provides a lot of growth in metallurgical coal.

But really, outside of Indonesia, Australia, and the U.S., there isn't a lot of support for new coal from other basins, which have problems of infrastructure, say, for example, in Colombia; expensive rail in Russia; domestic requirements in South Africa.

And so, every time people say, "Well, you know, PLB West Coast terminals are never going to get off the ground," well, where is it going to come from? In Indonesia, you need new mines. In central Kalimantan, in South Sumatra, with railways that have never been built before. In Australia, you're looking at greenfield projects that have completely gone off the radar, and now it's only perhaps one proponent in the Galilee basin. You know, the Surat is not really a word anymore in industry.

So, it kind of comes back and forth between these three countries across different quality types.

So, moving forward. What are we seeing now on costs and prices? And this is a key thing. So we saw at the start that prices have fallen, and costs have fallen as well. Why have costs fallen? Well, you've had a twin effect now. When prices rose, they were pretty sticky and it was quite hard to reduce costs. People went through layoffs or synergies or upping production efficiency to heighten productivity.

The other aspects of cost relief are coming from exchange rates and oil price falls. So, first of all, on exchange rates, just look at the way the Russian whole segment for -- actually that should be "thermal coal," not "metallurgical coal" -- 100 million tons of Russian thermal coal that is all net-positive now on a margin basis, while 25 to 30 million tons of metallurgical coal that's all positive on a margin basis, when a year ago, you would say 20-30 percent was under water.

But the ruble going from 35 to 1 to 60 to 1 and all cost-effectively being contained in ruble-denominated costs has turned the Russian cost segment around tremendously, and that's eating into market share in Europe, and that's eating into, you know, people like Indonesia's market share in markets like South Korea and Taiwan.

The second piece on cost is now the impact of the oil price slide, whereby, yes, you know, companies are hedged. But the diesel bills could be quite significant. The diesel bills for trucking in surface mining operations, particularly in places like Indonesia, could lower costs by $3, $4, $5 per ton, maybe $8 per ton for some extreme circumstances.

You know, for underground mining, that isn't such a great percentage share, but certainly for surface mining that's large. And then you look at the costs for ammonium nitrate for explosives. Those bills are coming down.

You're looking at rail fuel surcharges are coming down for markets like the U.S., where the domestic transportation chain plays a big approach. So we are starting to see a lot of cost reduction from the oil price slide, too.

So, finally, what I wanted to end on was our forecast for a perspective on prices for thermal coal and metallurgical coal, and then also just to put in context how the U.S. participates in these markets, too.

So, you know, what have we seen in 2015 so far? We've seen the lowest metallurgical coal settlement since the quarterly benchmark came into view in 2010 -- $109.50, the quarterly settlement for metallurgical coal. We've seen just two days ago the lowest settlement for prime Newcastle thermal coal, the JPU contract into Japan, at $67-$68 as well.

Are we starting to see a floor finally on price? We feel that we are. I think it's going to be very difficult to see those deep prices.

They're going to cut into the supply curve quite considerably.

But remember, in Australia, you're getting a lot of exchange-rate relief, now that the Australian dollar has moved to 1.3 to 1. And those prices now look actually a little bit higher than they did last year because the Australian dollar has weakened so considerably against the U.S. dollar.

The people who are going to be exposed the deepest, unfortunately, are U.S. coal exporters, who traditionally -- and this is a very generalized assessment -- are at the higher end of the cost curve. But, of course, that varies from producer to producer and from basin to basin.

But at those prices of 67 for thermal and 109 for metallurgical coal, we are going to see a steep fall-off in exports, you know, down maybe 15-20 percent per year over the next couple of years.

We do see that as positivity in thermal

exports out towards the end of this decade as we start to see some participation from the Illinois basin as that ramps up, very low cost curves from people like Forsight, and now with the Forsight-Murray energy tie-up, probably greater financial clout, and starting in the participation of PLB exports, either through expansions through Canada or through alternative solutions.

And I'll stop there because we're probably overtime, Janet.

MS. GELLICI: We'll take a couple of questions. Anyone?

(No audible response.)

MS. GELLICI: All right.

MR. FALWELL: None?

MS. GELLICI: You're off the hook.

MR. FALWELL: Thank you.

(Applause.)

MS. GELLICI: Thank you very much to all of our presenters this morning. Please join me in thanking all of our presenters. Thank you.

(Applause.)

MS. GELLICI: Gentlemen, I'd invite you to take a seat in the audience. We have a little, about 10 minutes of business to conduct here. But I'll let you go down and do that. Thank you.

And again, the presentations will be up on our website, so you'll have contact information for the speakers with any follow-on questions as well.

As they're making their way back to their seats, I'd like to take this opportunity to acknowledge two of our NCC members who were instrumental in putting our program together this year. So, Jackie Bird and Jeff Hopkins. Jackie, thank you very much for your support. I greatly appreciate it. I don't think Jeff is here, unless I've missed him. But thank you very much for your efforts in putting together a very fine program for us.

The final portion of our program this morning will focus briefly on a few business reports. I'd like to begin by introducing Greg

Workman, who is the NCC Finance Committee Chair. Greg is Director of Fields for Dominion Resources, and Greg will provide us with an update on NCC's financial status. Thank you, Greg.@@

MR. WORKMAN: Thank you, Janet.

I'd like to start off just by thanking the members of our finance committee that join with me and recognize those folks: Bob Bibb, who I'm going to affectionately nickname "Softball," Bob Softball Bibb; Paul Gatzemeier, who I think left; and Kathy Walton.

These folks have recently become much more engaged in the budgeting process and in overseeing the finances of the National Coal Council. So, to each of you, thank you. And you guys give them a pat on the back when you see them out in the hallway.

We've begun to more closely align our revenues and expenses through the budgeting process in the last two years. We've made significant strides in reducing operational expenses, and we've worked to enhance our revenue sources in order to provide us with the means to engage in more activities and to more effectively promote the study findings and recommendations.

Unfortunately, we ended up 2014 with a deficit due solely to unanticipated legal expenses associated with the termination of a former NCC employee. Were it not for the need to defend against that lawsuit, we would have, in fact, ended the year with a small surplus.

We anticipate that the shortfall will continue into 2015 due to the continuing litigation. The executive committee is fully engaged in the process of contingency planning to ensure that the member services are not impacted and that we have the necessary resources to meet our operational obligations.

I would be happy to address specific questions following the meeting today. Feel free to contact me via phone, via email. And Janet has my contact information, as well.

As I've noted before, the NCC is a selfsustaining organization. They receive no funding from the Federal Government. To finance the activities of the council, NCC relies on annual voluntary contributions from our members, the investment of council reserves, and the generosity of our sponsors.

We also rely on in-kind contributions from our members in support of our meetings and studies. So, in your package you'll find an acknowledgement of those NCC members who have contributed financially to the council this year, along with a list of the in-kind supporters.

On behalf of the NCC leadership, I'd like to thank those of you who have paid your dues, sponsored an NCC meeting, or participated on our chairman's advisory council. A big thank-you as well to all those who have contributed with in-kind support.

So, Janet, that concludes my finance report.

MS. GELLICI: Thank you. Thank you, Greg. I appreciate that.

I would now like to invite Fred Palmer to provide with an update on NCC's Coal Policy Committee activity. Fred?

MR. PALMER: Just very briefly, I do want to second what Janet said earlier with respect to the Fossil Forward study that just came out under Amy's leadership. And Bob Hilton, our dear friend, is here today, too. And I know Bob and the ALSTOM team worked very hard on that, a really important contribution to the intellectual capital that the National Coal Council has put together over the last several years.

We've had discussion, first of all, the Communication Committee has had discussion with, Janet will take you through on getting the study out and its reach. But we've had a lot of internal discussion about how to have a bigger impact with the studies that we have and different models that we can pursue.

And one of the things we did two years ago was the -- when Assistant Secretary Smith was first with us, was a retrospective on the studies that we have done. And I think putting together something like that will be really helpful to put everything in context in terms of all the different things we've looked at that have been discussed here this morning.

Enhanced Oil Recovery -- Dick is in the room. He chaired that study, when was that? In late '13, I think, 2013 that study came out. So we have been at the forefront of defining supply-side approaches to providing electricity, fossil fuels to the American people.

In the context of continual emission improvements leading to near-zero emissions and the work that we have done doesn't get the reach that it should and the attention that it should. And I think we need to work harder at finding ways to let it be known exactly how we can proceed.

And I include in that embracing President Obama's 80 percent reduction of greenhouse gas emissions by 2050 in 2009 in the study that we did then. And we actually did coal production up from 1 billion tons a year to a 1.5 billion.

So, the other initiative that we have undertaken, that Janet has undertaken, is at the request of the Secretary's Office, is an advisory group to create faster turnaround on studies, shorter studies with a shorter timeline. I'll let her describe that in more detail.

The National Coal Council Coal Policy Committee will be involved in each of those. All of you will have the opportunity for input as this progresses, but it will be quicker. And all of you will get an opportunity to both comment on, approve, disapprove, as we have done in the past.

Our client is the Secretary of Energy, and we do need to be responsive. And I think this is a great initiative that will give members an opportunity to have more proactive engagement with the Department of Energy, the Secretary's Office, and also for the National Coal Council, to continue the great work that is done here by all of you in participating in these studies, in building the record.

I want to say finally that I deeply appreciate the opportunity to continue to chair the Coal Policy Committee. I do regard it as an honor. The Secretary of Energy is a client of the NCC. The members of the NCC are the clients of the Coal Policy Committee. I'm a lawyer with a client; you're the client. Thank you very much.

(Applause.)

MS. GELLICI: Thank you, Fred.

A few points I'd like to make with regard to the NCC Communications Committee. We met yesterday to discuss communications-related activities, and I'd like to highlight just a few things.

We are in the process of finalizing our new website. The Communications Committee will be beta-testing that site over the next few weeks. And we hope to go public with the site sometime in May.

So we'll welcome your comments and

feedback on that. It's long overdue, and we're happy to be kind of moving into the twenty-first century with our new website. You'll actually be able to call it up on your mobile devices, unlike the current site.

I did want to thank Arch Coal and Peabody Energy for their financial support, which has made it possible for us to develop that new website.

Fred alluded to the fact of getting more, wider distribution and visibility around our studies. And that's been a focus of the NCC Communications Committee for our last two studies and since I took over in May of 2013, I guess, now almost two years ago.

So, in the past what we've done is produce reports for the Secretary and basically give them to him, and then assume that our work was done. So we've kind of taken a different approach. And we now feel that we need to take those studies and get some wider distribution on it.

So the Communications Committee has been working on that. They have been developing a series of facts sheets for the Fossil Forward study. These are up on the current NCC website.

A few weeks ago, we participated in a DOE briefing on the findings and recommendations from our Fossil Forward study. This is becoming a regular practice of us, thanks in large part to Julio Friedman, who is making that possible. So, for the last two studies, we've had the opportunity to go in and for an hour brief DOE on the findings and recommendations from our studies.

We've also briefed EPA on our former study. We've been doing a lot of outreach. Folks that were attending from DOE include not just the Fossil Energy Department, but EPSA, OE, and actually from the Secretary's Office.

So, with regard to the Fossil Forward study, I a few weeks ago participated in a Congressional briefing hosted by the CCS Alliance on the topic of the need for CCS. And additionally, I have made or will be making presentations on the study to various groups, including the Global CCS Institute, ICAC, American Coal Council, ASME.

So we're doing our best to kind of get the study out. Thanks in large part to some support from Peabody, we also got very extensive media coverage on our last study when it was approved in late January. Our news release on the last study ran on more than 400 news and media websites. Several trade publications picked up on the study, and Fred and I were quoted in numerous articles.

And then, we're also writing articles in blog postings on our study. So again, thank you to all the members of the communications committee for their support on this initiative.

And then finally, in terms of NCC business, I'll conclude. Fred referred to a new initiative that we have underway, which is the formation of a Secretary's Advisory Group.

In an effort to provide Secretary Moniz

with more and more timely responses to critical issues, we will be forming rapid response teams that are tasked with answering inquiries from the Secretary in an abbreviated form and in a more condensed time frame than is typical of our more expansive studies that we've historically done.

The rapid response initiative will not replace the more extensive studies that we do for the Secretary, but will supplement those efforts.

A Secretary's Advisory Group management team has been assembled and met this morning. This group will be responsible for organizing rapid response teams that have specific expertise in addressing whatever inquiries we might get from the Secretary.

Members of that rapid response team will need to be able to commit to developing a response within 60 to 90 days of the Secretary's request. We anticipate the document that will be produced will be on the order of 20 to 40 pages, as opposed to the 100 to 130 pages we do for our studies. So again, an abbreviated format, abbreviated time frame.

All responses that we provide to the Secretary will go through the usual review process by the full NCC membership. And in our compliance with our charter, all advisories to the Secretary will be subject to FACA requirements. So we will continue to host public meetings or webcasts that provide appropriate notice of meetings to the public for participation and comment.

And then, I just mentioned that I will be providing NCC members with further details on this initiative. But we're very excited about it. We think it will provide an opportunity for us to have a greater interaction with the Secretary's Office.

So with that, now in compliance with FACA requirements for this meeting, I'd like to note that this meeting is duly authorized and publicized, and is open to the public. The public can submit comments to the Department of Energy.

Or if any individual wishes to speak, they may do so at this meeting. Those who wish to speak may do so at this time. Does any member of the public wish to speak?

(No audible response.)

MS. GELLICI: All right. Seeing none, I'd like to thank our meeting sponsors, most especially Southern Company for its events sponsorship. Thank you as well to Arch Coal, Bechtel, Clean Coal Solutions, PPL, and the University of Wyoming for your sponsorship support. Thank you to Jeff Miller, who is our videographer. Greatly appreciate Jeff's support.

There is an evaluation in your packet. It's on the yellow sheet. If you can kindly provide us with some feedback on the meetings or suggestions for future meetings, and either leave those at your place setting or leave them with Hiranthie at the back of the room.

There is also in your packet, we're chartered every other year. So, we are now in the process of starting our rechartering for the

2016-2017 period. In effect, all of your memberships will be expiring the end of this year. And we will need to go through a resubmittal process where you are re-appointed to the council if you are interested in doing so.

So, there's a membership commitment form in your packet. If you would kindly complete that and let us know if you are interested in continuing to serve on the National Coal Council for 2016-2017, we'd appreciate that.

Lunch is going to be across the hall. You will need a ticket to get in. So that should be on the back of your nametags.

Is there any other business at this point to bring before the council?

(No audible response.)

MS. GELLICI: If there's no other business to come before the council, we stand adjourned. Thank you again for coming. Cheers.

(Whereupon, at 12:43 p.m., the meeting was adjourned.)

CERTIFICATE OF COURT REPORTER

I, Brian Knieser, the officer before whom the foregoing proceedings were taken, do hereby certify that the foregoing pages are a correct and accurate transcription of the proceedings that were recorded by me and thereafter reduced to typewriting under my direction; that I am neither counsel for, related to, nor employed by any of the parties associated with these proceedings.

BRIAN KNIESER