TRANSCRIPT OF PROCEEDINGS

In the Matter of:)
)
NATIONAL COAL COUNCIL)
MEETING)
)

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BEFORE THE UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY

In the Matter of:)
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NATIONAL COAL COUNCIL)
MEETING)
)

Exhibit Hall B South
Marriott Wardman Park Hotel
2660 Woodley Road, N.W.
Washington, D.C.

Friday,
April 12, 2019

The parties met, pursuant to the notice, at 8:30 a.m.

PARTICIPANTS:

STEVEN WINBERG, Chair
NCC Designated Federal Office
Assistant Secretary for Fossil Energy
U.S. Department of Energy

JANET GELLICI
Chief Executive Officer
National Coal Council

RANDALL ATKINS
Chairman & Chief Executive
Ramaco Carbon

FREDERICK R. EAMES
Partner
Hunton Andrews Kurth, LLC

DECK SLONE
Senior Vice President
Strategy and Public Policy
Arch Coal

PARTICIPANTS: (Cont'd.)

KEYNOTE SPEAKER:

MARK MENEZES, Undersecretary
U.S. Department of Energy

PRESENTATIONS:

SETH SCHWARTZ, President
Energy Ventures Analysis

WILLIAM WEST, President
Arq Limited

NICOLA FERRALIS
Massachusetts Institute of Technology

PETER REINECK
Peter Reineck Associates, Limited

P R O C E E D I N G S

(8:30 a.m.)

MR. WINBERG: It is that hour, folks, so if I could ask you to take your seats. Well, good morning, everyone. I hope everyone got a good night's rest. We're going to have a pretty busy morning this morning, but I think it's going to be a very positive and a lot of opportunities out there to get a lot of things done.

So we had an excellent dinner, and outstanding speaker yesterday evening, and I know we're all eager to have a good meeting today. So I hereby call the spring 2019 meeting of the National Coal Council to order. For 35 years -- it's the 35 year anniversary, so that's worth noting -- this National Coal Council has provided expert advise, counsel, and guidance on a broad range of coal-related policy issues, everything from technology to energy security.

Representing the broad diversity of coal interests, the National Coal Council has always been counted on to provide solid, reliable, and balanced analysis and counsel. And because of that, you have earned the respect of the industry that you represent and the policymakers that you advise. You should be proud of your work. I know I'm very proud to be associated with you.

Before we get started, I want to welcome Undersecretary Mark Menezes, who will provide keynotes remarks this morning.

So, Undersecretary, thank you for joining us this morning.

Michelle Sneed is -- Michelle? Yeah. Michelle Sneed is also here with us today. Michelle works in Secretary Perry's office, where she is the director of DOE's Office of Secretarial Boards and Councils. NCC is just one of 22 boards and councils that Michelle keeps track of, so I think it's pretty obvious that she -- she has a busy day.

But we do thank you for taking your time to be with us here today.

Allison Mills, deputy director of the Office of Secretarial Boards and Councils -- Allison, are you here? Ah, there you are. Okay. Good to see you. Good to have you with us.

We also have Fadi Shadid, a senior economist with the EIA, Energy Information Association.

Are you with us? Ah, okay. Thank you for joining us.

I also want to acknowledge some of our

leaders in the Office of Fossil Energy and NETL who have joined us this morning: Lou Hurtman, our deputy assistant secretary for Clean Coal Carbon Management. Lou? There he is. We have Angelos Kokkinos, who is the associate deputy secretary for Clean Coal and Carbon Management. Ang, where are you? There he is over there.

And we have Doug Metheny, who splits his time as senior policy advisor to me and also Secretary Perry. And so you can imagine who gets most of his time.

(Laughter.)

MR. WINBERG: Doug is over here.

And from NETL, I want to welcome -- a special welcome to Director Brian Anderson.

Brian, stand up so people know who you are? You're more new among -- thank you for being here today.

Joe Giovi, who has served as the deputy designated federal official, or DDFO, for about the last year or so, has done a tremendous job.

Joe, where are you? Okay. Thank you for working with us on NCC and keeping this smooth and making for a nice transition.

I also want to acknowledge Tom Sarkus. Tom is another deputy DFO, sitting up here in the front.

Stand up because people -- you're the one people are going to deal with. So he is in the process of assuming the primary day-to-day duties from Joe, so we're in a transition, but Tom has worked very hard with Janet to pull all this together, so Joe and Tom, thank you very much.

And thanks, of course, goes to our outgoing chair, Deck Slone, and our Vice Chair, Danny Gray, for their service. We want to thank you for your service on the NCC. And Janet Gellici, who works tirelessly on behalf of the NCC, and as well as Horinthie Stanford. Are you -- there she is. I missed you last night, so, Horinthie, thank you so much because we all know who does the hard work. Thank you.

(Applause.)

MR. WINBERG: And then I want to thank all the members and prospective members of the NCC for your service. And finally, I'm pleased to see members of the public here as well. I appreciate your interest in the topics that we will address today.

Before we move on, I want to call NCC incorporated legal counsel, Eric Hutchins with Hunton Andrews & Kurth to provide us with an important antitrust advisory that should be considered from the outset of our activities. And I think he's joining us by polycom. Is that, right, Janet?

MS. GELLICI: Fred Eames with Hunton Andrews & Kurth that's going to give us an antitrust advisory.

MR. EAMES: It's a good thing I keep this handy right here on my phone. As I'm sure you already know, at meetings such as this, everything competitively poses an antitrust risk. To assist the National Coal Council members in both avoiding antitrust violations, and preventing the appearance of a violation, you will abide by the following guidelines: Do not in fact or appearance discuss or exchange information with actual or potential competitors regarding any of the following matters, either before or after the National Coal Council sponsored meeting or social gathering. Don't even talk about any of these topics. What you say in jest now may look very different on paper if you have to repeat the quote in a deposition.

The topics to avoid include prices, costs, margins, discounts, customers, and corporate plans. Unless the information is already public, don't talk about new products you plan to offer in the future. They'll talk about products or services you plan to discontinue. Don't talk about the design, production, manufacture, distribution, or marketing of any products or services.

The U.S. Supreme Court has recognized that competitors can band together to attempt to influence legislative action. Lower courts have extended this beyond legislative actions to include efforts such as preparing joint presentations to influence other governmental agencies. This is called the Noerr-Pennington Doctrine. Its bonds are sold in --

(Technical interference.)

MR. EAMES: -- if you're fixing prices even in the context of this type of meeting.

If at any time you feel that the National Coal Council has strayed from these guidelines, please interrupt the meeting.

MR. WINBERG: Thank you, Fred. Good counsel, as always.

This morning we will conduct an election for the positions of chair and vice chair. Then following Undersecretary Menezes keynote address, we'll get a presentation on coal's national security role. And following that, we will announce the election results. And then following a break, we will have additional speakers.

Now, just one note. This meeting is being held in accordance with the Federal Advisory Committee Act and the regulations that govern that act. A verbatim transcript of this meeting is being made. Therefore, it is important that you begin by stating your name and your affiliation.

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

Having said that, I would like to welcome guests from the public who have joined us today. And I would like you to know that the Department of Energy welcomes your input on the topics that we are being briefed on today. Counsel members have been provided with a copy of the agenda for today's meeting. I would appreciate having a motion for the adoption of the agenda. Do we have a motion?

FEMALE VOICE: Clark Harrison, first.

MR. WINBERG: Do we have a second?

FEMALE VOICE: Dan Roling, second.

MR. WINBERG: Okay. Thank you. All in favor?

(Chorus of ayes.)

MR. WINBERG: Any opposed?

(No response.)

MR. WINBERG: Okay. Thank you for that. And so the agenda is now officially adopted.

So from here, what I would like to do is ask -- Deck, are you --

MR. SLONE: Yeah.

MR. WINBERG: -- Deck Slone to introduce Undersecretary Mark Menezes.

MR. SLONE: Thank you, Steve, and great to be here. Thanks to everyone for turning out. It's a great group and a great turnout. I'm really thrilled to have this opportunity to introduce Mark Menezes. Just a great honor to have him here with us. As Steve said, he is the undersecretary of Energy and the principal advisor on energy policy with this administration. And we all know what a sharp focus this administration has on energy generally and coal specifically, and what a force they have been in our space, and so really pleased to have Mark with us.

He is responsible for a wide array of existing and emerging energy technologies in this role and in driving transformative energy policy and technology solutions, as well as the coordinated planning, management, and performance of the department. He -- prior to this, of course, had a very significant career in the private sector. He was an executive at Berkshire Hathaway here in D.C. He was a partner at Hunton & Williams, and we all know, obviously, where he headed regulated markets and the Energy Infrastructure Group, was chief counsel for a key subcommittee of the House Energy and Commerce Committee prior to that, was the chief negotiator for the House majority in the enactment of the Energy Policy Act of 2005. And before that, he was an executive at AEP and one of its predecessors.

So if you're getting the idea that he's well-credentialed, he's well-credentialed, really quite impressive career. He has been a speaker and lecturer and author, frequently quoted in the *New York Times* and *Politico*, so a commenter on the scene here for quite some time, and somebody who is just highly engaged in the energy space.

And then just among his awards, he has been named best lawyer in America, corporate counsels top -- among corporate counsels top lawyers, *Washington Post* top lawyers, my favorite, D.C. super lawyers, which sounds like a super hero, 24 times. And so again, really quite impressive CV. He's an LSU Tiger, got his JD there, good basketball season, number one in the SEC, above Kentucky and Auburn, which is quite impressive. So well done on that front, too.

But really thrilled to have Mark with us. And so please help me welcome Undersecretary Mark Menezes.

(Applause.)

MR. MENEZES: Good morning. Thank you, Deck, for that introduction. I did ask you to keep it brief. It seems as though I've all over the place. I think I can keep a job. At least I'm very fortunate that the U.S. Senate unanimously confirmed me as undersecretary. So I do appreciate those remarks, and I appreciate the opportunity to be here today with you.

Before I get started, I'd like to join Secretary Winberg in recognizing your 35th anniversary today of being in existence. That's a tremendous accomplishment. It's one of our oldest and storied FACAs, and we do appreciate that very much. We have let it be known to the White House and to OMB the significance and the importance of this organization to the department, indeed to our nation.

I'd also like to recognize Janet's service to this organization. Janet, it has been great working with you over the years, and the success of this organization really is a tribute to your skills as a manager and a leader, and thank you very much. I just wanted to recognize that.

(Applause.)

MR. MENEZES: And I'd also like to take a moment, too, to commend the National Coal Council on your most recent reports. The power reset report and the report on the advancing U.S. coal exports that you released last October underscores just how important the NCC remains and continues to lead the conversation on today's coal and any future of coal.

I especially want to highlight your recommendation for optimizing the existing fleet, particularly the regulatory reforms that you have suggested. We also appreciate greatly your ideas on spurring investment in coal generation, which reinforce our department's focus on innovative technology for coal-powered generation. And we're grateful for your recommendations on boosting America's exports of coal.

We're also excited about the upcoming report on coal in a new carbon age, and we look forward to seeing that final version. And finally, I'd like to recognize your contributions and participations with the ongoing CCUS study with the National Petroleum Council. It was important that when we asked the

National Petroleum Council to look at CCUS and do a very deep dive, that we asked that there be robust collaboration with this organization. We know that they're anticipating getting -- finalizing that report in the fall, and so we hope that this organization is in full collaboration with them, because we do think that this report will set the stage for probably the next generation as to the future of coal, particular with the CCUS, and particularly focusing on the utilization aspects of that. So thank you for that.

And again, just on behalf of Secretary Perry, I just want to give you a huge, big thank you and a shout-out for your appreciation for all the work that you really have done for us.

So this morning, I'd like to talk about what we at DOE are doing with respect to American coal. We are very fortunate to be led by Steve Winberg. He has just been a rockstar on these issues. His support and understanding of these issues have been valuable. The secretary, the deputy, and all of DOE management, indeed the White House relies on Steve's expertise and his ability to reduce complex problems into an understanding that we can appreciate.

And, Steve, I just wanted to thank you, too, for your service and your willingness to serve.

(Applause.)

MR. MENEZES: So as you note in your report, the worldwide coal trade has more than doubled since 2000. Moreover, our EIA projects that worldwide coal consumption will remain solid and stable between 2015 and 2040. And the reason for this is clear. Coal is what it has always been, an abundant, affordable energy source, but also a reliable source that provides solid, around-the-clock, both here and abroad.

Last year, according to the EIA, we've exported 116 million short tons, the second year in a row that coal exports have risen. And that was up from 97 million short tons in 2017. Here at home, coal still provides about 30 percent of our electricity. And last year's extreme cold spell on the East Coast and most recently in the Midwest underscores its importance as a 24/7, 365 day a year source of reliable and resilient power.

During that time, during both the East Coast cyclone bomb and during the Midwest, we have seen coal provide almost one half of the incremental daily generation across the affected region. And there is a reason for this. What we have seen time and again, is that when our system is stressed, when people need energy the most, coal comes to the rescue. It is coal that provides that incremental increase of generation that was not anticipated during the times of stress. We see renewables go to negative numbers. We see natural gas spike to prices that are so high that fuel-switching occurs.

In the Northeast, these units switch from natural gas to oil. Oil use increases. Coal, those peaking units that historically might have -- were in reserve, they come on, and they provide that power that is needed when people need it the most. There is no doubt about that. You should be very proud that when we need energy the most, coal is the most reliable source of power that we have.

So in short, any nation that is serious about ensuring a reliable, resilient, and stable electric grid neglects the value of coal at its peril. Now, as everyone in this room knows only too well, coal faces more than its share of difficult challenges. But I've always thought that we could meet these challenges if right here in Washington, we followed the simple formula of supporting more innovation and less regulation.

And the good news is that today we have a president who is completely onboard with this formula, for coal and for every other energy source we have. The president's America First energy plan wisely aims to develop, produce, and use, and export as wide a range of energy resources as possible. Just two days ago, I had the great fortune to accompany the president on Air Force One down to Texas to sign his executive order, which did several things.

It addressed the misuse of states in section 401 of the Clean Water Act. It put in place a process to evaluate how to remove the barriers to export our resources on the West Coast. We should all step back and realize what is happening. Creative interpretations of environmental laws that were never designed for this use is being interpreted as a way to stop the export of U.S. resources to our friends and allies across the world due to parochial interests by states that have the possibility of blocking all exports on our West Coast.

Think about that. That is what is going on right now with the current interpretation of certain states under our federal environmental laws. This EO tries to address that.

The other thing the executive order also had was recognizing the importance of the resources in the Appalachian region. Coal is obvious. The uses of coal -- and, Fred, I hope I'm not violating any comments about new products of coal. But the fact is coal is a great source in the petrochemical space as well. So it can be a feedstock for, you know, many of the same products that the natural gas liquids coming out of the shale plays are in that region.

So the president recognizes that, and he has put in place a way to assess those opportunities and how to remove investment and regulatory barriers to increase the investment and the production in that region of the country.

And faced with the issue of cleaner energy, the president does not believe we should regulate fossil fuels, including coal, out of existence as some people are now appearing to advocate. Instead, he supports harnessing the full power of innovation to make these critical fuels cleaner. Rather than driving down fuels that produce emissions, the president wants to drive down emissions while producing those same fuels. He wants to continue the technological process toward cleaner coal that across the decades has reduced emissions, certain emissions, by 90 percent and higher.

So what is our strategy for supporting coal? Basically, through developing and deploying innovative technology, we seek to do the following things. We seek to improve and modernize the coal-fired plants of today. We seek to lay the groundwork for the coal-fired plants of tomorrow. We want to advance the commercial deployment of carbon capture utilization and storage technologies, and we need to address the water issues in coal-fired power plants as well as in oil and natural gas development.

So let's take a look at the first two of them and how we're making today's fleet more efficient, and how we must bring advanced coal plants online as our current fleet retires. There is no question that today's fleet of coal-fired plants are aging rapidly. As you note in the power reset report nearly a quarter of the U.S. coal generation capacity was retired between 2005 and 2017.

And since we're looking at 240 retired -- planned retirements between 2013 and 2020, that leaves us with just over 530 units scheduled to be operating after next year. And we've seen how these retirements can affect the grid. Most dramatically, last summer we saw Texas, recordbreaking summer, electricity demand coupled with these retirements of the three large coal plants. At one point in July, real-time electricity prices peaked as high as $2,116 per megawatt hour.

So over the past year alone, we have seen just how important coal is to the grid reliability, and we've gotten a glimpse of how a future where coal plants leave the grid, it's a future that should be deeply concerning to all of us.

So that's why we are focused on increasing the efficiency of existing plants so as to extend their lives and ensure that they can operate on an evolving grid that is accommodating more and more intermittent renewable generation.

If you're not aware of it, all new electric generation in the U.S. today, with the exception of the nuclear AP-1000 Vogel facility in Georgia, all new, new generation, is renewables and natural gas. We're not building any new coal fleets. And other than the AP-1000 Vogel plant, unless economic conditions change, we're not going to be building. We have no plans to build any large nuclear facilities.

Now, some of you have been around long enough to have seen this movie before. We saw this in the '90s when we switched to all -- to natural gas, for good reasons, I mean, increased efficiencies and the combined-cycle units. And the availability of gas is a good thing. But it appears, if you just look at what NERC studies have done, PJM itself, its modelings show that we are becoming over-reliant on natural gas, which as we know cannot be delivered like coal can be. It has to be delivered over pipelines. And we know that it's not easy to get any natural gas pipelines built in this country. Indeed, we see states that I had referenced before stopping interstate natural gas pipelines.

So, our modeling is showing this potentially over-reliance on natural gas. A pipeline goes down. You're not talking about 600 megawatts of coal facility or 1,200 comes off. You're talking about 35,000 megawatts of power. So it's important that we continue to have operating facilities that have onsite fuel generation that can be called upon when needed.

So to that end, we're working on a suite of advanced processes and technologies to improve the efficiency and the competitiveness of existing coal plants. We're also focused on improvements to critical components, like turbines and boilers, and we're developing data and analytics and the modeling to ensure these improvements and upgrades are coordinated and optimized to achieve the best results possible.

At the same time, we're preserving today's coal-fired plants. We need to begin developing the plants of the future, plants that are cleaner, very efficient, and have a smaller footprint. And that's why we have an initiative we call Coal FIRST, FIRST being an acronym for flexible, innovative, resilient, small, and transformative. And let me talk a little bit about each of those.

Being capable of flexibility operation to meet the needs of the grid. Our grid is changing. It is becoming more flexibility, and we're modernizing the grid to be able to accommodate more and more of the intermittent sources of energy that is coming online. We find that to accommodate these renewables, generation plants need to be able to load-follow. Coal needs to develop the technologies to allow them to be able to ramp up and down much faster than they have historically.

We will continue to have baseload running to provide energy in electric markets when needed, and ancillary services for frequency and voltage control. But we also need to be able to have the generation unit of the future with coal to be flexible.

We need to be very innovative, to develop the components that improve this efficiency, and we know that we need to reduce these emissions. All nations' goals are to try to reduce as much greenhouse emissions as we can. We do that as a nation whether we're a signatory to the Paris Accords or not. Indeed, we have led the world in actual greenhouse gas reductions from 2005 to 2017 by 14 percent. We have actual reductions, and we want to continue driving to reduce our emissions.

We need to rescale the size of these units. Instead of scaling up -- historically, the engineering challenge has always been to scale up engineering breakthroughs. We need to scale them down. We need to make them small. We need to make them modular. We need to be able to make them less costly. And finally, we need to transform how coal technologies are designed and how they're manufactured.

Now, we began rolling out Coal FIRST initiative in earnest last year, and in December we issued a request for proposal seeking conceptual designs for plants that address the Coal FIRST requirements. We had a great response to RFP. And I want to announce today that we've selected 13 projects to receive initial funding of nearly $2 million in federal funding, with an option to conduct pre-FEED -- that's preliminary front-end engineering design -- studies.

These 13 projects represent an impressive diversity of technical approaches that will the groundwork for our Coal FIRST initiative. I also wish to announce that later this year, in the fourth quarter of this fiscal year, we intend to issue a funding opportunity of over $100 million for projects to develop critical components an advanced manufacturing approaches required by Coal FIRST systems.

I've mentioned the manufacturing breakthroughs. Later this year, in fact in May, we are going to have the third of our X labs -- we've put together X labs at the department as a way to showcase to the world what our national labs are capable of. And it's a way that we bring in industry, people of the public, policymakers, investors, as well as our scientists and experts together in a forum to talk about what the Department of Energy is doing and how we're putting your taxpayer dollars to work.

The first one we had was in Silicon Valley, and it was storage technology. That included batteries, but went beyond that. The second one we had was in Seattle, and it focused on grid modernization, how we're creating a more flexible and resilient and reliable grid. The third one is going to be in May. It's going to be at Oak Ridge, in Knoxville, outside of Knoxville. And its focus is going to be on advanced manufacturing. The small modular coal units of the future will have a new manufacturing process that will involve likely 3D printing.

At Oak Ridge -- if you haven't had a chance, you should all go out there and see what we're doing, not only there, but also at NETL. The making the component parts of the future is going to take a manufacturing process that we are currently having under design, and it's this process that is going to be able to manufacture components, some of which are using materials that do not yet exist on a design that like I said will be so small it can only be manufactured that way. They simply can't be manufactured in the processes that we have today.

That's going to be the basis of our lab. The coal industry will benefit on that, and we look forward to your participation in that.

So we're very excited about the conceptual design projects and the potential of our funding opportunities to accelerate our Coal FIRST research and development. And, of course, by any measure, financing is the crucial success to our coal strategy.

And that includes financing from our department's loan guarantee program, which has more than $40 billion in available loan authority. Of that $40 billion, 8.5 billion include loan guarantees for advanced fossil fuel projects using innovative technology, and up to 2 billion of that includes partial loan guarantees for federally-recognized tribes for an all-of-the-above energy projects.

In the meantime, we're also exploring the development of super-critical CO_2 power cycles to improve efficiency, significantly reduce the size of future plants, as I've mentioned, and to reduce these costs. And right now, we have a project underway in San Antonio to design, build, and operate a 10-megawatt electric super-critical CO_2 pilot test facility.

We're also exploring advanced combustion technologies and novel concepts that can significantly improve efficiency and the flexibility to quickly respond to grid demands for both the existing and the future coal fleet.

Now, besides modernizing today's plants and designing the better ones for tomorrow, our third priority for coal is to advance the deployment of carbon capture utilization and storage. Now, as you know, the department has a robust CCUS R&D program, and we've had some impressive successes, but there are still some technical hurdles to commercializing these technologies, most significantly being the costs associated with carbon capture. We need to reduce by about 50 percent, ultimately getting the cost down to $30 per metric ton.

Now, this is indeed a challenging goal, but we're exploring early-stage R&D on advanced technologies that have the potential to get us there. And as I said, we hope that the report coming out of the National Petroleum Council will also emphasize the national need to prioritize the development on reducing costs for carbon capture and utilization to ensure the robustness of today's fleet and the fleet of tomorrow.

Finally, our fourth priority is to support DOE's larger water security grand challenge initiative to meet the need for safe, secure, and affordable water. When it comes to water issues related to coal-fired power plants, our R&D is targeting three areas: treatment and reuse of non-traditional waters, improving power plant processes, and data modeling and analyses.

Concerning water treatment and reuse, we aim to develop advanced technologies to reduce the amount of fresh water used for cooling. We're looking at ways to recover water from power plant flue gas. We're also focusing on treating the brines from CO_2 storage sites for potential reuse as cooling water at power plants and for processes like power generation or hydrocarbon production.

The usable water would be particularly helpful in regions of the country where water is scarce. Concerning the improvement of power plant processes, we seek not only to reduce water intake, but lower overall operating costs. Concerning the data, the modeling, and analysis, we seek to model and analyze the multiple components that impact the water energy system. And right now, at NETL, NETL is developing models and software to analyze the impacts that water availability may have against projected water use of power plants.

So in conclusion, we firmly believe that the answer to the challenges facing energy in general, and coal in particular, was and remains to be more innovation and less regulation. It's through innovation that we're developing the technologies we need. But as you know, we the government cannot do it alone. It's you, our partners, industry, critical to any success that we will achieve.

So we'll continue to need your help, this group's advice and counsel, your expertise. We all need to buy in to secure coal's future. So we look forward to continuing to work with you as we move ahead, and what Secretary Perry has described as the new American energy era.

Thank you very much for having me here this morning, and I wish you the best in the meeting today. Thank you.

(Applause.)

MR. WEST: Thank you, Undersecretary Menezes.

The next order of business that we have today is to elect a new chair and a vice chair for the NCC. Now, only official members of the NCC are eligible to vote, so if you're not presently a member, I would ask you not to fill out a ballot. Officially appointed members of the NCC should all have ballots. Looks like this. Is there anyone that does not have a ballot? We'll get one to you.

Someone in the back does not have a ballot. Anyone else? Okay. So please be sure to include your name on the ballot. We cannot verify your official status to vote without having your name on the ballot.

Please circle the candidates you would like to vote for. You will note that there is a write-in line in case you wish to vote for someone that has not yet been nominated. Please only vote once. Once you have completed your vote, the ballots will be collected, and we will tabulate the winners. We will announce the winners after Seth Schwartz's presentation.

If we haven't finished counting them by that point, then we'll go ahead and take a break, and then we'll announce the winners after the break. So thank you for your attention to this. It's important to have continued leadership of the NCC.

So with that, I'd like to -- what is that? Are you going to -- okay, great.

MR. SLONE: Whatever works.

MR. WINBERG: Yeah. Deck, the podium is yours.

MR. SLONE: No doubt, Seth, you are better served by Steve.

Again, it really is terrific to have Undersecretary Menezes. Steve, thanks for all your great leadership and all that you're doing for us here with the National Coal Council. Really thrilled to have Seth Schwartz with us today. He is a good friend as well to our industry, someone -- and a good friend to me personally, somebody I've known for a very long time, and is held in great esteem across the industry. He's the president of Energy Ventures Analysis. He leads the coal practice there. The words foremost authority are overused, but Seth is absolutely the foremost authority on coal markets in the country, and people do know him as just Seth. So, you know, that single-name thing applies to Seth.

Seth and EVA have been tremendously supportive of the Coal Council. Seth and his partner, Emily Medine, who is here as well, and who does terrific, terrific work for us and with us. So really pleased to have EVA's great, you know, support, ongoing support, with all that we do at the council.

Seth has been everywhere at once for the past 30 years or so in our space. He has launched a comprehensive suite of publications that most of us read religiously and every morning. So we rely heavily on that work across the industry to know what is happening in the space internationally.

He works directly with utilities, with independent power producers, and with other clients to develop fuel procurement strategies, negotiate long-term fuel contracts. He advises on acquisitions, advises on asset sales. He has been an expert witness any number of times.

So again, just a real force in our industry, and thrilled to have him here. He's a graduate of Princeton University. I don't know how your basketball team did this year, but it's Princeton, so, you know, I think academically you probably did okay. So he has a BSE in geological engineering, so again it shows you the depth as well, the sort of, you know, geology and engineering sort of depth.

So with that, Seth, looking forward to your comments.

(Applause.)

MR. SCHWARTZ: Thank you, Deck. I'm afraid the days of Pete Carill are kind of long-gone at Princeton. And most of these people don't even remember Bill Bradley, but he's still -- he's the one who built the gymnasium with his success.

So thank you very much for having me. I really appreciate it, Assistant Secretary Winberg. Given the room, I'm going to depart a little bit and instead of just making a PowerPoint, just talk, and then maybe I'll use a few slides.

Coal and national security was the topic I was asked to address. And I think if you look at the markets and the situation, the energy economy in the

United States, it really falls into two major categories. One is electric power and coal's role in the security of low-cost and reliable generation of electricity. And the other is exports. U.S. coal is increasingly becoming a major share of the world export market, bringing in jobs and revenue to the United States and expanding U.S. influence around the world.

Let me go back to the electricity sector and coal's role in energy security. And I think people need to understand a little bit how we got here, but let's start with the fact that I think everybody is aware that coal's share of energy supply, of electricity supply in the United States has been declining fairly sharply since its peak in 2007-2008. More than a billion tons per year of coal was burning for power generation in 2007 and 2008. Last year, 10 years later, in 2018, coal burning was down to just a little over 600 million tons, so it was a drop of almost 40 percent over a decade.

What happened and why? What happened was the growth of two factors, one -- or subsidies for renewable power generation, so the growth of wind and solar generation have penetrated the grid and changed the economics in the market. And the second was the advent of hydraulic fracturing or fracking of natural gas, which dramatically increased the supply and brought down the price of natural gas.

The grid security of supply is still provided by fossil-fuel generation. The other components are nuclear. Nuclear is about -- so coal's share of power generation is now about 28 percent nationwide. In some areas it's as high as close to 50 percent. In other areas of the country, it's below 10 percent.

But -- and natural gas has now surpassed coal, but it's roughly equal to coal, and almost 30 percent of power generation. So those two fossil components are almost 60 percent of total power generation. Nuclear is about 20 percent. Hydro is about 10 percent, and wind and solar are the other 8 or 9 percent.

The fossil generation, however, provides the critical role in ensuring reliability of power generation. And so what Mr. Menezes addressed was the ability to ramp and supply -- ramp generation and meet demand for electricity. So what is unique for electricity in the power sector is that supply and demand have to be matched on a real-time basis. And the independent system operators of the grid perform that function. And if they don't, if you fail to do so, you have swings in voltage, damage to, you know, companies and facilities connected to the grid, and grid failures.

So as a result, the grid operators are constantly calling on units to dispatch, that is, generate, at levels both increase and decrease in order to match demand for electricity. The non-fossil sources of generation don't do that. Wind and solar run whenever they are available. If there is an increase in demand for electricity, there is no ability for a grid operator to call on a wind turbine generator and say please generate more electricity.

Nuclear, for all the valuable things it brings to the grid, nuclear power does not bring the ability to increase generation in response to increased demand. Nuclear plants as, you know, the term was used, base load. Maximum generation at all times when operating. So, when there is a change in power demand, nuclear plants are not going to be called on by the grid operator to increase generation.

Hydro, it depends on location. Where there are large reservoir storage, like the Pacific Northwest, in fact, hydro generation is very valuable in ramping up and down to match power generation, but in most of the country it's just not true.

So what is left is fossil, coal and gas. Oil is really no longer part of our fossil generation supply in any significant amount except in small peaking units because the cost in large steam turbines is totally uncompetitive, both the price of fuel and the efficiency compared to gas-combined cycle units. So coal and natural gas provide the backbone that keeps the lights on, period.

But there is a difference between coal and natural gas. Natural gas has been a terrific technology and the breakthrough of hydraulic fracturing is truly the greatest economic event for the United Stats in the last 20 years. There is no question about it. I mean, if you were to think about what the U.S. economy would look like today without hydraulic fracturing, it's frightening.

Just simply I'll give you one quick number on balance of trade. Again, 10 years ago the United States had a trade deficit of $800 billion per year. 450 billion of the 800 was energy, mostly oil imports and natural gas imports. Last year, the United States still had a trade deficit of $800 billion. Only 60 billion was energy, and we are headed to an energy trade surplus.

If we did not -- and it is almost entirely due to fracking generating increased supply of oil and natural gas. Without that, the economy would be a shambles compared to what it is. I mean, just if you looked at the balance of trade alone, you took $400 billion added to the U.S. economy -- and it's not just that. It's all of the jobs in the fields of -- the shale fields in Texas and Appalachia. It'd change the economy there.

So my defense of -- or explanation of the role of coal versus natural gas is not intended to be a criticism of the role of natural gas, just a recognition of reality. And the reality is in winter peak periods, natural gas supply is simply not available to increase generation in response to peak demand. And we have had -- and the reason it's not available is that at the same time electricity demand is peaking, so is home heating demand, home and commercial, and to a certain extent industrial, but especially home heating demand.

And pipeline capacity is inadequate to meet that demand, and honestly will never really be adequate because we'll never build enough pipe, and it will actually never really be economically sensible to build enough pipe simply to meet the extreme winter peaks. And so, to do that both for home heating and for power generation.

So we have tested this now several times over the last five years. The polar vortex event of January 2014, the bomb cyclone event of January 2018 -- when we had extreme cold weather, the entirety of increased generation came from coal. I say entirety; I'm exaggerating a little bit. There is a little bit from oil, all right? And I'll explain why.

But -- so natural gas generation did not grow despite a dramatic increase in demand for electricity because -- not because the power plants weren't available, but because the gas wasn't available. And there have been multiple studies done by PJM, done by MISO, done by the New England ISO about the risk of increasing reliance on natural gas generation for security of supply in extreme winter events.

And it's not a summer problem. The reason why it's not a summer problem is because residential gas demand is very low in the summer. So, yes -- and natural gas plants do a great job of following load. There is no question they can be ramped up and down faster than coal and more efficiently than coal. But they're not available in extreme winter events.

So what does coal have -- and by the way, to a certain extent oil -- that natural gas doesn't have? It has onsite storage at the generator rather than storage in remote locations. Natural gas has plenty of storage, but not at power plants. It has a lot of storage mostly in the producing gas fields. That doesn't solve the problem. We have had clients for years who said, well, you know, who are utility clients, who with coal stockpiles said, well, we bought coal from the mine and they're storing it for us at the mine. And we're like, that doesn't do it, right? It's not at the power plant. It doesn't solve your security of supply problem.

So power generators across the country, coal-fired power generators, maintain on average anywhere from 20 to 40 days of coal onsite -- that's days of peak burn -- so that if there is a swing in demand for a power from that power plant, the coal is available even if there was a temporary interruption of supply. That's why coal supplies the increased generation in winter events, and it's going to be that way. And we have parts of the country that have virtually eliminated coal.

The entire New England/New York area now have almost no coal plants left, and they are running into spikes in winter peak power prices that are extreme. And, you know, they have done study after study. Because of other issues, they can't build more pipeline capacity in. They can't get more power line capacity in from Canada. And even -- they actually import LNG. People may not be aware that New England keeps its -- you know, balances its gas load in the winter and helps supply its power plants by actually importing liquified natural gas into a facility near Boston. But you can't import U.S. natural gas because the Jones Act doesn't have any -- stops you from going from a U.S. origin port to a U.S. destination port, one of the stupider laws that we have.

So without -- as coal is phased out in those areas, the risk of interruption is growing, and we are seeing it in other merchant power markets, and even to a lesser extent in some of the regulated power markets. Let me touch on the merchant power markets a little bit.

How did we get there on the merchant power markets? We got there -- and again, the reference to the 1990s is correct. We got there because of what happened in the 1990s. We had -- and it may be hard to remember, but we had a decade of natural gas prices staying below $2 per million BTU for the entire 1990s.

There were years were it averaged less than $1.50 per million BTU for natural gas. And with all the wonders of hydraulic fracturing, we're not there now. This is a much cheaper, especially -- you know, even with taking into account inflation, it was much cheaper in the 1990s than it even is now.

So with what appeared to be a long-term supply of gas below $2, combined with the development of the new efficient combined-cycle gas technology, gas seemed like the future. And there was extensive lobbying at the state level, mostly funded by a company called Enron, whom some of you remember, who came into the state governments and said, if you -- your regulated utilities will not let us participate in wholesale power generation because even the plants we want to build aren't even covered by PURPA, because that would only cover if we were a cogenerator and not just an independent power producer.

If you deregulate your markets, we can build new gas-combined cycle plants and bring down your cost of electricity. We can actually build it cheaper than running existing coal plants. And there were a number of states who went ahead and deregulated and created merchant power markets.

The merchant power market concept is fine.

The economists love the concept of merchant power markets. I like -- free markets are the greatest gift to civilization we have. And the concept is fine, but the reality is not so fine. So, the reality is right now in the merchant power markets, say some of the critical large markets like PJM, every non-fossil fuel is subsidized, heavily, all right? Wind and solar subsidies are massive.

You know what, your -- to give you some numbers, again the average power market price at PJM West Hub for the last year has been running at on-peak at about $34 per megawatt hour, off-peak at about $22. The average price literally that a generator receives for the full year is around 27 or $28. The production tax credit for wind-generation is $23 per megawatt hour after tax. The size of their subsidy, especially on a pre-tax value, is greater than the entire revenues for a merchant coal plant in PJAM. And that's just the reality.

Nuclear, right, nuclear was facing problems. Nuclear's full cost of generation on an ongoing basis is in the mid 30s. And again, I'm talking about an average power price in the high 20s. So almost every state now in merchant power markets has passed legislation to heavily subsidize their existing nuclear plants in order to keep them from closing.

It's true in Connecticut. It's true in New York. It's true in Illinois. It's true in New Jersey. We have legislation that is headed toward passage in Pennsylvania and proposed in Ohio. Only my state of Maryland is not doing it yet, and it's not far behind.

So, in order to reflect the value of coal to security of power supply, coal doesn't need a subsidy. Coal simply, number one, needs a level playing field, all right, where all of its competitors are not heavily subsidized, where coal is not. And secondly, the pricing structure needs a change so that coal-fired power plants are being paid for the reliability they supply.

And this has been done -- New England ISO is doing this now, saying plants must have pipeline contracts and must have dual-fuel capability in oil storage onsite. There is the -- oil does provide onsite storage. Natural gas could, if you just spent the money. You can have onsite LNG storage. They're just not spending the money. Coal is spending the money, has spent the money, is not being compensated in the capacity market. And energy prices are being artificially depressed by subsidized competitors. And without -- as we keep retiring coal plants -- and that's where we're headed -- we are going to see more and more power markets face disruptions, especially in cold winter temperatures. And as was mentioned about Texas, ERCOT -- the crisis in ERCOT is inevitable. This is coming. As surely as the California energy crisis was coming, you know, back in 2000, any year we had a drought and hydro fell in the Pacific Northwest, that was the year California was going to run out of electricity, all right?

ERCOT is designed to fail. Now again, economists love the design of the ERCOT power market. It was designed by MIT PhDs. They think this is brilliant. It's an energy-only market, and therefore generators will come in and participate at the market price, the clearing price for energy. And it's true that it works economically. But it's not going to work politically when people see what happens, all right?

What is going to happen is you need enough days of thousand dollar power prices in order to provide the incentive for new participants to join -- to build plants in the market. This market is designed to have $1,000 power prices. And when we have it, and we're starting to have it more and more each year as the capacity margins, reserve margins, shrink, I don't think it's going to be politically very acceptable to reflect truly what the real cost of bringing capacity into ERCOT is going to be because most of the year they're running at $15 power prices because all of the wind in west Texas got built in and in subsidized.

So the year is coming where you're going to read about the failure of the ERCOT power market, and everybody is going to say, what happened. And I'm going to tell you, it's designed to operate this way.

All right. A few minutes, and I want to touch on exports. So, what is coal's role in national security in exports? Number one, I think again we need to recognize the coal industry is in the midst of a large shift from supplying domestic markets to supplying export markets. Coal demand domestically is declining, in some cases for good reasons, and some cases not good reasons. But it's a fact, all right? We are not building, as was again just pointed out -- we are not building a single new coal-fired power plant and haven't started construction on a new coal-fired power plant in over a decade, all right?

So the fleet is aging. That doesn't mean old coal plants can't run efficiently. They can, with continued investment. But it is aging, and there are replacements coming, and there are some large incentives to replace the domestic coal fleet. However, U.S. coal is increasingly competitive in world markets. And what is maybe a little bit underappreciated is 2018 was a record year for U.S. coal exports.

In terms of volume, we exported over 120 million tons, larger than -- again, I know I'm dating myself, but for those you who remember the world coal 2000 study back in 1980 that predicted we were going to export 200 million tons by 2000, never happened. But we're getting a lot closer to it now than we ever did. And what is the reason for the change is despite what you hear, coal demand is growing worldwide, not in what Secretary Rumsfeld used to call Old Europe, but in the rest of the world, it is.

Outside of western Europe, coal demand is growing. It's growing in Turkey, in Egypt, in Pakistan, in Vietnam, and places you don't even pay attention to. They're building new coal-fired -- the Dominican Republic just started up a 600-megawatt coal-fired power plant.

Coal demand is growing. U.S. coal is a competitive part of the world environment. It has --

well, let me talk about a couple of the values of it. Number one, balance of trade and jobs, right? So 120 million tons of coal exports is over $10 billion in increased U.S. revenues from U.S. exports helping to balance our trade deficit.

Number two, as part of the administration's announced energy dominance strategy, coal is part of our geopolitical influence. And again, I'm old enough to remember when it was, right, when Taiwan and South Korea bought coal from the United States specifically because we had troops defending them. And it was part of the security of our world geopolitical strategy. It can be again.

What is -- everybody reads about the Russian dominance of the European gas market and the construction of Nord Stream 2 and the influence the Russians are going to use over Europe because they control their natural gas supply. Well, where do you think most of Europe's coal comes from? It's Russia. If you ask the Ukraine government right now what they're worried about in terms of energy supply from Russia, it's coal, all right? They lost their coal fields in the violence and the separatist violence in the Donbass in eastern Ukraine. And it's controlled by Russia, and coal was their primary source for power generation.

The Ukraine is now importing a lot of coal, where it used to produce coal. But it's not just Ukraine. It's all of Europe. Russia has been the largest source of growth of world coal supply over the last five years. And it's both in thermal coal and metallurgical coal. U.S. has coal that is competitive with Russian coal and can compete with Russian coal and provides a political benefit.

Let me mention one other thing, though, barriers to U.S. coal exports. I think it was mentioned, and I would like to mention it again. The largest barrier to increased U.S. coal exports is the lack of terminal capacity on the West Coast of the United States.

A number of terminal projects have been proposed and have been blocked for various reasons. There are two that are still in active development and litigation, the millennium terminal in Longview, Washington, and the Oakland terminal in California, that would unlock the ability to increase exports from Montana, Wyoming, Utah, and Colorado, where their domestic coal demand is declining, and those mines will close without it.

Current terminal capacity that we have in

California and what we use to go through Canada is fully utilized. And without the new terminal capacity, we are going to be forced into declining production in the western United States. So that is a critical element of achieving this shift from domestic to export markets to the world and the role U.S. coal can play in world markets.

So, with that, I think I'll wrap it up, Deck. Are we doing any questions, or --

MS. GELLICI: We do have a couple minutes, so I think we can take a couple of quick questions, but, first of all, I want to thank Seth for his remarks. Thank you.

(Applause.)

MS. GELLICI: And we can take a couple quick questions if anyone in the audience has a question.

FEMALE VOICE: If you'll announce who you are.

MR. KAPTUR: I'm Casey Kaptur --

(Technical interference.)

MR. KAPTUR: Can you be a little bit more specific about the changes that have to happen in the capacity markets to have those coal plants available on an on-demand basis since no new ones are being built and it's currently economically unvaluable to have them sit around until the demand arises?

MR. SCHWARTZ: Yes. Okay. And let me make sure it's clear. There are really conceptually two markets in the United States here, regulated markets and merchant markets. The regulated markets, the cost of maintaining a coal plant either idle or running at low utilization rates, and spreading those fixed costs or for fewer megawatt hours, they're actually being passed through to the rate payers. They're being paid by regulated utilities. And I can discuss some of the political problems that the regulated plants face.

But let me talk about the merchant markets, which Casey asked about. So in the merchant markets, what needs to be established -- PJM already established what is called a capacity performance payment that tried to separate between, for instance, gas-fired plants that had a pipeline contract and gas-fired plants that didn't have a pipeline contract.

Signing a firm pipeline contract costs a lot of money. I'll give you one simple example I got from the city of Lakeland, who is looking to building a new CCGT in Florida. The cost of their 20-year gas contract with Sable Trail Pipeline is greater than the cost of building the power plant, their firm capacity commitment.

So it's a big deal to require gas-fired plants to have firm pipeline contracts. But even then, there is still not the same reliability as coal. So what we need to do is create another capacity performance market that puts a value and a price on onsite fuel storage. And it doesn't have to be coal-specific. It can be fuel-neutral, maintain 30 days of peak capacity on -- peak generation onsite, and it can be coal. It can be oil. It can be LNG. Or it can be a CCGT gas plant that has oil backup with 30 days onsite.

PJM and other merchant markets can create another separate capacity performance market that is for plants that bid into that market that have onsite fuel storage. And that would let the marketplace value that reliability coal plants are bringing.

Thank you, Janet.

MR. WINBERG: Thank you, Seth.

(Applause.)

MR. WEST: Thank you very much, Seth for your very thoughtful comments, and enlightened comments, I might say, also. So at this time, I would like to announce the results from the election. The new chair of the NCC is Danny Gray.

(Applause.)

MR. WINBERG: And the new vice-chair is Randy Atkins.

(Applause.)

MR. WINBERG: So I need to ask, do you both accept these positions?

MR. GRAY: Yes.

MR. WINBERG: And I need a yes.

Okay. Thank you very much. Then congratulations are in order. And on behalf of all of us, thank you for your future service to the National Coal Council. And at this time, I'd like to call upon the new chair to provide us with an update on some things that NCC is working on.

Is that supposed to be you?

MS. GELLICI: Actually, I'm just going to acknowledge a few things.

MR. WINBERG: Okay, great.

MS. GELLICI: So thank you, Steve. So thank you very much, appreciate that. So, Steve, we're not going to sing to you, but at the count of three, we're all going to say Happy Birthday, Steve. So one, two, three.

ALL: Happy Birthday, Steve.

MS. GELLICI: Now you don't have to worry about having everybody say that to you on the break, and you can just enjoy yourself. So thank you very much.

So as you all know, and has been acknowledged here today, we're delighted to be celebrating our 35th anniversary, of 35 years of service to the secretary of Energy and the Department of Energy. So in 1984, Secretary Don Hodell named 23 individuals to serve on the council. Today we're honored to have 125 representatives who volunteer their time and efforts in providing advice to the secretary on coal-related issues.

I'd like to ask the following individuals to stand and stay standing, and if we could please hold our applause, but Sy Ali, Fred Palmer, Jerry Oliver, Jackie Bird, Barbara Altizer, Dan Rolling -- and I don't think that Lazura (phonetic) was able to make it, but I just wanted to acknowledge these folks who were first appointed to the council in the early to mid 1990s, serving on and off in the council for more than 25 years. So these are some of our founding members, and I'd like to acknowledge them. Thank you.

(Applause.)

I also know that Joe Craft wasn't able to be with us today, but Heath Lovell I believe is here.

Heath, thank you. If you would convey to

Joe our appreciation. Joe was appointed to the council in 1988, so we started in 1984. Joe was appointed in 1988, and he has been continually serving since that time. So just truly amazing. So we'll send some applause home with you, Heath, and let Joe know how much we appreciate his service. Thank you.

(Applause.)

Of course, we're always welcoming new members, and appreciate their willingness to kind of step up. We appointed 18 new members in March of this year. I'd like to ask those who have just been recently appointed to please stand so we can welcome and acknowledge you as new members of the council. So don't be shy. Thank you very much.

(Applause.)

Wow, that's great. Wonderful. Just a few other folks I'd like to acknowledge for their service to the council in various roles at DOE that supported not only the formation and the operations of the NCC throughout the year, but have been very supportive of us through the years. Again, please hold your applause, but if the following individuals would stand and be recognized. Richard Wolf. Is Victor here? I know he was here last night. Maybe not here today. Doug Swift, Bob Gentili, Chuck McConnell. Thank you, gentlemen, for your role that you played in the formation of the council. Greatly appreciate that.

(Applause.)

I'd like to do a personal shout-out to Bob Hershey. Bob, where are you? Bob is in the back of the room. Bob is responsible for my being here, so you can blame him. But back in 1988 -- 1998, Bob recommended and nominated me to serve on the council, and I was appointed to do so at the time until the year 2013, when I took over as chief executive. So -- but Bob has been a loyal supporter of the council, and again, you can blame Bob for me being here. So thank you very much, Bob. Appreciate that, so --

(Applause.)

So, finally, I wanted to acknowledge our executive committee leadership. If you are serving on our executive committee or have served in the past on the NCC executive committee, would you please stand? Great group of folks. Thank you so much for your service. Thank you.

(Applause.)

Special shout-out to Mike Durham and Greg Workman, who are some of our past -- two of our past chairs. Thank you both very much for your service and leadership roles.

And last but certainly not least, I'd like to ask Deck Slone to please stand. Deck, on behalf of the members of the National Coal Council, I wanted to thank you for your leadership of the council. You are a true champion of the industry, and you're very extremely insightful and a fearless proponent for the coal industry. I appreciate personally the advice and guidance you have given to me over the last year, but we appreciate your service this past year, and look forward to your continuing engagement with the council. Please join me in thanking Deck for the service.

(Applause.)

Steve, with that, I'll turn the program back over to you.

MR. WINBERG: First, thank you very much for the happy birthday wish. If I have to spend my birthday in this town, there is nowhere I would rather be than right here with you folks.

(Applause.)

So also, before my tease gets too stale, after the break I will be making the announcements. Undersecretary Menezes has afforded me the privilege of announcing our -- the first step in our Coal FIRST, so upon our return, I will make those announcements.

We're going to take a 30-minute break so everyone can stretch their legs, get something to drink, use the restroom. And we should plan on being back here at about -- let's say 30 minutes from now.

(Laughter.)

MR. WINBERG: I can't see my watch. I'm too old. So anyway, thank you, folks.

(Whereupon, a brief recess was taken.)

MR. WINBERG: Okay, ladies and gentlemen, if you could please be seated, then we'll go ahead and get started here. So the announcement that I talked about yesterday is the first step in Coal FIRST, and we are now announcing today 13 awardees to do a conceptual design, and then the Department of Energy will then have the option to request that any of these projects will conduct a pre-FEED study. It's a phase 1A and a phase 1B. And so in alphabetical order, the 13 projects are 8 Rivers Capital, LLC; Allegheny Science and Technology; Barr Engineering, Concept 1 and Barr Engineering, Concept 2; Consol Pennsylvania Coal Company; Constantin Technologies; Echogen Power Systems; Electric Power Research Institute; Hydrogen Energy California; Nexant, Inc.; Washington University; and Wormser Energy Solutions, Concept 1 and Concept 2.

So I think some of the folks are in the room. Maybe a round of applause for those that will be carrying on. Thank you.

(Applause.)

And so with that, I will turn the podium over to Janet, who will announce the rest of our speakers.

MS. GELLICI: Thank you, Steve, and congratulations again to the folks in the room on those awards. And we're thrilled about that. Thank you, Steve.

It's my pleasure to introduce Bill West from Arq Limited. Bill is one of our newest members of the council. We're delighted that he was appointed recently. The company Arq is based in London, England. Bill is stateside here. He serves as the chief executive of Arq Coal Technologies, which is a U.S. based Arq subsidiary that's based here in Lexington, Kentucky.

Since 1986, Bill has continuously served as senior officer or director of a leasing, mining, or heavy construction company, has a broad range of experience in various multistate mining, construction, and equipment leasing concerns. He has been involved in numerous startups and early-stage developments. He is going to speak to us today and provide an overview of the activities that Arq is involved in. Would you please join me in welcoming Bill West. Bill?

(Applause.)

MR. WEST: First I'd like to start with thank you for having us here. We really appreciate this opportunity, and we are believers in the coal industry and the opportunities that are available.

I think this is an exciting time for the coal industry. I know people have been talking about how -- the challenges that we face. I think the opportunities we face are bigger. We just got to look outside our typical paradigms that has been boxing us in and look forward towards opportunities.

So she already introduced you to who I was. I was -- there is a gentleman in this today, Joe Valis. We was probably -- you can almost call us employees 1A and B to Arq. We walked in the door at the same time. There was four original founders of Arq, and Joe and I was one of them. Julian McIntyre I'll introduce to you in a minute. A guy named Greg Licata, who runs Integrity Coal Sales, and some of you all might be familiar with Greg.

So we was there for the concept, and it has been a challenging ride, and we have brought on a lot of exciting internal and external partners that has helped us to make this happen because it's certainly beyond our intellect.

Let's start off on this film for a second. This -- oh, it's going to play. I'll let it play.

(Video plays.)

MR. WEST: So let's start with our -- if you'll let me give you a little history lesson, the concept of how Arq started. And we -- for some of the individuals that we were associated for a long time were very interested in the waste streams coming from mining, not just the coal industry, for the mining. We thought we spend trillions of dollars and a lot of effort to dig up resources that we as a society has got to have to move forward, and that much of it was going into our waste streams. And so we was very interested in how to look at those waste streams and pull value out of those waste streams.

A bunch of us had some background in the coal industry and had owned mines, been miners, been a miner. And so, carbon was a natural place for us to start. And then we really liked the idea, start at carbon, because it's such a -- it's a element that is so occurring throughout life that it just gave us a target-rich environment to go at.

So first we started looking at the waste streams to pull out a solid carbon product. And we're not smart enough at that stuff, so we went recruiting people, selling people on what we thought was a good idea, and we wind up with the chief scientist of Shell Oil, recruited him. Later on, we got the chief scientist of BP, recruited him. And these people like that took us into the fuels market as the process developed.

What we do is difficult. It's hard. We think we're there, but it's worth it. There is a lot of incentives for doing it. There is large economic incentives. There is large environmental incentives. It makes better use of our natural resources. I believe it will lead to increased coal exports. And it improves the quality of life here in the U.S., in the world. And those are all goals that our speaker last night laid out that they was wanting to achieve, they thought the coal industry should achieve.

So when I heard her speaking to that last night, it was like, you know, wow, that's right down where we're trying to head.

I'd just like to introduce you to our team here. Julian, the guy in the upper left corner, he was one of the guys that was sitting on my back porch when we came up with this idea. Richard Campbell-Breeden is the former vice chairman of Goldman. Mike Treanor, Shell Coal. Paul Groves is a project management guy, ran one of the biggest projects for Shell Oil and worked for Petrofac. Myself, sort of the miner type, and C.K. Lane, with a long history of the coal industry. John is a scientist. It's a varied group. You know, it's not like a bunch of people from one place got together because we realized very quickly we had to have oil expertise and coal expertise, construction expertise. So we started putting together a team that we thought could achieve these goals.

And then we went out and got some support, most just through our investor group, many of these people. Jeremy Blank, the upper right-hand corner, York Capital, he was our first believer, first investor, and has stuck with us through thick and thin, has been just a wonderful asset. Mike Muller, arguably one of the guys that has traded the most oil products in the world. He was chief trader for Shell Oil for years. Sir Mick Davis, some coal people probably recognize him. He was a former chief executive of Xstrata.

We've got a pretty varied group and a lot of experience that we're drawing through that helps us achieve what we want to achieve. So we think that of this opportunity as a vast market. We've spent a lot of time patenting and protecting the rights, both through processes and through utilization patents. It's literally low cost. It's very low on the cost scale. We think our costs or production of a barrel of crude is about $11 as an additive. That's a pretty -- those of you familiar with the coal business, that's pretty low on the scale, probably pushing the bottom 15 percent of oil production.

It's tradeable. We wanted a product -- we wanted to take our purified carbon and take it to a product stream that there is a ready market for, and that -- and in a way that you could use existing equipment, existing use sources to utilize our product. We didn't want to go to somebody and say, here is your nice new product to use. And by the way, you got to spend half a billion dollars to get ready to use. Our product uses existing infrastructure, existing processes to get going to the market.

We hope to have it almost immediately ready for market. Our first plant in Corbin, Kentucky, which we'll talk about later, should go online June, July of this year, producing wet cake, which will then be transported to the oil fields and probably work its way into actual crude or fuel oil sometime in the last or first quarter -- last quarter of this year, first quarter of next year, so our time frame is.

It's scalable. As you know, there is a big demand for oil fields. There is a big supply of raw material to work with, both reprocessed and raw coal. And it's -- we got some credible partners. I referred to one a while ago, York. We've got some great partners. We got Peabody, Mitsubishi, Vitol. So we've got some people that really believe in us and can help us get to market. And it's profitable. The sales price way outweighs the operational cost.

So this is sort of what the concept looks like. If you'll notice -- it don't work that far. But if you notice, we can uses coal refuses, underflow to figure plants. Of course, we like those too because the mining cost approaches zero, and it gives us a higher profit margin, though we can also take raw coal as a feed. And then from that, we can come out and go into the fuels market or we can go into the coals market with that product in a pelletized form.

About all of our product in the near-term future you'll see that we produce -- that we're expecting to produce in the next few plants that go into the fuels market. And the reason for that is just pure economics. Old fuels are -- we put a higher value on hydrocarbons coming out of oil and gas then we do coal, which is the whole concept that we're working with. So hydrocarbons to hydrocarbon. How do we make the hydrocarbons in coal as valuable as the hydrocarbons that you see coming off of fuels and oils and gas?

So this is the arbitrage, what I was just talking about. I lost track of my own slides here, but this is basically what I was referring to. The top line is sort of the market floating price of oil in America, and the bottom is coal. The delta there you see is the arbitrage difference between what the market is placing on the unit of coal and the unit of oil. And that arbitrage is what fuels our business model.

So we think we can do this in a very cost-effective way. The process is we can't -- what drives the cost so low is this is not a high-pressure, high-heat process, generally, except for proprietary parts, which we won't talk about today. But generally the process is mechanical. And it's not mechanical things that you might be used to seeing in your coal operations. Some of it is. Some of it comes from the refinery industry. Some of it is from the food industry. Much of it is from the pharmaceutical industry. We had to go looking for the equipment to achieve our goals of dealing with these very fine products, and where we went for that is to go to the industries that are dealing already with very fine products.

(Video plays.)

MR. WEST: I see that, and three thoughts come immediately to mind. You all have to deal with my southern Appalachian accent and a London accent, so it's accent city here today. And that film greatly oversimplifies the stuff that we went through to get here, but it is made for a simplified audience.

So we're trying to keep these plants as we go through our initial pilot designs in a modular format. We imagine these things being put in sort of in lumps like lumps of sugar, with very centralized design so we can scale easily. So that's what that slide is about.

I thought you might want to see what a blended product looks like. That is the blended product, not the raw micro-fine product. Again, I think the thing to notice here is it requires no end-user modifications from the -- no modifications from the end users. It drops right into the existing hydrocarbon supply chain.

Some of you have an interest in this, but just to give you an idea, so what the very rough economics we think looks like. We modeled our $60 a barrel Brent. We think that carries out pretty safely through the future. We have -- you know, that is being driven by basically Vitol, which is our marketing partner. Those numbers are current from them, and they feel comfortable with that number, and we do as well.

And we got an initial pricing around the 240 range, which is about a 30 percent discount to the market. Calorific value, we lose about 15 percent compared to oil, so that's 15 percent of that 30 percent delta. The 15 is what we thought we're discounting into the market to get acceptability of the product into the market. We think that that delta will really shrink over time. Actually, we think it will shrink pretty quickly.

And we're not here today talking much about these -- about the co-products, but, you know, I'll leave you this slide. It will be in the deck. But it will show you sort of what the process does if you apply it to a solid product.

The ash can be misleading. We put some numbers down there we think we economically get to very quickly and very cheaply, and it would put us above most of the -- slightly better product than most of the coal market. And we can take the ash much lower. We can take the moisture much lower. But, you know, it's sort of like, you know, the two guys running from the bear, you don't have to outrun the bear, just outrun the other guy.

So we're just trying to hit a market quality that's economical and that puts us in a good place to market. We really do not think we will have much material going to the coal market in the near future because of the arbitrage we've been thinking about -- talking about between coal and oil. But it's very doable.

This is stuff that, you know, this is probably the wrong audience for this slide because this is telling you what you already know. You know, most of this crowd is no stranger to the cost of coal tailings. And what we do really reduces the amount of those that a coal mine would have to deal with, and so I won't spend a lot of time telling you what the cost of that is. Most of you are related to the coal industry. You know the cost is significant. You know there are significant reductions in the tailing stream will give you significant savings.

I want to talk about partnerships a little bit. And here is two. It's Peabody and Vitol. Partnerships are very important to us because we're really ambitious and we want to scale very rapidly. And to do that, we need the skills, the resources that these partnerships can bring to us. So like Vitol, as all of you know, is probably one of the largest -- world's largest oil traders, almost unlimited oil trading resources. We thought it was very important to get somebody like that onboard very early to help us. And so we pitched the Vitol. They got excited about it, and they signed on.

Another one of our early adapters, our first large coal company adapter, was Peabody. And we're very pleased about that. They have been significant in helping us develop our ideal, have come up with a lot of wonderful ideals, and have been very supportive. Both of these companies are major investors.

We have some others. Mitsubishi is an investor partner of ours. York Capital is the first. Exigent, Essentia. So we -- and all of them have brought a skill set that has helped us get to where we're at much faster than if we tried to do it alone. So we're very pleased about the approach. We intend to continue that, and we expect to have other partnerships with large coal suppliers, large oil field users, shipping companies, which will be a major user of our product. So, you know, it's -- you give up some in these partnerships because they are partnerships, but we feel like we gain much more than we lose, and we've been very pleased with our partnerships, especially these two.

So this is our plant in Corbin. Just thought you might want to see it. It's big, very big. We expect to do about 100,000 tons, that's in metric tons. Being from London, we do everything in metric, which drives me crazy. But this little film playing in the top right corner shows the inside of the plant. And anybody that has further interest, we invite you to come visit us, fly in to Lexington, and we'll be glad to arrange a tour.

We love -- we actually sort of love guests because we're excited about what we're doing. And we'll talk about that some more in a little bit. And it's -- not only is it big, big. It's very complex inside, and it's very crowded. We think we'll simplify this in the near future pretty quick. And that's about it. Thank you for your time. Appreciate it.

(Video plays.)

(Applause.)

MS. GELLICI: I'm sorry. We have just a few minutes if anybody has any burning questions. I know, Bill, you'll be around for lunch. But if there is any immediate questions that anyone has, please raise your hand. Steve has one. If you could speak into the mike.

MR. WEST: I was craning my neck a little bit, but it looked like your pelletizing the fuel.

MR. WEST: Not, not -- we're not pelletizing as it goes into the -- into fuels. If we did a solid product, you know, it would drop back into the coal or metallurgical markets, the thermal metallurgical markets. We probably pelletize that. Our is to stay very fine powder, and that goes directly into the fuels.

MS. GELLICI: Thank you. Please join me in thanking Bill for his presentation.

(Applause.)

MS. GELLICI: And again, Bill will be around, so if you have additional questions.

It's my pleasure now to introduce our next speaker. Nicola Ferralis is currently a research scientist in the Department of Materials, Science, and Engineering at the Massachusetts Institute of Technology. Nicola is a native of Italy. He holds a bachelor's and a master's degree in physics from the University of Padua, and a PhD in experimental condensed matter physics, wow, from Penn State University.

While he was a post-doctoral fellow, he developed a novel technique to identify function property relations in carbon -- in complex carbon-based nano-materials. He is currently leading a number of research products on materials design, water filtration, intelligent automated algorithms, and a bunch of other things that I can barely pronounce.

But please join me in welcoming Nicola. Thank you.

MR. FERRALIS: Well, thanks so much. Well, first of all, it has been a great pleasure to be here. I'm very humbled to be among not peers at this point, but a bunch of teachers, as you are, and I'm very humbled to actually present some of the work that we are doing here.

I'm just going to say right away I am not by any stretch of the imagination a coal expert. So I'm not trying to say that I'm going to say stupid things, but, you know, you might see that our approach may actually be or appear to be to you somewhat naive.

So I'm going to switch gears a little bit from the discussion that has been going on, which has been fantastic if you want to learn about the industry and the value of coal, into something that we've been spending quite a bit of time in the past few years, and that is using coal not as a fuel, not to make any fuel, not to make any related fuel product, but to literally consider it as a material, something that you can build things on. And literally I'll give you some examples on how we sort of interpret that kind of approach.

So you're very familiar with this picture, right? And it's something that when I saw it a few years ago, it sort of struck me as to say this is exactly what we would like to do. So going from coal as a pit stop to a product is definitely not a new idea. It has been around for a long time. But what is also kind of interesting to us is that if you highlight some of those applications -- this is, by the way, from the 1930s -- so it's definitely new -- you can see that a lot of those products actually reflect the technology needs and the societal needs of their specific times.

So you might argue that that's kind of connects the technology of the '30s. The question is, can we do more. And in fact, that question was actually asked later in the last century and to say it's not just about using coal for doing something that otherwise would be done with some other material. But it's also using coal as a technology enabler, something that you couldn't otherwise do with anything else.

So while walking at the JFK Presidential Library, I came across this little panel that you can see where it's not just listing coal as a fuel. In fact, we barely see that as a fuel. But it's about being considered as in the -- basically in the '50s -- as something that you could use to make things that are unprecedented, from nylon stockings to aspirin.

So that's exactly the kind of thing that drove at the time some of the interest, and it's actually the inspiration that we took. Now, what is missing is that quite a bit of time passed between then and now, and a lot of knowledge actually that we acquired in the -- within basically 60 or 70 years is something that we never really connected to the world of coal.

So essentially, what we wanted to do is to use a lot of the technologies that have been developed, the processes and the understanding, chemical or not, and translate it into coal as a material to develop new products. And today, I'll be talking about three things that we are actually currently working, coal-based electronics, filtration and separation technologies, and I'll touch base at the end very quickly on the work in carbon fibers that we're actually doing.

By the way, if you're interested after that, I have some samples, so you can see them and touch them, so to just say that this actually exists.

So let's start with electronics. So here I just list something that when we look at coal, we think it's actually extremely relevant. As a material scientist and materials engineer, what is the threshold when we develop new products, new materials for new products? It's not just about how the material is, complex or not, but it's also how we manufacture it. And so the example goes, counterintuitively, if you wish, if you go from a very simple material, you don't need to know what it is, although I'll tell you later, but you don't need to -- and then you go into more complex materials -- those are atoms stuck together -- you might think that making them actually it's more complicated if you go this way.

It turns out that's the -- the opposite is actually true. So that material there at the beginning is actually silicon. Silicon comes from sand, right? That's all we know. But to process it to the point where it's actually usable in electronics is actually quite expensive. On the other side, you have these novel materials that are inorganic quantum dots, they're called. I'll tell you that you can make it at home. I wouldn't recommend it, but you could. In fact, the recipe to make it is shorter probably than your pizza recipe that you use every day, or every week.

And you might say, well, what do we use it for. Well, this is constrained, and you use it pretty much every time you check your phone or computers. Those are actually what we use to make LED screens. Your Samsung -- the latest Samsung models actually use quantum dots as the light-emitting diodes. So it's something that exists, but the most important things I wanted to sort of convey as a message is that the more complex the material, the more possibility there is to reduce the complexity of the manufacturing process.

And that's exactly what we want.

Coal is, one way or another, a very complex material, but also it's a very cheap one, as we know. So by leveraging that and going into a manufacturing process to make things, it's actually just as cheap. It's very much of an opening for coal itself.

For example, so silicon electronics, which is largely defined not just about chips that goes into your phone, but it can go all the way up to photovoltaics, which, by the way, right now, uses a lot more. It's about 60 percent of the silicon market actually goes to photovoltaics, no longer in electronics, just to give you a sense. Still requires a lot of processing conditions, and that kind of cost is actually listed right here. It's about $50 for a kilogram of silicon that has to be PD grade.

And developability is obviously not necessarily a huge problem because we do have a lot of sand. Now, if you counter that, and you look at coal, and obviously the cost of coal -- sorry. The cost of coal is actually sort of listed here as the feed stock material if you can use -- and that's kind of the work that we'll be showing in a second. If you can convey that kind of -- retain that kind of cheapness into the processing itself and leverage across the significant amount of production that you have, then you might have a viable way to scale beyond what silicon can actually do.

So at that point, I like to quote a colleague of mine with something that we believe is essential when we think about coal. And if you want to make something cheap, dirt cheap in fact, you can only make it out of dirt. And if that dirt is organic, we are from Cambridge, so we kind of sense those kinds of things. If it's organic and locally sourced, that's even better.

So if you interpret that quote, which is not necessarily a joke -- it's actually quite real -- in terms of if you can develop manufacturing conditions where your mine is also your manufacturing process, your manufacturing facility, and everything that gets out of the mine is actually a product, you have the potential to scale these technologies quite significantly. And that goes beyond electronic companies. It goes beyond any, any process that we can sort of see.

So this is kind of the grand vision of it. How do we go about it? Well, as I said, we are material scientists. We are not petroleum engineers, coal people, which literally naively says let's try and get some coal, and I'm not going to tell you how we got it -- and there is a place online called Amazon that you can buy coal from, and you might laugh about it. Why buy it on Amazon? But we didn't know anywhere else.

So we just got some coal from Amazon, and -- I knew that was going to create some -- and then we got better sources. I'll tell you that. But at the beginning, we just went with that. And we started saying can we make something that resembled something that we could use as an electronic material. And so the first challenge that we had is to make films, to make something that goes and becomes a film that we can then translate into devices.

And so, we literally took that coal from Amazon, then we grind it down a little bit, then a little more, and then until we get satisfied in the results, and then place it into a substrate, some sort of support, and then try to see what we got. And we tried then to see different coals, what they did, naively, if you wish, from anthracite to bitumen, and then see what we got.

Now we were not -- I'll tell you something pretty much honestly right away. We were not impressed. This is not what -- if you show this to an intel engineer, you'll basically -- you'll destroy a friendship you might have built in the last 10 years. They will look at you and say, what are you doing. This is plain stupid. It's coarse. It's bad. It's not good.

Because we're MIT, folks, we persist. We were not trying to give up by any stretch. So we say, well, let's suppose this is good enough. Let's just make some electronic devices, something that not necessarily we're going to power any iPhone any time soon, but let's see if there is something that we can do.

So we proceed and develop making these sort of devices in large scale -- and by that large scale, it's wafer scales, actually the one that you see in the picture right there, using conventional fabrication techniques. Again, the film doesn't look right. That said, though, this is a very dense slide, and I'll try to go over it very quickly, but, you know, very thoroughly.

We were surprised that beside being very bad to look at, the performance actually, it's not decent, but it's actually really good. So you can see here a bunch of terminology that you don't need to necessarily know much about. I'll just point out that the G here always refers to something that you might have heard about, is graphene, the wonder material of tomorrow.

So you can see here that -- and CB is carbon black, and you got amorphous carbon. All different kinds of -- different types of carbon that you actually have. And each one of them has its own set of not a future, but current application set in place, products that you can buy right now. The problem is each one of them actually is constrained in the electrical properties, which is what, you know, in electronics you care about, and within specific regions.

So here is sort of a range of electrical tools you might actually have. And so, graphene is great if you really want a lot of electricity to go through, amorphous carbon if you want a little to go through, and somewhere in between for making semiconductor.

Now, the good news is that by changing basically how we treat these materials, we can go pretty much anywhere that their materials can do. We can go from being an amorphous carbon material, almost diamond-like, all the way up to graphene. And that is something that we can do despite that kind of cheesy, bad look in terms of the film itself.

So we got excited, and say, okay, well, there is a long way to go, but can we make something useful. And the first thing you do when you want to make something electronic is a resistor. As simple as that. So a resistor is something that you run some current through. It brights up because it heats up. And that tells you a little bit about, first of all, if it's a good electronic film. If it blows up, obviously it's not good. If it combusts, then it's not good, at least from our standpoint.

You want something that resists, if you can heat up and down. As a matter of fact, you can see here the little chip, which I have somewhere here. Again, you're very welcome to see it later. It can actually get up to 300 Celsius, which is a lot for these kinds of material. Those are nano-scale films that below 1 micron in thickness, and they can actually sustain that kind of temperature for extended weeks, actually be around there for weeks in air, unexposed.

So just to give you a sense, you might say so what is the big deal here. The state of the art for these kinds of things -- they are used for biomedical devices and other systems -- actually achieve at most about 200, then oxidation takes place, and these materials are destroyed. So this is not just competitive, but it's basically state of the art as far as heaters are concerned.

But we were still bothered, very much so indeed, by the fact that this was looking like a cheese that, you know -- our intel friends actually sort of -- you know, we want to go back and become friends again. So we started to actually look at not necessarily coal as a particle, as a material itself, but derived products from it. And so these are actually from tar.

Initially, it was petroleum tar. Now we're actually using coal tar. And then we can see that the films that actually -- you see it right here. They're a lot more uniform. They are very nice. They're electronic grade. And most importantly, they are transparent. You can see here that you can see through.

Now, why is that a big deal? Well, first of all, you retain all the properties there I just told you about. But most importantly, now you can start thinking about things where really you can upscale the technology. You can imagine if you have something that is not transparent, you're not going to use it for much, maybe a little device here and there. But if it's transparent, you can go after a lot of much bigger, potentially much bigger technologies. One of it is de-icing.

So we had a project with BMW where they're looking actually seriously about these technologies embedded in the windshield. And you might wonder how they do it today. Well, they just don't. Regulation is such that you cannot have those little lines that you have actually in the back shield itself. You need something transparent. You need something rapid that actually would work mostly for electric vehicles. So that is something that is going on.

But you can upscale that even further. There is a project looking at graphene for de-icing planes, right. so where your plane is basically coated out. So rather than de-icing in a chemical way it's done now, you can just blast it with energy. And you can go beyond that, obviously. You can go in to do smart windows, where you can actually heat up the windows to preserve this little thermal barrier that you actually have.

So those are the things that again we are literally -- this is the technology that is probably 10, 15, 20 years ahead of us. But this is basically kind of how we think a lot of these things actually sort of may translate in the future. And they're not necessarily something that relates to your phone, very little things, but can actually be big. And the reason they can be big is this technology can be scaled.

You can go beyond that. And I'll share an example on what we're doing. It's not just about heating. Heating is the first thing you do, but then you want to become a little smarter, or at least have your device to become a little smarter, and that is to actually make something like a sensor, something that is active, that tells you, that gives you information.

So we are actually making all of the above, essentially soft robotics, biosensors, things that you can apply to your skin to actually measure things like, you know, glucose levels and all the above. Those are actually not that complicated to do. But the most thing that we are excited about is the ability to actually make pressure sensors, strength sensors, and those exist, but they're actually very expensive, and they cannot scale. And they're mainly related to infrastructure. So I'll show you an example in a second of how that can translate and how that would work.

Finally, obviously, once you enter these kinds of things, you cannot leave out energy. And by energy, I don't mean in its generation necessarily, but energy storage. Regardless or -- if you believe in batteries or not, batteries are part of our world. It could be into electric vehicles, but phones, and all the rest of it. And so, a lot of research is going on using carbon as the main materials, not just, for example, the electric battery, but also make filter capacitors, high-power applications, where you need a lot of fast response electrics. And all of this can be achieved with these kind of devices that we're actually making.

So as I mentioned before, this is kind of a technical picture here some of us is up in the lab. It's a string sensor. So a string sensor is a fatigue sensor. Essentially, you apply to something, then you stretch it. If you have a little meter, it will tell you how much -- you can translate that number that you see into how much you actually strain it. It's again not a novel idea. It's very commonly used.

What is uncommon is the fact that all that you see in black into the device, which is up here, is coal. And that can be upscaled, and I'll show you also that in a second. You can upscale it to as big as you want it to be, the idea being that you can start thinking about not those as being sensors that you strategically place in little bits of, for example, a bridge, but you can coat the whole bridge with it. You can make it all out. And so, you can have now an infrastructure sensor that can literally in principle allows you to literally state and control the health of your infrastructure or building. Your sensor itself is the building, with huge benefits.

And again, upscaling these kinds of processes and the process we design to that level, it's actually extremely cheap.

So upscaling. Upscaling means a lot of things to a lot of different people, obviously, and it depends -- it needs to be contextualized. The way we think about upscaling is the same as the idea of using the printing press. Before the printing press, if you wanted to have a book, you had -- manually you had to literally copy it for you.

That's basically a lot of the science and technology materials in this kind of world. If you want a new device, someone have to make it for you, customized. When the printing press came out, that went all away. We say, well, we have one masterpiece, and then everything else will be continuously made.

That's exactly what we wanted to do. And that is basically -- these actually things involve essentially printing press, really a wall of transparent conductors, or transparent substrates, or not transparent, and an ink made out of coal that you can use not for writing letters, obviously, but for writing your devices, and you can customize on demand.

And so at that point, it's not how much you can make, but how fast you can make it that becomes the actual question. So right up here, you can see there is two little discs. Those are something else that we actually make in military devices that use similar processes, but we actually make it to actually develop membranes, filtration membranes, which is the next topic of work that we're actually doing.

So filtration, it's a big topic in that -- for obvious reasons. But it all scales out to -- it goes down to one specific aspect, and that is you want to be able to filtrate all the way down to the smallest thing you can, obviously, but under the weirdest condition as possible. Sometimes it's high temperature, sometimes it's harsh environment. And the fact of the matter is there isn't any material that we know of today that can do both. You can go very low in size, but you lose a lot of that reliability and reliance to harsh environment, or the opposite.

Now, so that material -- so we spent a lot of time thinking about this quite extensively, and before we actually started looking at coal, we came out with a sort of process in which we took carbon as a material in the form of graphene, and that was in 2012. By 2018, the product was actually spun out as a company, Bioseparations, which uses these membranes for the food industry.

Now, why the food industry? Well, first of all because they have a huge problem in current membrane technologies for separations. Every two hours, if you -- mostly in dairy products -- you need to kind of clean the membranes themselves. You can't use chlorine because they're polymer-based, and polymer gets dissolved in chlorine. So every two hours, you got to shut down your plant, change the membranes, and restart all over again.

So these membranes are chlorine-resistant, meaning that you can literally bleach them out, and then you don't have to change anything. So that's a huge market with lots of access. And it's only possible because this is a different form of carbon than actually polymer have.

Now, keep in mind, this is not graphene just yet -- this is not coal just yet, it's just graphene. But the goal is -- and you can see an example here of a filtrate below two nanometers in size, that dye that you see, that blue color. It's a dye, which is about two nanometers after filtration. It's actually no longer there.

So can we do it with coal? Well, the answer is yes, possibly, meaning that we just started actually transitioning from actual graphene to those. The beauty of it is that we are not just trying to do a replacement as much as kind of an important process. That is, we don't want to just replace graphene with that. We want to use all of it that we can from coal itself. So the actual particles or the actual parts of materials that can be derived in the graphitic part of coal are used with tar that acts like a binder to allow for the membranes to be resilient, and using fly ash as part of a substrate, the supporting substrate of the membrane.

So essentially, the message here is coal is deconstructed, taken apart, and then reput together, but in a kind of an engineered way. So we are somewhat reengineering what nature did best, I suppose. And we're not trying to say that MIT people are better than nature. Far from it. We heard it before that, you know, MIT people are great at creating policies that nobody follows or that actually fail. And so that is very true.

But what I'm saying is there's a tremendous pace for these kinds of action. And again, I have some samples that here are actually good. We're not there at the target of two nanometers, as we want, but it's actually already performing quite well in terms of stability.

Finally, I want to touch base on a final project that we have. It's more traditional in the sense that it's not again a novel idea, but to look at pitch-based fibers, carbon fibers production. So this is actually sponsored by DOE and through an FLA that came out a couple of years ago. The goal here is to achieve less than $5 a pound of final product for the carbon fiber.

Now, as I keep saying, this is not a project that we conduct alone, and for good reasons. It's because it's a vertically-integrated construction that goes all the way from the mine to the actual manufacturer, and not just these fibers, but because the target here is automotive, the manufacturer themselves, we have the ability to actually track all of the possible steps that, honestly, at MIT or any other academic institution we can't really touch into. We don't know where the mine actually operates in which kind of conditions, what kind of upscaling possibilities that they have.

So this is a conjunction of a lot of different expertise that are all interconnected with each other. So what are we doing in that kind of sector? One thing that we wanted to do -- and again, considering this is not a novel idea by any stretch. This has been around as an idea for a long time -- is to try to make sense out of the parameters that we wanted to use to allow going from one end, which is coal, or pitch, or derived feedstocks, into the fiber itself.

So creating this sort of advanced models of the coals allows us to actually go back and tell the other members of the consortium what to do to optimize that.

In addition, we are collecting a lot of data out these consortium members, and using -- and those are actually data that goes -- they're not lab data only. They are production data as well in terms of scalability -- and then creating predictive models that allows you to say how the fiber will perform under those conditions, what kind of costs they may actually have, and what kind of processing conditions you may actually use.

So to conclude, I just want to say that for us, we believe coal is a sustainable material, something that you might not really hurt much, the two words together, coal and sustainability. Because we don't believe -- there is nothing wrong as far as coal as a material that you can use sustainability to create new things, just like there is nothing wrong in polymers that you use for creating, for example, plastic.

Any plastic that you use today, pretty much almost all of it anyway, comes from petroleum. And we don't question that. Never will I come to you and say, you should stop using plastic because it's made out of petroleum, right? So the same goes for here. You should not stop using coal because -- or whatever you're making with it, your electronic device -- because it's made out of coal.

The fact that it's also scalable and compatible with additive manufacturing, we believe, will allow actually to have a new sector sort of developing into the future.

So with that, I'd like to thank some of the early sponsors. Obviously, Exxon did not pay for the coal part, as you can imagine. But they paid for some of the sponsor -- and in fact, I just want to say, if I have a minute, I would just say Bose actually -- it's probably the most important of these things. Bose, it's the speaker phone company of -- and they were looking for project to sponsor that had nothing to do with their business, but that nobody else would sponsor.

And so the project was about can we make electronics -- in fact, not even electronics. Can we make solar panels out of coal? And literally that was our project, with literally two lines. And we said -- we proposed that to any possible funding agency, and it was turned down every single time because coal and photovoltaics don't like each other as terms.

Bose took it up and says, we love it. We see why nobody wants to do it. You should go ahead and do it. So that's kind of why it's there.

With that, I'd like to thank you very much, and taking questions.

(Applause.)

MS. GELLICI: Strange bedfellows indeed. So, Nicola, thank you very much. Any questions from the audience?

(No response.)

MS. GELLICI: Well, join me in thanking Nicola, and I think he'll be around if you have questions afterwards.

I will mention and take this opportunity to mention that the National Coal Council at the secretary's request is conducting a report right now on new markets for coal, so coal and a new carbon age. You will all as members of the council be receiving notice of a webcast that we will be hosting on May 15th to approve the report. We're in the process of finalizing that, headed up by Randy Atkins, and so please be looking for that, and we encourage you to participate in that webcast.

All right. My pleasure to introduce our final speaker of the program for our spring meeting, Peter Reineck. Peter has a broad commercial background in senior management roles with major chemical and environmental service companies in both the UK and Canada. He has been serving as a consultant since 1995, working with technology developers to support, market, and business development. He's joining us today to talk about ITEA's flameless, pressurized oxy-combustion clean-coal technology for commercial use in a large pilot plant. Would you please join me in welcoming Peter. Peter?

(Applause.)

(Asides.)

MR. REINECK: Okay. Well, thank you for the invitation, Janet. I've got a low-vol microphone here. Okay. Oh, man alive. I think we'll stick it there like that. Is that okay?

So as a consultant then, ITEA was a client of mine, and now I participate with ITEA, which is an Italian company, in a DOE project to build a large pilot plant to scale up their -- the ITEA flameless, pressurized oxy-combustion technology for commercial use.

My co-author in this, by the way, is Massimo Malavasi, and Dr. Malavasi is the developer of the process. So I've got to get myself organized. There we go. So my presentation today provides a brief introduction to the FPO technology and a brief update on the pilot, and then looking at the potential for improving coal-powered economics with this technology, in particular by retrofitting it to existing power plants. Oops, wrong way. Okay.

So FPO was developed as a technology to enable complete combustion of brown fuels, including coal, low-ranking and high-ranking, as well as waste, with near-zero emissions and integral CO_2 capture. And when I say complete combustion, we're talking 9.9999 percent.

Coal is fed in this process as a slurry in water, which are some advantages, and fired with oxygen in an atmosphere of CO_2 and water vapor, and this triatomic molecules basically can -- or irradiated in the combustion chamber and carry the energy from the combustion out of the chamber and into the boiler.

The CO_2 and water vapor are coming from recycling 80 percent of the flue gas after it has gone through the boiler. Incombustibles exit this process as a vitrified slag, little granules about 3 millimeter diameter. There is no fly ash.

Now, the value of the ITEA FPO technology is several points, but I'll just focus on three. The first one is it enables the use of low-ranking coals with up to 40 percent ash and large amounts of water, including alkaline ash, so lignite, for example, and without drying. You're going to slurry them to feed them, so need to dry them.

It enables CO_2 capture on economically viable basis, which means, I suppose, affordably, and a good thing about the process is it increases -- or rather it addresses peaking by its fast response. It can go from 5 percent to 100 percent of capacity in less than half an hour.

Now, we believe the ability to retrofit is of particular interest today. We'll look at this in more detail shortly. In summary, by improving the economics of coal power with CO_2 capture, FPO technology is really an enabler for the use of coal reserves for a secure and reliable supply of power going forward. And I think we're seeing a lot of interest in it as a result.

The development path we're on at the moment is a large pilot for coal power, with CO_2 capture. Sorry, the commercial plant will have CO_2 capture. The pilot captures and releases. The planning project is underway. The plant will scale up from the existing 5-megawatt thermal power plant in Italy, which has been running for 10 years or more, and there is a large body of work based on that plant, which was put together in part with NL, the utility in Italy.

Looking at the chevrons at the bottom, we're now moving out of phase one of the so-called pre-FEED study, and hopefully in the middle of the project we'll start a FEED study to build the pilot plans for construction 2021, '22. That should allow the construction of a commercial plant probably starting as early as 2024. At least that's the plan.

In summary, if FPO technology can be scaled up as planned with this DOE project, then the technology can potentially enable coal power with CO_2 capture at an affordable cost. So here is a bit of an update on the pilot. There are a couple of references there. These projects are moving ahead under the leadership of SWRI, Southwest Research, as prime and PI, the phase one project completed in July and subject to the award. The second phase two project should start in August.

Okay. Now, looking at this one, I'm going to try to click through this to highlight some things that are notable about the cycle diagram, and we'll see how well that works. There we go. So for a commercial plant, the key ingredient is an ASU oxygen plant, and that needs to be for good economic something called a gaseous oxygen or GOX plant, which is not yet common, but the technology exists, and it allows oxygen to be separated very much more cheaply than with a tradition cryogenic technology, a liquid oxygen plant, if you like.

Coal preparation and slurrying, as I said, has some advantages in terms of logistics. You're not moving around fine powders, pulverized coal. You're just granulating the coal, grinding it under water. The boiler is a novelty. It's a once-through steam generator. Now, there is no need because of the flue gas that goes through the boiler -- it all gets recirculated back to the combustion chamber. So you don't have to get all of the heat of it out. As such, the steam generator can be quite efficient.

There is a turbo expander operating on the -- effectively the bleed of the flue gas. Around 20 percent or a bit less is being removed from the system and going to atmosphere via flue gas desulfurization cleanup. And since that has got a lot of energy in it, not least from expanding from boiling, vaporizing the water, then you can get some energy out of it effectively against turbine.

Finally, the CO_2 coming out of the system and ready for compression, liquefaction, no need to purify it. And the water out, which doesn't have a highlight, right at the bottom there, is condensed water from the heat recovery system. So that can be used not only for coal slurrying in the front end again, but it can potentially be used for other purposes. With the low-ranking coal, which has got a lot of hydrogen and water in it, then quite probably you're going to have more water produced by this process, clean water, than you use.

Uh-oh, what happened here? Yeah. Now, this is showing a plan for a commercial-scale cycle. It would have three modular combusters, which could be up to 500-megawatt thermal feeding one steam turbine. The boiler is part of the combuster loop. And there would be a single heat recovery train, which would process the flue gas and produce CO_2.

The modules could be a lot smaller than 500-megawatt thermal. The typical module for waste recovery -- waste treatment at the moment is 15 megawatts. The pilot will be 50. You can certainly go to a 100- or 200-megawatt thermal without much difficulty.

Now, I want to move on now to look at the -- a comparison of the LCOE for three cases. One is the -- the first is the S12A baseline, which is super-critical pulverized coal for -- the PRB coal without carbon capture. That's the basic one. And then the second one is the same thing, case S12B, with post-combustion carbon capture. And the third one is the FPO technology. And if we look at the LCOE comparison there, you'll see that the FPO can give you, according to the ITEA, a projection which is so-called nth of a kind, a LCOE which is 119 percent, 120 percent of the baseline, with carbon capture. So that is quite a modest amount to pay for CO_2 capture.

Some notable things looking at the post-combustion case -- the reason that becomes so expensive is that you've got to produce, of course, for that process -- you need a lot of power in, in order to produce power for the post-combustion capture system, but also heat for the reboiler and to get the CO_2 out of the AME.

If we look at the efficiency of the FPO system, it's quite high, not least because of heat recovery. You're condensing all the moisture in the flue gas. And, of course, the turbo expander works better with wet coals. As I said, the LCOE is quite affordable. We can go into that in more detail if somebody wants to.

Now, looking at a retrofit case, which is the -- in this slide, the first three columns, the blue ones, are what you've just seen. And the right one is a retrofit case, which is also PRB. And it's retrofitting -- and I'll show you in a minute the diagram of how that would be done -- and retrofitting an FPO firing module or loop to replace the boiler in an existing super-critical pulverized coal plant, firing PRB.

And you can see there that the LCOE is quite low, not least because the capital cost of doing that is quite modest, and for a 550-megawatt E plant, but -- and also, of course, you're writing off the cost of the existing plant.

Now, what -- the plan would be to retain all of the parts of the existing plant except the boiler. The boilers would be replaced by the green unit at the top, which would be an ASU, and a separation unit, and the FPO firing module or loop producing steam, and that would go to the existing turbine, and the CPU for CO_2 compression and liquefaction producing a stream of CO_2.

So you could, it's envisioned, build that alongside the existing plant, and then take a shutdown when it's running for perhaps several months, and then connect it up there. How does this look in terms of what you get out of it? There is an extra case on here, which is retrofitting to the first line, is retrofitting to subcritical. There is quite a few subcritical plants firing PRB around, and some are super-critical. And the subcritical plant produces 20 percent more CO_2, and that is shown in tons an hour, so it's comparable with the megawatts capacity operating at capacity. And the reason it's producing 20 percent more CO_2 is because the turbine is less efficient, as it's a subcritical system. You need higher heat in.

Now, I didn't on this slide propose values for powering CO_2 because they're going to vary according to location and mode of operation. We talked about load following. You could possibly, one imagines, get more money, a higher price, for power for a load-following plant, one way or another. For CO_2, the price could vary. I mean, if one were to assume that it were going for sequestration, and you would get, let's say, the tax credit divided out, possibly shared, probably shared, with pipeline operators and so on, you'd get a portion of that.

What is quite interesting is that if you compare the revenues from power and CO_2, depending on the numbers, they are typically of the same order of magnitude. So this is -- the suggestion being, of course, here that CO_2 could -- selling CO_2, certainly for EOR, where you'd get a price for it and less transportation costs, et cetera, plus a share of the 45Q tax credit, could be very significant indeed versus the price of power.

So it does suggest there is a potential new model here for power generation and for a plant that can produce CO_2. Certainly it isn't a nuisance product.

So finally, and then I'll remove myself from your path to the lunch table, we'll summarize by saying that FPO, in our belief, will provide the most economic cost of electricity with carbon capture, and it will be the best choice for coal going forward in a carbon-constrained world. Retrofitting looks a pretty good option, and the technology supports small modular plants. And FPO can also support the growth of coal expert markets as this technology could be adopted in those export markets to capture CO_2.

So that's all I have to say. Thanks for your attention, and let me know if there are any questions.

(Applause.)

MS. GELLICI: Wait for the mike, please.

(Pause.)

MS. GELLICI: It's on the --

AUDIENCE MEMBER: Yeah. Alex Fasbender (phonetic), Ecovia. So you mentioned efficiency and recovering the water, the latent heat vaporization of the water. Do you have a temperature, a range, that you focus on recovering that to get it back into the process?

MR. REINECK: The reactor itself is operating at about 400 -- 1,400 degrees C. The loop after quenching operate around 700 C, 650-700. So the hot gas coming out of the turbo expander going to the heat recovery section, has got to be 300-400, in that kind of an area. And it has dropped down in stages. The flue gas desulfurization is at temperature and pressure. So it's running about 1.5 atmospheres, and 120 or something C.

AUDIENCE MEMBER: And your reactor itself is operating at what pressure?

MR. REINECK: About 11 bar.

AUDIENCE MEMBER: 11 bar, okay. Okay, thank you.

MR. REINECK: You're welcome.

MS. GELLICI: Any other questions for Peter?

(No response.)

MS. GELLICI: Please join me in thanking Peter for this presentation.

(Applause.)

MR. REINECK: Thank you.

MS. GELLICI: Thank you, Peter. Sorry for all the challenges with the microphone here. Not sure what is going on.

So I was struck by the presentations that we've just heard about the variety of ways that we as an industry continue to work towards using coal in the future, so using some of the waste coal in a more efficient way, using coal in new ways outside of power generation, and using coal to retrofit existing power plants so that they're more efficient and effective and environmentally sound.

So we continue to work, and I think that's very obvious for our program today and from the secretary's remarks this morning that we have a future in this industry, and we are working hard on a variety of fronts to get things done. I was also struck by the fact that we've got a lot of international activity going on, that DOE's reach is obviously extending beyond U.S. borders, and this obviously is a universal technology challenge for us, and having more folks involved internationally I think benefits us all.

So wanted to thank our panel once again. Please join me in thanking these folks for their great presentations.

(Applause.)

MS. GELLICI: Before I turn the program back over to Steve, I just wanted to acknowledge and thank all of our sponsors. They're listed in your program, but in particular I wanted to thank Randy Atkins with Ramaco Coal for sponsoring our dinner last night, and for his event sponsorship.

Steve Krinsky with Jupiter Oxygen, thank you very much for your event sponsorship. And, Scott Teal with Southern Company, thank you for your event sponsorship as well. Greatly appreciate all of our sponsors and their contributions.

We do have evaluations that we've left at your tests if you could complete those. We will also be sending those out electronically so you can respond that way. For those of you who are joining us for lunch, we will be meeting back upstairs on the lobby level at the Maryland ABC rooms, where we were for dinner last night.

Upcoming meetings. I mentioned the May 15th web cast. Please do put that on your calendars. I'll get a notice out next week to you on that. And then our fall meeting will be hosted back here at this Marriott property September 11th and 12th.

So as I turn the program over to Steve, I'd like to thank you again for sharing your birthday with us, and I hope you have a better rest of the day, and that you're off to a good start. So thank you again for being here, Steve.

MR. WINBERG: I don't know that it could get any better than this.

(Laughter.)

MR. WINBERG: So, ladies and gentlemen, a couple of days ago 4,500 Amazon employees wrote Jeff Bezos a letter asking him to fix climate change. I'm very concerned about what those 4,500 employees are going to do when they find out the boss is selling coal.

(Laughter.)

MR. WINBERG: Think about it. So it is now time for our public comment period. As stated at the beginning of the meeting, the Department of Energy cares about your viewpoints and wants to hear from you. In the *Federal Register* announcement we posted several weeks ago, we offered any party the opportunity to provide a written statement that could be read at this event. However, we did not receive any written statements.

However, we've also set aside time at this meeting for any individual who wishes to speak directly at this meeting. We have a sign-in sheet, but no one signed up for the sign-in sheet. However, anyone wishing to speak can be heard by raising your hand, and we will have somebody with a microphone come over to you.

If there are many individuals that want to speak, we may have to close the public comment period and ask the remaining folks to submit their comments in writing, and then those comments will then be included in the meeting minutes as an addendum.

So do we have anyone in the audience that wants to speak?

(No response.)

MR. WINBERG: All right. Seeing none, it is now time to conclude our meeting. I want to thank everyone for making this assembly a priority and for traveling a long distance. I know some of you crossed the country to be here with us today and to participate in this meeting. Your cooperation and your input have been invaluable in helping to make this a very successful meeting.

For those of you traveling to the Midwest, please be careful. If your flight gets canceled, give me a call. I'll ask my wife to water down the soup a little bit, and you're invited over for dinner. But hopefully everyone will get out this evening so that you can enjoy a very nice weekend with your families.

We look forward to seeing you in September, and if there is no business, this meeting is now officially adjourned. Thank you.

(Applause.)

(Whereupon, at 11:55 a.m., the meeting in the above-entitled matter adjourned.)

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REPORTER'S CERTIFICATE

DOCKET NO.: N/A

CASE TITLE: National Coal Council Meeting

HEARING DATE: April 12, 2019

LOCATION: Washington, D.C.

I hereby certify that the proceedings and evidence are contained fully and accurately on the tapes and notes reported by me at the hearing in the above case before the United States Department of Energy, Office of Energy Efficiency & Renewable Energy.

Date: April 12, 2019

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