

U.S. DEPARTMENT OF ENERGY

+ + + + +

NATIONAL COAL COUNCIL

+ + + + +

2014 ANNUAL FALL MEETING

+ + + + +

THURSDAY

OCTOBER 16, 2014

+ + + + +

The Council met in the Annapolis Room 2-4, Gaylord National Hotel, 201 Waterfront Street, Oxon Hill, Maryland, at 9:00 a.m., Jeff Wallace, Chair, presiding.

PRESENT

JEFF WALLACE, Chair, National Coal Council & Vice President Fuel Services, Southern Company Services

MICHAEL DURHAM, Vice Chair, National Coal Council & President/CEO, Advanced Emissions Solutions, Inc.

JANET GELLICI, Executive Vice President & Chief Operating Officer, National Coal Council

THE HONORABLE DAVID C. BOYD, National Association of Regulatory Utility Commissioners, NARUC Chair-Committee on Electricity, Commissioner & Vice Chair, Minnesota Public Utilities Commission

JULIEN DUMOULIN-SMITH, Executive Director-Equity Research, Electric Utilities & IPPs Group, UBS Securities LLC

AMY ERICSON, U.S. Country President, ALSTOM Inc.

KIMBERLY GREENE, Chief Operating Officer,
Southern Company
JUDI GREENWALD, Deputy Director for Climate,
Environment & Energy Efficiency,
Office of Energy Policy & Systems
Analysis (EPSA), U.S. Department of
Energy
KENNETH B. MEDLOCK III, Energy Resource &
Economics Fellow, Baker Institute for
Public Policy, Rice University

ALSO PRESENT

ROBERT WRIGHT, Designated Federal Official
KAREN BENNETT, National Coal Council Legal
Counsel, Hunton & Williams

A-G-E-N-D-A

Welcome. 4
 Jeff Wallace, Chair,
 National Coal Council

Antitrust Advisory 7
 Karen Bennett, NCC Legal Counsel

Keynote Session

Judi Greenwald10
 Deputy Director for Climate,
 Environment and Energy Efficiency,
 Office of Energy Policy and Systems
 Analysis, DOE

Kimberly Greene.51
 Southern Company, COO

The Honorable David Boyd82
 National Association of Regulatory
 Utility Commissioners

A Financial Industry Analyst Perspective on
 the Utility Industry
 Julien Dumoulin-Smith,
 UBS Securities 115

Trends in Energy Resource Development and
 Utilization: Focus on Natural Gas
 Ken Medlock, Rice University 152

National Coal Council Business Reports

Finance Committee. 207

Coal Policy Committee
 - NCC Study Update 200

Communications Committee 211

Governance Issues. 212
 Opportunity for Public Comment 213

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

P-R-O-C-E-E-D-I-N-G-S

9:03 a.m.

CHAIR WALLACE: Good morning, ladies and gentlemen. My name is Jeff Wallace. I'm the chairman of the National Coal Council. The fall 2014 meeting of the National Coal Council is hereby called to order.

We're fortunate to have a number of very special guests today including last night we had Deputy Assistant Secretary of Clean Coal Julio Friedmann. He was with us last night. We enjoyed that. He couldn't be here today.

I'm also pleased to recognize Robert Wright, senior advisor to the DOE's Office of Fossil Energy and federal designated officer. Welcome, Bob. It's good to have you here today.

We'll kick off our program with a keynote presentation from Judi Greenwald, Deputy Director of Climate, Environmental and Energy Efficiency at DOE's Office of Energy

1 Policy and Systems Analysis.

2 Our keynote session this morning
3 will continue with presentations by Kim
4 Greene, chief operating officer at Southern
5 Company, and the Honorable David Boyd,
6 commissioner and vice chair of the Minnesota
7 Public Utilities Commission.

8 Following a program break we'll
9 hear from Julien Dumoulin-Smith, executive
10 director with UBS Securities, and Ken Medlock,
11 Energy Resources and Economics Fellow with
12 Rice University, the Baker Institute of Public
13 Policy.

14 We'll conclude our program today
15 with some council business including an update
16 on our newest study currently underway.

17 We'll hear from Amy Ericson, U.S.
18 country president with ALSTOM Power who's
19 chairing the NCC study.

20 As you can see we have a very full
21 agenda this morning so let's get down to
22 business.

1 Our meeting is being held in
2 accordance with the Federal Advisory Committee
3 Act with regulations that govern that act.

4 Our meeting is open to the public.
5 I'd like to welcome guests from the public who
6 have joined us today. An opportunity will be
7 provided for guests to provide comment at the
8 end of the meeting.

9 Full and complete minutes of the
10 meeting are being made as well as a verbatim
11 transcript. Therefore it's important for you
12 to use the microphone when you wish to speak
13 and to begin by stating your name and your
14 affiliation.

15 Council members have been provided
16 with an agenda for today's meeting. I would
17 appreciate having a motion for the adoption of
18 the agenda.

19 MS. MOHN: So moved.

20 CHAIR WALLACE: And do we have a
21 second?

22 MS. WALKER: Second.

1 CHAIR WALLACE: All in favor?

2 (Chorus of ayes)

3 CHAIR WALLACE: Opposed?

4 (No response)

5 CHAIR WALLACE: Thank you. I'd
6 now like to call to the podium our National
7 Coal Council legal counsel Karen Bennett with
8 Hunton & Williams to provide us with an
9 antitrust advisory.

10 MS. BENNETT: Thank you, Jeff.
11 All right, let me just take a quick minute to
12 just remind everybody that participation in
13 the meetings such as this where you bring
14 folks in and discussions are focused on an
15 industry, even when it's a part of a federal
16 advisory committee or FACA meeting, are
17 subject to antitrust laws.

18 And so it's just a good idea that
19 we pause and consider that all discussions,
20 including anything you say in the hall, the
21 restrooms, that these antitrust laws do
22 prohibit any discussions or conversations

1 about agreements or concerted actions that may
2 be construed as restraining competition.

3 I think everybody is fairly
4 familiar with these prohibitions. We do have
5 a copy of the National Coal Council's
6 antitrust guidelines available here if anybody
7 needs more detail than that.

8 But I would say that as your
9 counsel the Department of Justice does --
10 these laws are broadly interpreted and
11 strictly enforced, and particularly sometimes
12 with industry groups such as this.

13 So, enjoy the meeting.

14 CHAIR WALLACE: Thank you, Karen.

15 It's now my pleasure to introduce
16 our opening keynote speaker, Judi Greenwald.
17 Please note her detailed bio that is included
18 in your packets. But I'd like to highlight a
19 few of her accomplishments.

20 She has more than 30 years'
21 experience working on energy and environmental
22 policy issues.

1 Prior to assuming her current
2 position she worked at the Center for Climate
3 and Energy Solutions and was responsible for
4 co-convening the National Enhanced Oil
5 Recovery Initiative.

6 She has served on the Advisory
7 Council for EPRI, on several panels with the
8 National Academy of Sciences, as a senior
9 advisor on the White House Climate Change Task
10 Force.

11 Ms. Greenwald currently serves as
12 Deputy Director for Climate, Environment and
13 Energy Efficiency at DOE's Office of Energy
14 Policy and Systems Analysis.

15 Her experience and expertise have
16 particular relevance with the National Coal
17 Council members who are intently focused on
18 addressing these critical issues on a daily
19 basis.

20 Please join me in welcoming Judi
21 Greenwald.

22 (Applause)

1 MS. GREENWALD: Thanks so much for
2 having me. I have a presentation in two parts
3 because at 11 o'clock last night when I was
4 trying to merge them I couldn't. So the
5 formatting got all messed up and I was tired.

6 So we'll do this in two parts.
7 And then you'll actually see on the second set
8 of slides why they're hard to merge.

9 One of the things that I'm still
10 getting used to even though I have actually
11 now been at DOE for a year -- I had my
12 anniversary two weeks ago which I know about
13 because on LinkedIn it sends --

14 (Laughter)

15 MS. GREENWALD: -- all of your
16 contacts a notice that you're having a work
17 anniversary. So all these people sent me
18 congratulations on your work anniversary. So
19 that's how I found out that I actually was
20 having a work anniversary.

21 So I've been there a year. So I
22 don't have the excuse that I've actually used

1 for a long time, you know, I'm new to the
2 government, I don't actually know where things
3 are. I mean, at this point I really have to
4 be -- I can't use that excuse anymore. I've
5 got to be all in.

6 And I do say that, many of you
7 know I do struggle that I do -- I now
8 represent DOE, so I speak for DOE, so I can't
9 always say quite as much as I would like. So
10 don't tempt with questions.

11 So, the first part of the
12 presentation is DOE's role in the President's
13 Climate Action Plan.

14 I think many of you know about
15 this so I'm going to kind of go through it
16 really quickly so that you can have the
17 opportunity to answer questions, most of which
18 I'll be able to answer.

19 So I'm going to talk about the
20 President's Climate Action Plan, mitigation,
21 climate resilience and the QER.

22 And the President's Climate Action

1 Plan many of you know was launched in June
2 2013. It's got three basic pillars - cutting
3 carbon pollution in America, preparing the
4 U.S. for the worsening impacts of climate
5 change and engaging internationally.

6 Some examples. I'm going to focus
7 more on the mitigation. That's a little bit
8 more of what you all work on.

9 I'm going to talk a little bit
10 about impacts work and I'm not going to really
11 cover international.

12 And a lot of things that DOE is
13 doing and the government is doing broadly have
14 to do with the Climate Action Plan. So to
15 some extent some of this stuff is
16 multipurpose.

17 We're working on a lot of things
18 with renewables, with developing an
19 Interagency Methane Strategy which I'll
20 mention.

21 And I think that a lot of the work
22 that we do, efficiency standards, you can

1 think about as the right thing to do from an
2 energy perspective, but also has climate
3 benefits.

4 But we also are specifically
5 focused as an administration on making sure we
6 work on mitigating climate change.

7 An interesting insight which I'll
8 repeat again later is that the Quadrennial
9 Energy Review, which I'm going to talk about
10 in the second part, is actually started under
11 the CAP. It's actually part of the Climate
12 Action Plan.

13 So part of the Climate Action Plan
14 is that we have to think broadly about our
15 energy system. So it's not just about dealing
16 with climate, but dealing with climate in the
17 context of an energy system that works for
18 everyone.

19 I'm also very involved in the
20 Interagency Methane Strategy. The DOE's role
21 in this is we've been less focused on coal,
22 but I actually would be interested if people

1 have ideas about how we could do more on that
2 front.

3 This is part of the Climate Action
4 Plan. And it said curbing emissions of
5 methane is critical to our overall effort to
6 address climate change to achieve additional
7 progress.

8 The administration will develop a
9 comprehensive methane strategy and pursue a
10 collaborative with state governments as well
11 as private sector and cover all methane-
12 emitting sectors.

13 And there's three pillars. We're
14 big on pillars, I guess, in the
15 administration. Assessing current emissions
16 data and addressing data gaps, identifying
17 technologies on best practices for reducing
18 emissions, and identifying existing
19 authorities on incentive-based opportunities
20 for reducing emissions.

21 As many of you may know we've been
22 very involved. The Secretary convened a

1 series of roundtables that were focused on the
2 downstream and midstream part of the natural
3 gas sector. And that's been a big focus of
4 ours, at least at the moment.

5 Certainly the methane issue is
6 much broader. It comes from all kinds of
7 sources including a lot of agricultural
8 sources.

9 We at DOE have been more focused,
10 obviously, on the energy sector. And this
11 year we've been mostly focused on the down-
12 and midstream part because, as I'll talk about
13 later, that has the same boundaries as the
14 Quadrennial Energy Review.

15 This year we're focusing on
16 transmission, storage and distribution. So we
17 focused on the methane emissions from natural
18 gas for that. So that's been our focus this
19 year.

20 Methane strategy is much broader.
21 Possibly next year we'll get more into other
22 issues, including, for example, coal in that

1 context.

2 Probably the biggest-ticket item
3 in the Climate Action Plan is the power plant
4 rule that EPA proposed in June of this year.

5 This is from the President's
6 Climate Action Plan and in particular there
7 was a Presidential memo to EPA in light of the
8 Climate Action Plan that specifically laid out
9 a few things that I think are of particular
10 interest to DOE.

11 And basically the memo that the
12 President sent to EPA saying, you know, we
13 need you to work on this rule, and then they
14 proposed the rule just this past June, said
15 that they need to maintain the continued
16 provision of reliable and affordable electric
17 power, allow the use of market-based
18 instruments, performance standards and other
19 regulatory flexibilities, tailor regulations
20 and guidelines to reduce costs and enable
21 continued reliance on a range of energy
22 sources and technologies.

1 And if you sort of look at that
2 part you sort of see that there's a lot of
3 energy in that. And so we at DOE are
4 certainly concerned with all of these issues
5 and are thinking actively and playing an
6 active role in considering the rule and making
7 sure that we can be helpful to states.

8 So, the process that the
9 Presidential memorandum laid out is that EPA
10 was to launch their effort through the states.
11 And you've all seen that's what they've been
12 doing.

13 And so the Department of Energy
14 were actually specifically called out and
15 other federal and state agencies.

16 And so we have the role of
17 providing the best technical information we
18 have to all of the parties, including of
19 course EPA and to the states.

20 And we have a particular interest
21 in helping states and are now offering
22 technical assistance to states who need it to

1 explore the sort of energy system aspects of
2 this role.

3 And particularly things like with
4 energy efficiency where we have a lot of
5 expertise, for example, in how you actually
6 measure energy efficiency.

7 And of course reliability, that's
8 a key interest of ours. And again, we're very
9 interested. We're starting to think a lot
10 about that and very interested in other
11 people's thoughts about how you actually think
12 about reliability and make sure that it's
13 addressed in the context of the clean power
14 plant.

15 This is our website that we have
16 recently stood up on state, local and tribal
17 technical assistance.

18 This is much broader than the EPA
19 rule, but it includes it. It's an all-of-the-
20 above approach to technical assistance.

21 Throughout DOE there are offices
22 that offer states technical assistance. We're

1 now trying to make it easier for states to
2 find the information that they need.

3 Hopefully you can tell from the
4 picture it's everybody. It really is all of
5 the above. The Secretary, and actually this
6 is true of me, in fact, was into all-of-the-
7 above before it was cool.

8 And this is the Secretary and
9 certainly the policy office really thinks that
10 you have to look at all of our energy
11 resources and take best advantage of them.

12 So we are looking to help folks.
13 They don't have to necessarily go in through
14 the individual offices although they can get
15 help that way.

16 But also this is a portal so that
17 if you have a broad question, you're not sure
18 where to start, this is to sort of help state
19 and local officials come in and get the
20 assistance that they need on any kind of
21 energy issue, including that might be relevant
22 to the clean power plant.

1 So, I'm also going to talk a
2 little bit about some of our -- we have a lot
3 of other work on mitigation so I'm just trying
4 to give you some highlights.

5 We're also doing a lot of work on
6 resilience. It's interesting that the lingo
7 is changing a bit. I have, the guy who works
8 for me, he's on point on resilience as he used
9 to work in adaptation and now he works on
10 resilience because that's what people call it
11 now. I don't know, somehow I guess the term
12 polls better.

13 And so this is about building
14 stronger and safer communities and
15 infrastructure, protecting our economy and
16 natural resources and using sound science to
17 manage climate impacts.

18 And this is a report that we put
19 out last year, it's been over a year ago, on
20 U.S. energy sector vulnerabilities to climate
21 change and extreme weather. Many of you may
22 be familiar with it.

1 And we're now in the process --
2 and everything sort of takes longer in the
3 government than I had hoped -- we are now in
4 the process of doing follow-on work on this
5 where we're looking at the vulnerabilities in
6 a more regional and fine-grained context. So
7 looking region by region in more detail on
8 what we can learn about vulnerabilities.

9 And we're also looking more at
10 solutions. So we're very interested in what
11 it is that folks can do in the energy sector
12 to become more resilient.

13 And this feeds into a number of
14 different processes. There's actually a state
15 and local task force that's looking at
16 resilience that reports into the
17 administration White House process.

18 And there's also an Interagency
19 Climate Resilience Council and my boss,
20 Melanie Kenderdine, co-chairs the
21 infrastructure piece of that Resilience
22 Council. So there's lots of places this fits

1 in.

2 It also fits in the Quadrennial
3 Energy Review which is also looking at
4 resilience questions.

5 And if you're familiar with the
6 report this will be a little boring, but for
7 those of you who are interested you can -- if
8 you take a look at the report there's a lot of
9 interesting anecdotal information mostly. We
10 don't have a great comprehensive view of all
11 of the issues that are occurring.

12 But certainly the energy sector
13 has vulnerability to climate conditions and
14 this is something that we're looking at.
15 Whether it's low water levels that reduce
16 hydropower, or wildfires damaging transmission
17 lines, or flooding issues in different parts
18 of the country, lower river levels that can
19 affect barges, cooling water intake or
20 discharge that's too hot, there's all kinds of
21 issues that the energy sector itself has to
22 worry about in terms of climate and extreme

1 weather, and particularly in light of climate
2 change.

3 And that's what the report talks
4 about.

5 And then it also starts to get a
6 little bit into solutions. And this is where
7 we want to do more work and would definitely
8 welcome input on this, about what it is that
9 one actually can do to become more climate-
10 resilient. What kinds of investments can you
11 make to make your systems more flexible, more
12 resilient to be able to withstand storms.

13 This could be anything from just
14 hardening infrastructure to a better use of
15 demand response, to making your various sub-
16 processes using wastewater, for example,
17 instead of clean water. There are ways that
18 you can deal with your -- water availability
19 can be an important constraint for power
20 systems and using different sort of non-
21 traditional water supplies is what they refer
22 to.

1 So that's kind of what we're up to
2 broadly on the Climate Action Plan. I'm happy
3 to answer questions about that.

4 And then sort of segueing into
5 my next presentation which hopefully someone
6 can find is the Quadrennial Energy Review is
7 a big focus of our office, the Energy Policy
8 and Systems Analysis.

9 And this is something that
10 President Obama initiated in January of last
11 year. The first installment is due in January
12 this year so we're really crunching on that.
13 And I'll get into that a little bit.

14 And the idea is to take a really
15 comprehensive view at our energy system and
16 make sure that it's meeting all of the goals
17 that we have.

18 And it's government-wide, it's not
19 just DOE. DOE is called the Secretariat for
20 the Quadrennial Energy Review, but the work is
21 actually being done across the federal
22 government. And we have a big job actually

1 just to coordinate that process.

2 It's being coordinated out of the
3 White House and we are sort of staffing that
4 whole process. But it's really -- since
5 energy, as many of you know, is really not
6 just a DOE issue, energy is dealt with in all
7 parts of the federal government. So it really
8 is an administration-wide effort to develop a
9 comprehensive view of what we can do on
10 energy.

11 So, how do I pull up the next one?
12 I'll just wait.

13 So while that's coming up I'll
14 just tell you a little bit about coal in the
15 QER.

16 The Quadrennial Energy Review,
17 we've kind of changed the meaning of the word
18 "quadrennial."

19 So we're not doing a study every
20 four years which is what I'd initially thought
21 "quadrennial" meant and, in fact, that's
22 generally what it means.

1 But what we're doing is we're
2 basically doing a Quadrennial Energy Review
3 but in four parts. So every year we'll
4 produce some piece.

5 The piece for this year is energy
6 infrastructure for transmission, storage and
7 distribution.

8 And so given that context where
9 does coal fit into that? And I would say that
10 for QER what we're calling 1.1 because the
11 next year will be 1.2, I would say there's
12 more equities for coal likely in future
13 Quadrennial Energy Reviews than in this one.

14 We'll not be considering things
15 like safety, environmental performance,
16 productivity and so on on the coal power
17 plants or coal production. That's sort of not
18 in scope this year.

19 So, I think a lot of the issues or
20 the pros and cons of coal utilization
21 technology -- so I think a lot of the issues
22 that you deal with are more likely to be in

1 future increments of the QER.

2 So, I think that this is in a way,
3 to make virtue out of necessity, I think you
4 all might be actually lucky because this year
5 while we've been starting up our office and
6 doing the first QER we've been very rushed.
7 And I think that next year we'll have more
8 time.

9 And I think you all might already
10 want to start thinking about how you can feed
11 into future QERs that will take on other parts
12 of the energy system.

13 So the things that are in scope
14 this year that you might be interested in is
15 with the increase in crude oil by train.
16 That's actually causing rail system effects
17 which have and actually are having effects on
18 you all.

19 And I think that that is something
20 that will be -- and I know that that will be
21 something we'll talk about in the QER, what's
22 happening to the railroads as oil -- oil by

1 rail, how does that compete with other things
2 that move by rail and what does that mean for
3 our system. So we will be talking. We've
4 been doing some analytical work on that and we
5 will be talking about that in the QER.

6 There's particularly examples, as
7 I understand it, that there were coal-fired
8 power plants in Wisconsin and elsewhere had
9 trouble getting the coal that they needed
10 because of rail constraints. So I think that
11 those issues will -- I know that those issues
12 will come up.

13 We're also looking into what are
14 the plans of the private sector to address
15 freight rail capacity. So again, that's in
16 scope too.

17 The Surface Transportation Board
18 recently required railroads to report on a
19 weekly basis on the speed of deliveries of
20 coal and other commodities.

21 Will this produce positive results
22 for utilities? What other levers exist for

1 federal and state governments to assist in
2 addressing these capacity, service and
3 reliability concerns? So that's all part of
4 what we're doing.

5 Again, not sort of the main thing
6 like clean power, how do you make coal
7 cleaner, all those kind of things. That's
8 really not this year.

9 I should also mention a couple of
10 other things that are in scope.

11 There's a lot more crude moving by
12 barge than we've seen before. And also that's
13 potentially got issues for coal. And is that,
14 again, displacing coal, and what does that
15 mean for, for example, power plants in the
16 Southeast.

17 And we're also interested in what
18 the movement of all that coal and crude on the
19 inland waterways does with regard to the age,
20 maintenance and refurbishment and replacement
21 of the nation's two hundred some odd locks and
22 dams.

1 I've actually been learning some
2 about locks and dams, and apparently a lot of
3 the locks that we have are still hand-cranked.
4 There's just a lot of old infrastructure in
5 that world which I didn't know about.

6 We're also looking into port
7 facilities and associated infrastructure, and
8 looking at what implications that might have
9 and what is also competition potentially for
10 LNG. You know, all the different ways that
11 the whole energy system moves energy around
12 and what might that mean for coal as well.

13 We're also looking at the status
14 of CO2 EOR pipeline infrastructure. That
15 might be a way that we back in a little bit
16 into some of these issues. But that is
17 something that we're looking at as well in the
18 context of this QER.

19 We're also looking at air
20 emissions and ports and rail yards which again
21 may have some implications for coal.

22 So this, can anyone read this

1 slide? Yes, okay.

2 So, we have this habit in the QER
3 of making slides that I think are too busy.
4 And this is why I couldn't merge the other
5 ones. I sort of lost half the information
6 when we tried to merge.

7 So this is basically the story of
8 what we're doing in the QER. We're trying to
9 look at minimal environmental footprint,
10 affordability, flexibility, safety, robustness
11 and scalability.

12 Sort of how do you get an energy
13 system with all those attributes. What is it?
14 How close are we? What do we need to do to
15 get there?

16 This is the QER schedule and this
17 is why I was working on this presentation at
18 1 o'clock last night because we are in -- so
19 we are in this October place. And this is
20 where we're just bringing all of this work
21 together.

22 Because we only just got started

1 as an office about a year ago and we only
2 started the QER in January, and so lots of
3 things were happening at once, we're doing a
4 lot of things in parallel.

5 We're doing synthesis analysis.
6 We're doing white paper and technical paper
7 scenarios and modeling. We've got a bunch of
8 working papers in train. I actually had a
9 deadline for a working paper yesterday so
10 that's why things were a little nuts for me.
11 So there's just all of this analysis that's
12 coming in and being synthesized.

13 And of course we've had a lot of
14 stakeholder input. We've had 14 meetings
15 which I'll show a slide on around the country
16 getting input from stakeholders.

17 Hopefully you all are aware that
18 the deadline for comments was Friday, although
19 I imagine we'd welcome input from you if we
20 can get it as soon as possible.

21 And so the entire process now is
22 we're synthesizing, we're analyzing, we're

1 doing scenarios. We're also working with
2 other agencies to make sure that the entire
3 federal government equities are taken into
4 account.

5 And then the idea is to get most
6 of that work done in terms of an actual
7 report. And then it goes through interagency
8 review process which as you know can take
9 quite a bit of time.

10 So this is a little bit about how
11 we're thinking. There is the electricity,
12 natural gas and liquid fuels is kind of the
13 categories that we've been talking about.

14 Of course there's lots of
15 crosscutting. I tend to do a lot of
16 crosscutting work because climate is
17 crosscutting.

18 We're doing a lot of work on
19 interdependencies like gas-electric
20 interdependency is something that we're
21 looking at.

22 Energy transport infrastructure

1 interdependencies like I mentioned earlier.

2 Land use and siting.

3 And then issues like, for example,
4 conventional air pollution from stationary
5 TS&D sources. And also as I mentioned methane
6 and some of the other things that we talked
7 about.

8 So there is a particular paper --
9 I don't know if I can figure out how to show
10 it -- but there is an oil by rail safety
11 paper, and there's also coal by rail but I
12 guess that isn't shown on this slide.

13 So I think there is -- there's a
14 lot that we're doing that impinges on you.
15 But again, it's not the central kinds of
16 issues that we generally think about for coal.

17 And -- oh here, here's the coal by
18 rail paper is under liquid fuels for some
19 bizarre reason.

20 So there's as you can see a ton of
21 stuff. A lot of our work is going to be
22 synthesis and we will definitely need -- we'll

1 be taking into account stakeholder input as
2 much as we can get it.

3 This is a potentially interesting
4 example for what we're looking at with the
5 pipeline, rail, barge and intermodal issues.
6 And this is, again, an area that you all might
7 be interested in.

8 And you kind of see the beginning
9 of what the effects, the sort of key cause
10 that all of these other things are kind of
11 trying to adjust to is this incredible
12 increase in oil by rail.

13 And we're sort of looking quite
14 deeply. I think this is something everybody's
15 noticing, but we're trying to look really
16 deeply in what the impacts of that are for the
17 energy system as a whole.

18 And this is another example, not
19 specific to coal, but of the kinds of
20 vulnerabilities that we're looking at -
21 hurricanes and flooding, destructions of crude
22 imports potentially.

1 And this is a list of our public
2 engagement meetings. Hopefully you all have
3 been participating, but if not let me know and
4 we'll figure out. If there's input that you
5 want to provide we'll get it in somehow.

6 So we did have these 14 meetings
7 around the country. And this is really
8 supposed to be, and we will make sure that it
9 is, a process that's inclusive, that makes
10 sure that we take into account a range of
11 views within the government as well as outside
12 the government.

13 So with that I would be happy to
14 take questions and thank you.

15 (Applause)

16 MS. GELLICI: Any questions for
17 Judi?

18 I'll start out with one, Judi.
19 This is Janet Gellici.

20 I would ask if you do have a
21 question, by the way, for the transcriber if
22 you'll give your name and affiliation, please.

1 So, Judi, thanks again for being
2 here. I appreciate it. It sounds like you've
3 been incredibly busy.

4 One of the things that we're
5 interested in at the Council is enhanced oil
6 recovery, and I know that's a topic that's
7 near and dear to your heart.

8 So, how is that being addressed
9 right now in the QER, or is it being covered?
10 That might have flown by on one of your
11 slides.

12 MS. GREENWALD: Right. So, for
13 this QER the only thing that we're looking at
14 are CO2 pipelines because that's all that's in
15 scope.

16 But I believe, and we don't have a
17 decision yet on what the scope is for next
18 year, but I'm fairly confident that sometime
19 in the next three years we will look at more
20 broadly CO2 EOR in the QER.

21 I also am looking, as many of you
22 know I have a history of great interest in CO2

1 EOR.

2 And I'm looking in the context of
3 our analytical work making sure that we have
4 the best information on the costs of carbon
5 dioxide enhanced oil recovery, and how that
6 can enable carbon capture and storage, and
7 also increase domestic oil production.

8 So that's something that we're
9 incorporating in our analytical work. I have
10 a work stream to make sure that we're updating
11 all of our cost information so that when we do
12 any policy analysis that's part of the
13 picture.

14 I'm actually -- I think you all
15 know this, but you do have a Secretary and
16 certainly with Julio Friedmann you have a
17 leadership who's very interested in carbon
18 capture and storage and CO2 EOR.

19 So I think we have -- I don't at
20 least feel in this context in this DOE that I
21 have to fight for interest in that. I think
22 that that's something that we have a lot of

1 interest in.

2 And I think it's more
3 operationalizing and making sure that we take
4 advantage of the best available information.

5 That's another thing I would
6 welcome input on, if there are things you
7 think that we ought to be doing on CO2 EOR
8 that we're not. I think that would be of
9 great interest and I'd certainly be very
10 interested in doing that.

11 But we are doing a little bit of
12 work on that and I'd say more later with the
13 QER.

14 MS. GELLICI: Wonderful. The
15 National Coal Council completed a study on
16 enhanced oil recovery in June of 2012 and I
17 think there may be some very relevant bits in
18 there. So I'll follow up with you on that.

19 MS. GREENWALD: Terrific.

20 MS. GELLICI: So, thank you.

21 Questions?

22 MR. CARR: I'm Mark Carr with

1 Channel Design Group.

2 I'm in the water transportation
3 business. A lot of that is fuel and energy,
4 but there's other commodities too.

5 Your corresponding agencies would
6 be the Corps of Engineers and the Coast Guard.
7 I hope that they've been supportive.

8 But a challenge with the Corps of
9 Engineers, they're terrific engineers, but
10 they're -- the executive focus is toward being
11 an environmental restoration organization.

12 So, there might be some tension
13 within the organization of drilling down into
14 the questions that you're asking because
15 they're leaning toward a different mission.

16 So I'd be happy to be a resource
17 to you folks.

18 MS. GREENWALD: Actually, that
19 would be great. If you could give me your
20 card after that would be good.

21 We are finding, and this is --
22 it's probably -- this might be one of our most

1 boring but most important recommendations is
2 that we're identifying a lot of data gaps.

3 There's just a lot of lack of
4 information on particular issues. We're sort
5 of surprised what we can't find.

6 And so I think that actually may
7 be one of the key -- there's going to be like
8 a set of these. You know, we were trying to
9 find this data and nobody had it.

10 And that's actually something we
11 need to do better on as a government and as a
12 society. So that would be -- I would love to
13 consult with you on that.

14 MR. ALI: Sy Ali with Clean Energy
15 Consulting.

16 MS. GREENWALD: Hi.

17 MR. ALI: We all know that forests
18 are a major source of CO2 absorption. Recent
19 wildfires in the West are destroying that
20 resource. Is there any plan in your program
21 to include advanced or accelerated
22 reforestation of those areas?

1 MS. GREENWALD: So, yes, broadly
2 there's -- within the administration there are
3 definitely people working on forestation.
4 That's mostly out of USDA and the Forest
5 Service. I'm less involved in that particular
6 thing.

7 What we look at for our work at
8 the moment is on what's the vulnerability of
9 the energy sector to forest fires, and what
10 can one do about that in that context.

11 But yes, that is definitely part
12 of the broader Climate Action Plan, but it's
13 not work that I'm particularly focused on.

14 And it's interesting because DOE
15 does a lot of different things, but that's
16 probably not a big focus of ours.

17 But I know that USDA and the
18 Forest Service are doing work in that space.

19 MS. GELLICI: Other questions?

20 MS. OBENSHAIN: Hi, Judi, this is
21 Karen Obenshain of Edison Electric Institute.

22 You mentioned that in this

1 particular QER you're looking at oil by rail
2 as well as coal by rail.

3 And you did mention one decision
4 the STB had made on reporting by the rails on
5 their delivery success.

6 What is your interaction with STB,
7 or are you asking them for input?

8 MS. GREENWALD: So, yes.

9 Basically I have another very hard-to-read
10 chart of all of the interagency process. I
11 mean, it can make your head spin.

12 Basically every federal agency,
13 everybody is involved, and we're getting input
14 from all of them.

15 And it's been interesting because
16 it depends sort of who you get to at different
17 agencies. Some sort of just want to review
18 what we did, and other people actually want to
19 do work and give us stuff. So it's been kind
20 of uneven.

21 So I'm not specifically sure about
22 what they've been providing, but we definitely

1 are reaching out to everyone. And when I say
2 "we" it's really the White House that's making
3 sure that all of the agencies are a part of
4 it.

5 But we have to operationalize that
6 and make sure that the information is used and
7 that we share everything with everyone.

8 So it's really quite, just a --
9 there's logistics of this which I think is
10 really important. I really think it's
11 important that we have an integrated energy
12 strategy.

13 I mean, that's one of the reasons
14 I came to DOE to work on this. Energy is just
15 done all over the place. And it's really, you
16 know, one could think about a reorganization
17 and all that sort of thing which is, you know,
18 impossible.

19 But I really think it's probably
20 impossible in general to get all of the energy
21 stuff under one agency or department.

22 So really we just have to

1 coordinate better and make sure that we have
2 an overarching that then we're all aligned in.
3 And that's kind of the idea.

4 I should say, I don't know if I
5 mentioned this, this recommendation to do a
6 Quadrennial Energy Review in this coordinated
7 manner came out of the President's the -- I'm
8 trying to remember. The Sustainability
9 Advisory Board? I'm trying to remember what
10 it was called.

11 But Secretary Moniz was on that at
12 the time so he sort of describes it that he'd
13 sent a pass to himself that he then caught
14 when he got here.

15 (Laughter)

16 MS. GREENWALD: So we're actually
17 operationalizing. It's PCAST, that was
18 President's Council on -- whatever it stands
19 for.

20 PCAST made this recommendation and
21 Secretary Moniz, at that time Professor Moniz
22 was one of the people recommending it. And

1 now as Secretary Moniz he's implementing it.

2 MR. JAMES: Yes, Revis James, the
3 Electric Power Research Institute.

4 I just wanted to understand what
5 the purpose of the QER is and how it will be
6 used.

7 Is it an interagency coordination
8 tool? Is it a policy information tool? Is it
9 a DOE R&D strategy tool? Can you comment on
10 that?

11 MS. GREENWALD: How do I get this
12 back up?

13 MS. GELLICI: Can we get the
14 slides back up? Just a second.

15 MS. GREENWALD: While I'm waiting
16 for that, the goal is to actually make
17 recommendations and kind of an action plan.

18 So the idea is to not just
19 coordinate which is part of it, but to sort of
20 coordinate toward an end. So the idea is that
21 we will come out with a set of integrated
22 long-term objectives.

1 So, outline of legislative
2 proposals to Congress. This is going to
3 include executive actions that we can sort of
4 collectively agree we're going to do.
5 Programmatic, regulatory, fiscal. So there
6 will be budgetary implications of this.

7 And then the coordination. So
8 it's all sort of coordination for a purpose,
9 a set of purposes and a set of objectives. So
10 we're actually going to get to the point.

11 This is going to be -- we talk
12 about recommendations a lot. You'll sort of
13 hear when we talk about the QERs we're going
14 to come out with recommendations.

15 Really it's sort of an action
16 plan. Because we're recommending to
17 ourselves. And that's the idea, is that this
18 is going to actually be an action plan and
19 like a roadmap for what we're going to do.

20 And that's one of the reasons that
21 we didn't want to, or that the Secretary
22 didn't want to wait four years.

1 He wanted us to start getting
2 going on pieces of this so that we'd have
3 actionable stuff. We'd have a plan, we'd then
4 start executing on that as we did the next
5 installment. So that's the idea is that this
6 is actually going to turn into things that
7 we'll actually do.

8 So, for example, these data gaps
9 that I mentioned. We're actually -- the idea
10 would be we identify them and then we actually
11 figure out how to fill them so that we don't
12 have those gaps anymore.

13 MS. GELLICI: To close things out
14 what I heard was that it's not too late to try
15 and get some information into you, but hurry,
16 hurry, hurry, which we'll do. And we do
17 appreciate Judi.

18 Also, just for planning purposes
19 so we can start thinking ahead. The next
20 segment of the QER is devoted to?

21 MS. GREENWALD: So, we're waiting
22 for a decision on that. That's not DOE's

1 decision, that's a White House decision.

2 This is co-chaired by OSTP and the
3 Domestic Policy Council. So they're the co-
4 chairs. And it's Dan Utech and John Holdren.

5 So it's -- we're in discussions
6 actually about QER 2 now, but there has not
7 been a decision yet about what the scope is.
8 Or QER 1.2 since this is the second part of a
9 four-part series.

10 So we don't know, but it will be
11 other than TS&D. And I would be surprised if
12 it didn't have more of the equities that I
13 described that I see as the high priorities
14 for the coal industry in it.

15 So I think as soon as we have that
16 which will hopefully be sooner than we had it
17 last year I think that we'll be able to get
18 going and we'll welcome input. And as early
19 as possible would be good.

20 And when I -- I should say since
21 I'm speaking for DOE, you know, officially the
22 comment period was over on Friday.

1 But you know, I think that because
2 you're an advisory committee I think there
3 would probably be a way to fit it in.

4 But I would hurry because as you
5 saw all that work is in train. And I wouldn't
6 want you to miss any boats so to speak. Or
7 barges.

8 MS. GELLICI: Thank you.

9 (Applause)

10 CHAIR WALLACE: Thank you, Judi,
11 for sharing your perspectives.

12 Now, I would like to turn the
13 program over to Mike Durham, the vice chair of
14 the National Coal Council to introduce our
15 next two keynote speakers.

16 VICE CHAIR DURHAM: Thank you,
17 Jeff. I appreciate the opportunity this
18 morning to introduce our next speaker, Kim
19 Greene, executive vice president and chief
20 operating officer at Southern Company.

21 Ms. Greene oversees Southern
22 Company's system of operations including

1 generation, transmission, engineering and
2 construction services as well as planning and
3 research in environmental affairs.

4 Ms. Greene is a native of
5 Knoxville, Tennessee, earned her bachelor's
6 degree in engineering science and mechanics
7 from the University of Tennessee, earned a
8 master's degree in biomedical engineering from
9 the University of Alabama, and an MBA from
10 Samford University.

11 Ms. Greene is a member of EPRI's
12 board of directors and recently served as
13 EPRI's board chair. So please join me in
14 welcoming Ms. Greene.

15 (Applause)

16 MS. GREENE: Thank you very much,
17 Mike, and thank you, Jeff and the rest of the
18 National Coal Council for inviting me this
19 morning. It's a privilege and a pleasure to
20 be here.

21 It's nice to look out and see some
22 faces that I haven't see for awhile. Mike

1 Duncan, speaking of my growing up in
2 Knoxville, Tennessee, I had the pleasure of
3 working with the Tennessee Valley Authority
4 for about five and a half years.

5 And during that time Mike was on
6 the board and served for a time as the
7 chairman. Appreciate now your leadership at
8 ACE. Thank you very much.

9 Also, Jim Hunter with IBEW. And
10 certainly there are thousands of employees who
11 are bright and talented and committed that we
12 depend on every day to provide the clean,
13 safe, reliable, affordable electricity to our
14 customers.

15 And we appreciate the relationship
16 and the partnership that we have with the IBEW
17 and look forward to that continuing. So nice
18 seeing you as well.

19 So as I mentioned, our goal at
20 Southern Company, and certainly many other
21 utilities is that we are here to provide
22 clean, safe, reliable and affordable

1 electricity.

2 And balancing all of those
3 elements takes a lot of time and care and
4 thought.

5 And trying to be too overweight on
6 one might underweight another in a way that's
7 difficult for our customers.

8 And I will say that at Southern
9 Company we have a philosophy that we call the
10 circle of life.

11 And at the center of the circle of
12 life are customers. And every decision we
13 make we do with the customer in mind.

14 We still have over 260 local
15 payment offices open within our service
16 territory. We serve most of the State of
17 Alabama, Georgia, parts of Florida and
18 Mississippi.

19 Forty-eight percent of our
20 customers have an annual income of \$40,000 or
21 less.

22 I've walked into these payment

1 offices and I've seen someone walk up to the
2 window and greet the person behind the other
3 side of the counter by their first name and
4 pull out of his or her pockets cash.

5 And tell the person that's what
6 I've got this week and I'll be back next week
7 with some more. Thanks for keeping my heat
8 on, my air conditioning on, my refrigerator
9 going in the meantime.

10 And with the large population of
11 people that we have who are making baseline
12 economic kitchen-table decisions every day we
13 are obviously focusing on the affordable part
14 of clean, safe, reliable and affordable, maybe
15 more than some others.

16 And for years the ability for us
17 to be able to provide that clean, safe,
18 reliable, affordable power has been rooted in
19 our well-running, very efficient and reliable
20 coal fleet.

21 And over the years we are shifting
22 from at one point, in fact, back in the

1 sixties 85 percent of our electricity came
2 from coal generation. Last year that was less
3 than half of that, in the forty-something
4 percent.

5 Over time of course we've added
6 nuclear, we've added natural gas, we have
7 hydro, we have energy efficiency.

8 And just as Judi mentioned, the
9 all of the above, I think that's something
10 that a lot of people were talking about even
11 before it was cool, and certainly something
12 that our company and others really believe in
13 deeply as the best way to meet those
14 obligations that we have to our customers
15 every day.

16 We provide a product that people
17 cannot live without, at least not for very
18 long, and in some cases not even for a moment.
19 So again, we take that obligation very
20 seriously.

21 And we've embarked at Southern
22 Company in trying to maintain the ability to

1 use all of those energy resources for the
2 foreseeable future.

3 Let's talk about coal. Even back
4 in the sixties I mentioned when we were
5 producing as much as 85 percent of our
6 electricity from coal we began a very strong
7 push in research and innovation.

8 We knew we needed to ensure that
9 these resources would be used and useful and
10 available for our customers into the future.

11 And a gentleman who at the time
12 was not the CEO of Southern Company but later
13 became the CEO, his name is Alvin Vogtle.
14 Some of you may have heard of Alvin Vogtle.

15 He actually is the person who the
16 movie the Great Escape is about. He was a war
17 pilot. He was a POW during World War II and
18 he tried seven times to escape and finally
19 did.

20 He was patient, although maybe
21 some might argue about that, but he
22 persevered. And certainly that kind of a

1 culture and characteristic is important for
2 this industry.

3 So, Alvin Vogtle came to Southern
4 Company and the CEO at the time Harley Branch
5 and he got together and said we've got to find
6 the best and the brightest minds because we've
7 got to innovate our way through this.

8 We can't give up on these
9 technologies. We've got to find ways to make
10 them better.

11 And Alvin Vogtle went and found a
12 man who at the time was the director of
13 research at Virginia Polytechnic Institute,
14 but he had a Ph.D. from University of
15 Tennessee, my alma mater.

16 And brought that man to Southern
17 Company. And they developed a team of
18 researchers. And for over 50 years Southern
19 Company has invested in robust and proprietary
20 research.

21 We partner with EPRI. It's a
22 pleasure to be on that board. And certainly

1 EPRI represents a great opportunity to
2 leverage all of the resources from the
3 electric utility industry to solve problems
4 that all of us are interested in.

5 But again, over the past 50 years
6 we've focused on how to make coal cleaner and
7 more efficient.

8 We're still doing that. And
9 thanks to our very good partnership with not
10 just EPRI and the other industry participants
11 but also DOE we've worked for the last couple
12 of decades to perfect a gasification
13 technology that we are now building in
14 Mississippi.

15 It's our Kemper facility. It's a
16 state of the art coal gasification technology
17 that uses low-grade coal lignite that is
18 plentiful in that part of Mississippi and
19 gasifies that to create electricity.

20 We're capturing 65 percent of the
21 carbon and we're putting that in a pipeline
22 and sending that to companies to use for

1 enhanced oil recovery.

2 It's a wonderful opportunity,
3 uniquely situated in terms of the availability
4 literally at the mine mouth for the coal and
5 the close availability to the coast for the
6 desirous use of the CO2 for enhanced oil
7 recovery.

8 So, we are committed to making
9 coal viable for the future, keeping coal
10 viable.

11 We've also, as I mentioned, moved
12 into natural gas in a way that we think is
13 appropriate. We're not overweighting natural
14 gas but having the ability to utilize lower-
15 cost natural gas when it's available makes
16 sense for our customers.

17 Now, at some times lower-cost
18 natural gas is not available, and we certainly
19 experienced that this past winter during the
20 polar vortex.

21 When during that period of time
22 and as we've gotten through the summer as

1 Southern Company finds itself actually peaking
2 this year in the winter. We have always
3 peaked in the summer. But this year it was so
4 cold we peaked in the winter.

5 And so we had a huge demand. And
6 in fact, we had nearly our all-time peak as
7 far back as 2007 when the economy was going
8 very, very strongly.

9 So we had to provide electricity
10 to our customers and at the time natural gas
11 prices were soaring.

12 And certainly there are stories
13 you've all read about natural gas prices being
14 as high as \$120 an MMBtu in the Northeast
15 United States.

16 Fortunately it wasn't that high
17 where we are. We're closer, again, to more
18 pipelines and more access. But natural gas
19 was still much more expensive.

20 And we were able to use the low-
21 cost coal that we had and run our coal fleet
22 in a way that actually saved our customers

1 over \$100 million in fuel charges.

2 This flexibility that our diverse
3 portfolio provides is the best answer, we
4 believe, for our customers. And we believe
5 we've got as much flexibility as anybody, but
6 we've got to continue to improve that
7 flexibility.

8 So again, in addition to coal and
9 gas there's nuclear. Nuclear has to be a part
10 of the picture.

11 And I'm proud to have worked at
12 TVA and Southern, two of the three companies
13 that are building nuclear.

14 Of course, TVA is completing a
15 unit that was started back in the late
16 seventies and early eighties. And Southern
17 Company is pursuing new generation, the
18 advanced passive Westinghouse design, at our
19 Plant Vogtle which I must say I think is
20 fitting given the namesake of that plant for
21 us to be pursuing this new generation of
22 nuclear.

1 Of course, there are renewables.
2 And within the Southern electric system wind
3 is not as prevalent as in the Midwest, but we
4 have entered into some wind contracts. So
5 we're getting wind by wire.

6 And we're also entering into some
7 solar -- actually, it's not necessarily solar
8 contracts. We are building some solar plants
9 within the State of Georgia.

10 And over the next couple of years
11 the State of Georgia will have the largest
12 amount of solar power in a state that does not
13 have a renewable portfolio standard mandate.
14 So we are pursuing renewables where it makes
15 sense.

16 And then of course there's energy
17 efficiency which has to be a part of the mix
18 too.

19 And we do want people to use
20 electricity more wisely. We want our
21 customers to be educated and make better
22 choices.

1 I often will talk about the fact
2 that this industry with all that we say about
3 our focus on the customers, and we want them
4 to be satisfied, it's a little ironic that we
5 actually shock our customers often once a
6 month when they receive a bill.

7 They open it up in the middle of
8 September, often having no idea what to
9 expect, and when they see that bottom line
10 number they're usually surprised.

11 Some people are surprised and
12 still very grateful to have had the comforting
13 cooling during those hot summer months.

14 But how can we communicate with
15 our customers more? And certainly Southern
16 and many other utilities are embarking on
17 automated metering systems so that our
18 customers can get information online.

19 And in fact, right now if I pulled
20 up the Georgia power website I could pull up
21 my account and show you all what my bill is so
22 far this month, and what it's estimated to be

1 by the end of the month based on my current
2 usage patterns.

3 We had some storms roll through
4 Alabama and Georgia yesterday. I could pull
5 up and see where the outages are and what the
6 estimated restoration times are.

7 Providing information to our
8 customers is very important and we want them
9 to be wise consumers of our product.

10 But at the same time we also
11 believe that in many cases electricity can be
12 the better choice compared to other energy
13 options.

14 I'll just give you one example.
15 The Savannah Port, one of the largest ports in
16 the country, one of the largest particularly
17 on the east coast, had had very large gantry
18 cranes fired by diesel motors.

19 They have converted all of those
20 cranes to electric cranes. For Georgia Power
21 that is a tremendous additional load, as much
22 as 35 to 40 megawatts.

1 However, it is a much better
2 environmental choice for that port. It's a
3 more economic choice. It's a safer choice.

4 And so therefore where electricity
5 usage makes sense we want to promote the
6 selection of electricity.

7 Again, we want wise consumers of
8 energy, wise consumers of our product and
9 certainly want people to have access to. And
10 we have some of the most robust energy
11 efficiency programs in the country.

12 But at the same time, electric
13 vehicles and electrification in many other
14 parts of the economy makes a lot of sense.
15 And we want to make sure that our customers
16 are not penalized because our electricity
17 usage may, in fact, be growing.

18 Coal is a workhorse of this
19 economy. Today it provides about 40 percent
20 of all of the electricity generation.

21 It's very available, very
22 abundant. Twenty-seven percent of the coal

1 reserves in the world are in the United
2 States. We are the Saudi Arabia of coal and
3 we should absolutely find a way to use that
4 resource.

5 I've already talked a little bit
6 about innovation and that is a way for us to
7 move forward, but let me talk about some of
8 the headwinds that coal is facing, and
9 certainly not the least of which are some of
10 the environmental regulations that we see in
11 front of us.

12 They threaten to remove coal from
13 the energy mix rather than work to find a way
14 over a reasonable period of time to innovate
15 and make the continued use of coal viable.

16 Certainly EPA's new source
17 performance standards essentially eliminate
18 coal as a future generation option.

19 And the proposed greenhouse gas
20 emissions guidelines for existing sources is
21 an overreach in our mind by EPA.

22 We see the proposal as unworkable,

1 and increasing electricity prices, and hurting
2 reliability, in four areas particularly.

3 Now, I'm an engineer. One of the
4 first things I did at Southern Company was
5 chase Btus. I did synthomodels which are
6 essentially heat balances and I worked with
7 our engineers in the plant.

8 And at all of our plants we have
9 at least one person and in many cases a team
10 focusing on literally every day chasing the
11 heat rate, getting rid of wasted Btus,
12 lowering the heat rate.

13 How can we make the efficiency of
14 our plants as great as possible? And that's
15 part of what I did early in my career.

16 And the thought that there is
17 still 6 percent reduction left at our plants
18 is just not reasonable.

19 The unprecedented expansion of
20 renewable I've already talked about certainly
21 in the Southeast would be unworkable.

22 The guidelines require reducing

1 the amount of electricity customers receive
2 from coal and increasing that amount from
3 natural gas, not giving a company like
4 Southern the flexibility to use the lower-cost
5 resource, and exposing customers to higher-
6 cost natural gas when coal may be less
7 expensive.

8 So, the idea of this economic
9 dispatch which is also very close to the
10 hearts of people who run electric utilities is
11 challenged.

12 And all of these combined assume -
13 - well, let me just say that the modeling that
14 was done assumes that you do one, and then the
15 other, and then the other, when, in fact,
16 actually all of them in a combined way are
17 even more difficult to achieve.

18 So, essentially this type of a
19 proposal we believe, again, first of all is an
20 overreach and secondly unworkable,
21 particularly for a company like us who has
22 focused on maintaining highly efficient,

1 flexible resources over our lifetime.

2 So I mentioned that a key to
3 moving past this is innovation. And this is
4 something that Southern believes to its core,
5 and believes actually not just in talking
6 about it but investing in it.

7 And over the past decade we have
8 managed about \$800 million worth of research
9 and development in environmental areas.

10 We've invested more than \$9
11 billion in environmental controls and we've
12 reduced our emissions more than 80 percent
13 while increasing electricity consumption and
14 supply by 40 percent.

15 So, a couple of the examples of
16 what we're doing are as follows. We have a
17 plant in Mobile, Alabama. It's called Plant
18 Barry.

19 We have what was the largest
20 carbon capture and sequestration demonstration
21 until just recently, so one of the largest
22 carbon capture and sequestration demonstration

1 projects where we are capturing up to 150,000
2 tons of CO2, which is the equivalent of the
3 amount of CO2 from about 25 megawatts of
4 generation per year for underground storage.

5 We also house at a facility south
6 of Birmingham, Alabama, the National Carbon
7 Capture Center. Southern Company operates and
8 runs that facility for DOE. It's the nation's
9 carbon capture center.

10 Prior to that it was called the
11 Power System Development Facility. And again,
12 through our partnership with folks like DOE
13 and other vendors we have researched solutions
14 to use coal in a more clean way and tried to
15 particularly focus on a resource that was near
16 to us which is lignite in Mississippi.

17 So, again, let me just talk for
18 one more minute about the Kemper facility.

19 That facility is a state of the
20 art facility, one that we are very proud to be
21 a part of.

22 Now, those of you who have read

1 about it in the headlines know it's over
2 budget and past schedule.

3 Well, again, nothing worth having
4 is easy. Nothing worth doing for the first
5 time and being a leader in is easy.

6 And I'm proud to say that Southern
7 Company has persevered over the years, and
8 certainly with leaders like Alvin Vogtle, and
9 more recent leaders like David Ratcliffe and
10 certainly Tom Fanning today, we recognize that
11 we're going to get through this. And while
12 it's hard today we'll look back a few years
13 from now with pride.

14 We've got a lot of amazing people
15 working at that facility doing amazing work.
16 And if you haven't been to that facility I
17 would love for you to come and take a tour.
18 I'll also throw that out for the new Vogtle
19 construction as well.

20 It's an amazing facility that
21 takes amazing dedication and perseverance to
22 get through. I'm proud to be part of the

1 industry and part of the company that will see
2 that through.

3 So thank you very much for your
4 attention this morning and I'm happy to answer
5 any questions you may have.

6 (Applause)

7 MR. HOOKS: Hello. Steve Hooks.
8 I'm with Coal and Energy Price Report.

9 Can you give me kind of a snapshot
10 of how your coal delivery rail service is
11 doing now and what you see?

12 And also, how has your coal
13 structure changed? As I understand it you're
14 burning more Illinois basin and PRB coal than
15 ever as opposed to cap.

16 MS. GREENE: So, thank you for
17 that question. And I would answer it if I
18 weren't sitting the next to the expert, the
19 man who does this day in and day out.

20 So I'm really going to turn it
21 over to Jeff because he will give you the very
22 specific numbers where I'd probably be a

1 little bit more general in my answer.

2 CHAIR WALLACE: Your first
3 question, rail deliveries. We have been
4 challenged.

5 But I would tell you the eastern
6 rail movements have improved and we're where
7 we need to be.

8 The western movements we're still
9 challenged a bit. Have some shortage, but the
10 expectation that we'll be picking up the
11 amount of capacity that we need moving forward
12 into '16. But between now and '15 we still
13 have some struggles in terms of getting all
14 the resource that we need.

15 Relative to change in our coal
16 supply we have moved significantly to Illinois
17 basin, moved away from Central App in a big
18 way. Our Powder River Basin, likewise, that
19 use of coal is increasing.

20 To put it in perspective we'll be
21 consuming 50-52 million tons of coal annually.
22 Twenty-six or twenty-seven is Powder River

1 Basin and the great majority of the rest of it
2 will ultimately be Illinois basin as we
3 continue our transition.

4 We still have some existing coal
5 contracts with Central App and Alabama coal
6 and some import coal that will continue. But
7 that puts in perspective. We moved in a
8 really big way to Illinois Basin.

9 And also what enabled us to do
10 that is really economics as well as the fact
11 that now nearly all of our coal fleet that
12 continues operation is scrubbed.

13 And so we're able to go back to
14 Illinois Basin which we have historically used
15 in a big way prior to 1991 and the Clean Air
16 Act.

17 MR. HOOKS: What was that
18 breakdown again? Fifty-two million tons as of
19 when?

20 CHAIR WALLACE: That will be
21 roughly our annual burn.

22 MR. HOOKS: And 26-27 Illinois

1 Basin?

2 CHAIR WALLACE: In that
3 neighborhood. I'd say low twenties.

4 MR. HOOKS: Okay. Thanks.

5 MS. GELLICI: Thank you, Jeff.

6 Other questions for Kim? Sy?

7 MR. ALI: Sy Ali with Clean Energy
8 Consulting.

9 You mentioned of your Kemper plant
10 operating successfully now. Does your company
11 have any plans to replicate at other
12 locations?

13 MS. GREENE: Thank you for that
14 question because I want to make sure that I
15 clarify. The unit is not operating yet. It
16 is over -- past schedule and over budget and
17 we're still not finished.

18 But we would like to try to find
19 other opportunities to use this technology
20 within our service territory. But we are also
21 partnering with the other major contributor to
22 the technology and that's KBR, Kellogg, Brown

1 & Root.

2 And so together we are actually
3 partnering to work with countries like China,
4 Poland, India where there are large needs for
5 electricity. They're looking for clean coal.

6 We've actually signed a couple of
7 MOUs. So we're very optimistic that this
8 technology will be very successful in the
9 future.

10 MS. GELLICI: So, I had the
11 privilege to go down to Kemper. And I think
12 one of the great things that Southern Company
13 has done is to make this plant open and
14 available for people. You know, go down, take
15 pictures. It's just been a great service to
16 the industry, Kim. Thank you.

17 MS. GREENE: Wonderful. Well, I'm
18 so glad that you took the time to go down
19 there. It's not a real easy trip.

20 MR. HUNTER: Kim, Jim Hunter with
21 IBEW.

22 I know I had heard you said you

1 had a peak this winter. And I know I was down
2 in Birmingham. We went down January because
3 it would be nice and warm down there. We got
4 off the plane. It was 8 degrees.

5 But I heard part of the problems
6 that you had with load was the heat pump
7 issues where they were kicking on the second
8 unit of heaters, that you hadn't really
9 experienced that cold of weather.

10 Was that relevant in a lot of
11 other places, or just particularly in your
12 territory?

13 MS. GREENE: Well, Jim, I'll start
14 by saying no one was more surprised that it
15 was 8 degrees than we were.

16 But, yes, it's actually been
17 something that at least within our service
18 territory it's really interesting.

19 Certainly all four of our
20 utilities have been marketing heat pumps for
21 the past several years in a bigger way.

22 And during a period of time when

1 natural gas prices were higher there were a
2 lot of people who were choosing a heat pump.

3 And it's just taken, we believe,
4 this amount of time with the continued
5 penetration to really show up in a way that's
6 pretty significant.

7 So if you look sort of at a de-
8 seasonalized way we do see that our winter
9 load has been growing faster than our summer
10 load.

11 So, in addition to when it's 8
12 degrees there are people that are going to do
13 additional types of heating in terms of a
14 space heater, or strip heating, or something
15 like that.

16 And while we don't have a lot of
17 facts to talk about the specific numbers of
18 that, but that is certainly something that
19 adds to the peak as well.

20 But right now it's primarily
21 driven by the penetration of heat pumps.

22 MS. GELLICI: Kim, we'll do one

1 last question and then give you break.

2 MS. CAMBRIDGE: Thank you. Hi,
3 this is a question for Jeff. Claire Cambridge
4 from Argus Media.

5 Just to go a little bit further
6 with what you said about some of the
7 challenges that you expect to see on the
8 transportation front between now and, say, end
9 of 2015.

10 In the meantime as a result of
11 that can you just sort of outline a little bit
12 about the alternative sources that you're
13 having to look at?

14 CHAIR WALLACE: Sure. To overcome
15 some of those challenges we're using
16 supplemental rail deliveries from other rail
17 carriers. So we're kind of doubling up.

18 We also have, as you heard earlier
19 we, as have other utilities, had to curtail
20 some of our coal burn to catch up our supply
21 so that we've got it available for peak
22 periods.

1 And we'll probably continue in
2 that mode a bit. Not a great deal, but enough
3 to ensure that we've got a reliable coal
4 supply when we need it. So those are the two
5 primary things we're doing to overcome the
6 challenges we have, the struggles we have with
7 getting all the delivery that we need.

8 MS. GELLICI: Thank you, Jeff.
9 Thanks for graciousness. I don't think you
10 anticipated the questions here.

11 And, Kim, thank you very much. I
12 do have to thank Southern Company for its
13 leadership on our last study that we completed
14 in May of this year on the existing coal
15 fleet.

16 We do have copies out there, but
17 Southern Company chaired that initiative. We
18 did an assessment of the polar vortex and the
19 value of the existing coal fleet, and
20 appreciate your leadership and support on
21 that.

22 MS. GREENE: Well, thank you very

1 much. And Jeff of course is our leader and it
2 would be a shame not to let him have the
3 microphone on these questions where he is
4 absolutely the expert.

5 So, thanks to all of you very much
6 again for your attendance. I look forward to
7 seeing you in the future.

8 MS. GELLICI: Thank you.

9 (Applause)

10 VICE CHAIR DURHAM: Thank you, Ms.
11 Greene. We appreciate you being here this
12 morning.

13 It's now my pleasure to introduce
14 the next speaker, Commissioner David Boyd, who
15 currently serves as vice chair of the
16 Minnesota Public Utilities Commission.

17 Dr. Boyd is a member of the
18 National Association of Regulatory Utility
19 Commissioners board of directors and serves as
20 the chair of NARUC's Committee on Electricity.

21 Dr. Boyd holds many esteemed
22 positions with various utility-related groups

1 including the International Confederation of
2 Energy Regulators, the Organization of Midwest
3 ISO States, the Mid-American Regulatory
4 Conference and EPRI.

5 He earned a Ph.D. in chemistry
6 from the University of Minnesota and is the
7 2013 recipient of the prestigious Terry
8 Barnich Award for his contributions in
9 building international regulatory
10 relationships across the world.

11 In fact, I understand he recently
12 returned from a trip to China and perhaps he
13 will share some of his experience here with us
14 this morning.

15 Finally, I wanted to acknowledge
16 Dr. Boyd is one of the newest members of the
17 National Coal Council. We appreciate your
18 membership in the organization. And so please
19 join me in welcoming David Boyd.

20 (Applause)

21 DR. BOYD: Good morning, everyone.
22 And Mike, Jeff and Janet, thank you for having

1 me here. It's quite an honor and it's also a
2 chore to follow two excellent speakers because
3 about half of what I was going to say has now
4 been said.

5 (Laughter)

6 DR. BOYD: We face interesting
7 times right now as regulators in a partnership
8 with all of you. And as time allows I'm going
9 to try and talk about a few points.

10 The first is really focusing on my
11 perception of how the state regulators are
12 digesting the environmental rules that are
13 before us.

14 And we don't have the answers,
15 clearly, but we're working on it. We're
16 trying to be responsive.

17 And particularly in light of
18 reliance on certain fuels, lack of diversity
19 and what that will mean to reliability, and
20 how those are impacting the electricity
21 markets in the U.S.

22 I was in China recently, I came

1 back from Turkey last week, so I'm kind of a
2 gadfly these days flying around.

3 And I can tell you that some of
4 the issues we're facing are being repeated all
5 over the world.

6 The southeast Europeans are bound
7 by EU standards to achieve things like 20
8 percent carbon reductions, but they don't have
9 the resources or the opportunity to simply
10 take some of their coal units offline the way
11 theoretically we can in the U.S.

12 And then lastly I have a list of
13 things that we'll see if we get to, other
14 issues from a regulator's perspective.

15 And I think this goes without
16 saying. Our bedrock is always as regulators
17 trying to make sure that we can oversee
18 provision of safe and reliable service at just
19 and reasonable rates.

20 The exact meaning of those words
21 perhaps morphs in ebbs and flows from time to
22 time, but that is our basic premise as

1 economic regulators.

2 We do have an obligation to see
3 that all customer classes are treated fairly
4 and equitably, and that includes vulnerable
5 customers, industrial customers.

6 And then increasingly we're
7 finding this is difficult as we deal with a
8 changing, and I guess by the standards of the
9 electric industry rather rapid change in
10 generation portfolio and government rules like
11 the 111(d) rule.

12 So, this is where I probably want
13 to spend a little bit of time.

14 As regulators we've been working
15 with people like our RTOs or in the Southeast
16 with a company like Southern whose story, by
17 the way, plays out all over the country.
18 Maybe not quite as eloquently, and maybe not
19 with some of the investments.

20 And I've been to Kemper and I've
21 been to Vogtle and I look forward to getting
22 back to both of those.

1 What we've done in the Midwest in
2 terms of MATS compliance is tried to work very
3 closely with MISO to figure out what the
4 issues are, what kind of a future we're
5 looking at.

6 MISO doesn't have the advantage of
7 requiring advance information on MATS
8 compliance from the generators that are part
9 of the MISO market.

10 So we partnered with MISO trying
11 to get a survey out to the generators to
12 simply better understand their intent with
13 regard to MATS compliance.

14 It's not enough to know how many
15 megawatts will come offline. You obviously
16 need to know the timing of those retirements
17 or retrofits and locations to make sure that
18 the system remains reliable.

19 So we've iteratively had these
20 surveys out to the generators asking what
21 their plans are in a confidential manner,
22 trying to preserve the business quality of the

1 information.

2 The response rate has been over 99
3 percent. We've had some interesting
4 communication issues. The meanings of words
5 matter and we haven't always agreed on what
6 those words mean.

7 I think MISO is at the point now
8 where they feel like they have not only an
9 idea of what's coming at them in terms of MATS
10 compliance, but also they can start to tell us
11 which zones or which states are facing
12 generation shortfalls.

13 And MISO being heavily vertically
14 integrated it's a little simpler than perhaps
15 to our east in PJM. In a crisis we have the
16 luxury of directing generation be built in
17 certain locations. In some ways our situation
18 is a little simpler.

19 Now, layer onto that the 111(d)
20 situation which states are now individually
21 and in some cases as groups trying to better
22 understand.

1 And the questions now become how
2 do your decisions in a MATS world, are they
3 consistent with 111(d) compliance.

4 Eventually we'll get to that
5 point. Right now we're all trying to figure
6 out whether we understand the rule or not.

7 We're partnering with our
8 colleagues the air regulators in the states.
9 We've always had a relationship with those
10 folks more or less, but that relationship has
11 really changed and improved.

12 If there's a universally
13 recognized favorable outcome of our exercise
14 in 111(d) it's that the regulators in those
15 two worlds are communicating and sharing
16 information in a different and a more
17 productive way.

18 There are ranges of opinions about
19 111(d) among the states. There are states
20 that are very, very fond of the rule as
21 written. There are states that are not quite
22 as happy with the rule as written.

1 And there's a large body in
2 between I think where they're seeking some
3 clarification, some points of concern.

4 One example is in my state there
5 are some straight up factual issues that EPA
6 will have to address.

7 The largest coal-generating unit
8 in Minnesota was offline in 2012 which is the
9 baseline year that the EPA used. So obviously
10 the numbers for the state's compliance are not
11 right. Whether they're going to go up or down
12 remains to be seen, but there was a great deal
13 of coal generation that was offline.

14 There's a lot of concern about the
15 assumptions with the natural gas dispatch that
16 are in place. Some of the units physically
17 weren't designed to go to 70 percent dispatch.
18 There are gas supply issues.

19 MISO very carefully studied the
20 gas-electric interface with respect to MATS
21 rules and determined that were there to be
22 repowerings there is an adequate supply of

1 natural gas pipeline supply in the Midwest.

2 That study is now going to be
3 repeated with the 111(d) assumptions about
4 bringing facilities up to a greater level of
5 dispatch.

6 The intermediate 2020 target is of
7 concern to some of our utilities. The concern
8 is that meeting that intermediate goal will
9 force some perhaps hasty and unproductive
10 investment decisions.

11 If that goal were removed as an
12 intermediate target, even if the target stayed
13 the same it would give the industry more time
14 to innovate and to meet that ultimate 2030
15 objective in a more cost-effective and a more
16 sensible way.

17 We do have some concerns about the
18 dispatch issue. Moving in a market setting
19 from an economic dispatch system to an
20 environmental dispatch system if you will
21 carries with it some cost obligations,
22 potentially some reliability issues.

1 The actual choice of baseline
2 itself is contentious and probably didn't have
3 to be.

4 My state started at about 2000 was
5 almost 69 percent coal. We're down to about
6 46 percent. We have an aggressive renewable
7 portfolio standard that primarily wind has
8 been coming online over a period of years.
9 And it's not clear that some of those actions
10 are properly credited.

11 That's, I think, just a function
12 of this choice of baseline, or confusion over
13 the baseline year.

14 At the end of the day we have to
15 come up with a state-based plan. And we had
16 the option of dealing with a regional or a
17 multistate plan. EPA has provided us with
18 that opportunity.

19 Before we can even think about a
20 multi-state plan we're trying to understand
21 the economics of where we are as one single,
22 isolated state so at least we have a baseline

1 to compare some multi-state compliance option
2 with.

3 The system has evolved as a
4 utility system, not as a state-based system.
5 The state-based plan here is awkward. It
6 would be more logical to enter into a multi-
7 state plan.

8 Xcel Energy in my state covers
9 five Upper Midwest states. Eighty percent of
10 their generation is in Minnesota.

11 All of the nuclear is in Minnesota
12 so the credit for nuclear would fall in my
13 state. The coal is in my state so the lack of
14 credit falls in my state.

15 We have utilities that have
16 invested heavily in North Dakota with wind
17 generation. And as originally released the
18 rule would put the credit for the wind into
19 North Dakota, denying the ratepayers the
20 opportunity to see credit for what they've
21 paid for.

22 Now, we hear that EPA will resolve

1 that particular question, but the point is
2 that the system has evolved on a utility
3 footprint basis, not on a strict state basis.

4 I can imagine us having multi-
5 state plans, or negotiating multi-state plans,
6 but I don't think it will be easy.

7 And I'm not sure that the extra
8 time that EPA has allowed for this sort of
9 conversation will be enough to allow that kind
10 of plan to necessarily come to fruition.

11 So, with the help of MISO we're
12 all right now trying to assess where we are as
13 individual states based on the draft rule.

14 The individual states are
15 absolutely going to be making comments. The
16 extra time is helpful for making comments.

17 And then we'll begin to talk about
18 whether we can have states in twos or threes
19 or fives, or conceivably the whole MISO
20 footprint operate as a compliance unit. That
21 will be an interesting challenge.

22 When we move onto our regular

1 business we're a state with a pretty regular
2 cycle for resource planning. We have our
3 utilities in every 2 to 3 years to talk about
4 the future, looking out 15 years in advance
5 and focusing on a 5-year near-term action
6 plan.

7 We don't feel that we can wait for
8 the final rule, delay these resource planning
9 proceedings and wait for the final rule.

10 We're going to go ahead and we're
11 going to assume the draft rule is the final
12 rule for the sake of this resource plan. Not
13 to order particular generation decisions, but
14 to make sure that we have a broad, open
15 dialogue with all the stakeholders who take an
16 interest in resource planning, and to keep
17 iteratively improving these resource plans as
18 time goes by.

19 There are lots of concerns about
20 resource adequacy and reliability. Are we
21 going to be able to manage the MISO market in
22 this new world?

1 A lot of our utilities at points
2 in these resource plans know they're a little
3 short of generation, maybe for the resource
4 adequacy mandate, and they'll go to the
5 market. They'll go into the wholesale market
6 for capacity.

7 We don't know what the market's
8 going to look like. We've had a very nice
9 cushion in the Midwest like in other parts of
10 the country.

11 We know that that's coming down to
12 something closer to the 1 in 10 standard. We
13 don't know if we'll even be dipping below that
14 standard as time goes by.

15 So, again, with the safe, reliable
16 part of this we're very concerned about
17 implementing the rules and keeping the lights
18 on.

19 In terms of costs we'll get a
20 window, a peek into that through these IRP
21 processes.

22 We know that there's strains put

1 onto the markets and the market prices are
2 changing. I think you can see changes in the
3 forward capacity auctions at PJM that start to
4 reflect the implementation of MATS, not yet
5 111(d).

6 I think you're actually even
7 seeing the prices in the MISO capacity market
8 which is thinly traded start to go up, perhaps
9 in response to an opportunity to trade across
10 the MISO-PJM border, or maybe because of these
11 same kinds of pressures.

12 There's also an interesting
13 question that could come up about territorial
14 or jurisdictional disputes between FERC and
15 EPA.

16 It's entirely conceivable that a
17 plant is to be retired based on 111(d) but
18 that retirement places a reliability
19 constraint on the system, and that FERC might
20 decide to order that plant to run. And I'm
21 not sure the lawyers have figured out yet
22 who's going to win in that jurisdictional tug

1 of war.

2 And then lastly, a point that
3 Commissioner Clark raised which is interesting
4 in my state is the question of whether a state
5 plan might unwittingly cede some state-based
6 authority to the federal government.

7 We have an off-ramp in Minnesota
8 for our renewable standard. If the cost of
9 complying with our renewable standard becomes
10 too onerous utilities or conceivably consumers
11 could petition us for relief from the rule.

12 If we put our renewable standard
13 into part of our state plan and we file it at
14 the EPA, it's not clear whether we have to go
15 ask the EPA to implement our own state law to
16 exercise an off-ramp.

17 We're trying to sort out all of
18 these issues as we move forward.

19 I was in China in August. It was
20 a DOE-funded mission. We had five state
21 regulators and Joe Giove from the Office of
22 Fossil Energy at DOE was there.

1 We had a really excellent
2 opportunity to have some very frank and honest
3 dialogue with any number of groups. I'll show
4 a list in a minute - thought leaders,
5 utilities, regulators.

6 We were given really amazing
7 opportunity and access to plants. We
8 actually, at Sanmen we actually were in the
9 containment unit of one of the AP1000's as it
10 was being constructed.

11 One of my colleagues noted that
12 he's never been on a tour where you really
13 needed the hard hat before, but this was one
14 where it was a good idea. There was things
15 falling on us and it was definitely not an
16 OSHA-approved kind of a situation.

17 They're under some interesting
18 pressure. Low growth, yes. A rising middle
19 class. An expectation of prosperity. Air
20 quality issues in the major cities. They're
21 definitely pursuing every generation
22 technology you can imagine in a big way.

1 But there's also talk of some
2 reform inside, say, the natural gas sector,
3 delivery of gas, ownership of gas.

4 We caught little whiffs of
5 potential changes in the energy sector that
6 are interesting.

7 At the end of the day a mission
8 like this is a great chance to exchange ideas
9 and maybe talk about best practices.

10 So, among the groups we talked to
11 were the American Chamber of Commerce.

12 There are independent power
13 producers in China. I didn't know that. They
14 fit in around the edges of the five major
15 generating state-owned entities.

16 China 5e and the Beijing Energy
17 Club are sort of these groups of thought
18 leaders, academics, industrial folks who are
19 interested in change. We had some very, very
20 interesting meetings with these folks.

21 And then we did get to Huaneng
22 Power's GreenGen IGCC Plant, the Shidongkou

1 carbon capture facility.

2 We met with State Grid. State
3 Grid has -- about 30-35 percent of the
4 electricity for Shanghai comes in through this
5 one converter station from the Three Gorges
6 Dam and Sanmen Nuclear.

7 So here's my travel pictures from
8 the summer. This is the delegation on the
9 left. Commissioner Brevitt from Kentucky,
10 Commissioner Jones from Washington,
11 Commissioner Anthony from Oklahoma,
12 Commissioner White from Michigan. Joe Giove
13 is the tall gentleman on the left. And then
14 two representatives of Gee Strategies who took
15 care of our logistical issues. Okay, enough
16 of the travel photos.

17 A couple of other things that are
18 probably good to talk about. I'll jump down
19 to rail because that was on the list. It's
20 been mentioned before.

21 It has been an issue in Minnesota
22 in particular. And this is not new. In fact,

1 our Governor and our two Senators just sent
2 another letter to the Surface Transportation
3 Board asking for some more dialogue on the
4 issue.

5 We do have coal plants that are
6 closed temporarily to preserve their coal for
7 the winter. We don't say polar vortex in
8 Minnesota. We call it winter. It's just part
9 of life.

10 (Laughter)

11 DR. BOYD: But we're trying to
12 move iron ore from the northern Minnesota
13 mining. We're trying to get propane into the
14 state for rural areas for heating. We're
15 trying to get last season's grain out by barge
16 and by rail. And we are trying to get coal.

17 And with the Bakken oil it's a
18 complicated situation. It's not that it isn't
19 being addressed, it isn't being discussed, but
20 at the point we have smaller-scale coal
21 facilities shutting down temporarily it's
22 certainly something that has our attention.

1 We receive weekly reports from our
2 utilities on their coal stockpile so that we
3 can keep on top of this.

4 It's not being ignored, the issue
5 isn't being ignored, but it is one that as we
6 move into winter will be important.

7 Distributed generation I'll
8 mention. It's a little off-topic but rooftop
9 solar.

10 In Minnesota we have a new solar
11 mandate. There's a lot of conversation about
12 bringing more solar into the generation mix.
13 And the ongoing dialogue of what this means to
14 utilities and their business model.

15 This is something we really have
16 addressed in a light way in Minnesota. We're
17 not sure what the impacts are. We're not even
18 sure what the penetration -- at what point
19 penetration becomes really meaningful.

20 I will note that in Minnesota we
21 adopted by statute a tariff for our solar
22 called the Value of Solar -- it's just a

1 methodology at this point. It isn't actually
2 an official tariff.

3 But this notion of pricing solar
4 power based on its value, its net of cost and
5 benefits, as opposed to pricing this
6 electricity on its cost basis in some way.

7 And it begs the question, it opens
8 a new paradigm whether we're going to talk
9 about the value brought by different
10 generating sources for other regions.

11 Do we want to have a value of
12 storage if we get storage brought into the
13 system? Do we want to talk about the
14 particular value that base load generation
15 brings to the system?

16 It's not clear to me whether we'll
17 go forward, but we've kind of cracked the door
18 open for a different kind of conversation.

19 And arguably PJM's new capacity market product
20 which will provide greater value for resources
21 that can arrive on time, on peak are leading
22 that exact direction.

1 I think the market issues we've
2 talked about. No one has capacity markets
3 figured out. Heaven help us, someday we'll
4 figure this out in a way that serves all the
5 purposes. That's an ongoing issue.

6 Demand response. Vacating Order
7 745 from FERC has created a lot of trouble at
8 PJM. They rely on their marketed demand
9 response for meeting peaks.

10 Last winter when things were at
11 its worst the demand response was a tool that
12 kept them going, as were inter-system trading.
13 It was interesting.

14 And I'll mention another thing.
15 In the dead of winter, one of those coldest
16 days -- you'll remember this, Brad -- the
17 Trans-Canada pipeline that brings a lot of
18 natural gas to Minnesota primarily for home
19 heating purposes went out of service. Well,
20 it blew up.

21 It took four pipelines out for a
22 short period of time and it put an interesting

1 stress onto -- in Minnesota the system broadly
2 for the region, the gas system worked pretty
3 well.

4 They back-streamed gas from
5 Michigan towards Minnesota to keep pressure in
6 the pipes.

7 Everyone who's interruptible was
8 interrupted. Everyone dual fuel was shifted
9 to the other fuel.

10 Residential customers were asked
11 to bring down the temperature of the
12 thermostats and we all made up.

13 But it does show that you never
14 know what's going to trigger some sort of a
15 reliability event inside a system. And were
16 we more reliant on natural gas for electricity
17 we might have been impacted rather
18 significantly by that.

19 We'll skip the court actions and
20 maybe just try to have a little bit of a
21 dialogue.

22 Thank you, again. I apologize for

1 the redundancy but these are important issues.

2 And thank you.

3 (Applause)

4 MS. GELLICI: Thank you, David.

5 Any questions for David?

6 MR. KAPTUR: Dr. Boyd, thank you.

7 I'm Casey Kaptur with RungePincockMinarco.

8 Most of the popular media shows
9 air pollution in China looks like particulate.

10 Is that coming from coal plants?

11 Is there an opportunity to retrofit with
12 precipitators and baghouses and that kind of
13 thing? As opposed to shutting these units
14 down.

15 DR. BOYD: I'm not an expert even
16 though I just passed myself off as one, but I
17 think it is a lot of particulate matter.

18 We had one particular day in
19 Beijing where I think it was Joe who's been to
20 Beijing many times said, "I've never seen
21 those mountains off in the distance because
22 the haze is typically significant enough to

1 obscure vision."

2 My sense is it is a lot of
3 particulate matter. Could it be replaced, or
4 could they retrofit? I'm sure they could, but
5 they're in the middle of -- they're building
6 28 nuclear plants right now. Heaven knows how
7 many coal plants are going in. And I think
8 their focus is a lot more on new generation as
9 opposed to retrofits.

10 I do know that in some of the
11 bigger cities they're shutting down the coal
12 plants that are proximate to the cities for
13 the air quality reasons.

14 I think it may be more a
15 replacement cycle than a retrofit cycle. But
16 I'm sure there's others in the room who are
17 much more knowledgeable about this than I am.

18 DR. BURKE: Hi, my name's Frank
19 Burke. I'm retired from Consol Energy. I do
20 a little bit of consulting for them, but my
21 opinions here are my own.

22 You mentioned a situation that I

1 think was really interesting. Of all the
2 unusual things the EPA did in the 111(d) rule,
3 ignoring interstate electricity trade was to
4 my mind one of the most unusual.

5 And international electricity
6 trade for that matter as well is an extremely
7 important thing in this country, particularly
8 for states that are big exporters or big
9 importers.

10 And you mentioned one specific
11 instance of that where you've got wind
12 generation in North Dakota. You're importing
13 it in Minnesota.

14 And I thought I heard you say that
15 you've had some dialogue with EPA about that,
16 and you perhaps see some way to resolve that.

17 Do you have any sense for whether
18 they're going to go back and look at that
19 issue in a more serious manner? Because I
20 think that's an overarching issue that we're
21 looking simply at generation and not
22 consumption in the state. It creates numerous

1 anomalies within this whole goal-setting
2 process.

3 My sense from EPA is that they're
4 definitely reconsidering that cross-state
5 border rule where renewables are involved.

6 Now, the natural next question is
7 what makes wind power different than other
8 generation. Should the nuclear that's in
9 Minnesota that's ultimately sold into
10 Wisconsin, shouldn't that transfer as well?

11 They were a little more cautious
12 about that piece of it for some reason.

13 And Minnesota, our upper midwest
14 cluster, we buy power from Manitoba. We use
15 the hydro out of Manitoba. And we asked them
16 what about the international.

17 There they kind of immediately got
18 a little more firm. There's apparently some
19 part of the law that mandates that you have to
20 be dealing with U.S. jurisdictional utilities
21 inside these conversations.

22 So, the notion of international

1 getting in seems to be the least likely of the
2 three. The renewables seems high, the cross-
3 border coal, nuclear, gas, I think they're
4 fiddling with that idea.

5 But the origin of the state
6 boundary is a Clean Air Act problem. I mean,
7 the Clean Air Act is defined as and typically
8 dealing with a point source where you can put
9 scrubbers on a stack, or particular equipment
10 on a generating facility within a state and
11 the compliance is state-based.

12 We're dealing with a different
13 critter now in 111(d) with the CO2 and the
14 mobility of the CO2 and the issues. And it's
15 just an enforcement action that isn't well
16 matched to the verbiage, at least that's my
17 take.

18 MR. HOOKS: Hello, Mr. Chairman.
19 I'm Steve Hooks. I'm with Coal and Energy
20 Price Report. And I hope I'm wearing
21 regulation Minnesota Vikings colors so I can
22 get an especially insightful answer from you.

1 Which plants remain down and what
2 is the timetable for restarting them?

3 DR. BOYD: The specific plants due
4 to the coal?

5 MR. HOOKS: Yes.

6 DR. BOYD: I can't give you the
7 exact names. I could find them and get them
8 to you.

9 There are at least three small
10 plants that are in Minnesota Power's territory
11 in the northern part of Minnesota. Those are
12 the ones that are the immediate ones.

13 Others are moving on a modified
14 schedule. It depends on the size of the coal
15 pile. But I can probably get you the exact
16 plants.

17 They are not the big -- Boswell is
18 a large generating facility in that part of
19 the state. We're not talking about the 1,000
20 megawatt. We're talking about smaller, 150
21 megawatt.

22 MR. HOOKS: What is the timetable,

1 do you think?

2 DR. BOYD: It's indeterminate. It
3 really, it seems to depend on how well we can
4 -- and this has been true while we've been
5 monitoring the rail situation. It ebbs and
6 flows. So it will depend entirely on the
7 delivery of coal.

8 And as for the Vikings, they need
9 all the help they can get.

10 (Laughter)

11 MS. GELLICI: So, David, to close
12 this out I'll ask you what are the one or two
13 things that most impressed you or surprised
14 you about energy developments in China on your
15 trip?

16 DR. BOYD: What surprised me was
17 how open everyone from developers and power
18 companies and the state-owned entities were.

19 They really weren't hiding
20 anything, they weren't couching their answers
21 to questions. They seemed very direct and
22 very open as they engaged.

1 And they were very interested in
2 some issues of regulation from our side which
3 is what -- this notion that maybe they're
4 considering some changes to the way they're
5 doing business.

6 That surprised me. I expected a
7 much more cautious public face to the groups.

8 What impressed me was that they
9 really are dealing in a very sophisticated
10 manner with their growth.

11 It's just happening so rapidly,
12 you know, it's like a large-breed dog trying
13 to grow into its legs. They're kind of
14 stumbling at times because they're moving
15 along so quickly.

16 There's some challenges there that
17 they understand.

18 MS. GELLICI: Well put. Thank you
19 again for your leadership at NARUC as well.
20 Thank you.

21 DR. BOYD: Thank you.

22 (Applause)

1 VICE CHAIR DURHAM: Thank you, Dr.
2 Boyd, for being here this morning with us.

3 We're going to take about a 20-
4 minute break. And I'd ask you to be back at
5 11 so we can conclude the session this
6 morning.

7 (Whereupon, the above-entitled
8 matter went off the record at 10:41 a.m. and
9 resumed at 11:05 a.m.)

10 MS. GELLICI: Thank you. We have
11 two exceptional speakers to round out or
12 program this morning.

13 We'll begin with a presentation
14 from Julien Dumoulin-Smith who is executive
15 director of electric utility equity research
16 for UBS Securities.

17 Julien has been covering the
18 electric utilities sector since 2007. It
19 didn't take him long to be ranked as a rising
20 star among utility analysts by Institutional
21 Investor magazine. In fact, he's been ranked
22 as a rising star for three consecutive years

1 running, 2010 through 2012.

2 He's been ranked among the top
3 three stock-pickers for the utilities sector
4 by numerous prestigious organizations
5 including the Wall Street Journal.

6 I've had the pleasure of working
7 with Julien as a speaker at a number of
8 industry events that I've hosted.

9 He's a brilliant man with a unique
10 ability to translate that brilliance into a
11 language that's comprehensible to us financial
12 market-challenged mortals, Julien.

13 So, would you please join me in
14 welcoming Julien Dumoulin-Smith. Thank you.

15 (Applause)

16 MR. DUMOULIN-SMITH: So, good
17 morning, everyone. Thank you for taking the
18 time.

19 Again, Julien Dumoulin-Smith,
20 electric utilities analyst. So I'm going to
21 be taking this in a little bit of a different
22 perspective. I focus on power, but maybe

1 that's what counts.

2 And again, for those of you who
3 get my research or did not, feel free to send
4 me an email afterwards if you'd like to be
5 added. We publish pretty much daily on a
6 variety of issues.

7 So in some senses in coming here
8 and providing some context I was like what are
9 the key issues that we've been writing about
10 in the last three to six months that are kind
11 of pertinent to the financial outlook for not
12 just the power industry, but kind of bringing
13 it back and saying what matters for coal here.

14 And I think frankly they're fairly
15 -- I mean, clearly interrelated.

16 So, I always start every
17 presentation, let's talk about the commodities
18 and where we stand because I think that is so
19 central in understanding where we are.

20 And I probably take a little bit
21 of a different perspective from a lot of folks
22 out there.

1 And actually, I think the point
2 is, and it's really clear on that slide of
3 heat rates. Heat rates are hitting multi-year
4 highs.

5 And you might be like really, it's
6 that good? But yes, absolutely.

7 I mean in some senses I literally
8 -- I was talking to a commodity trader last
9 night and he called this the Golden Age of
10 power in some senses.

11 And it doesn't feel that way
12 necessarily, but in some senses the heat
13 rates, you know, frankly I can't remember the
14 last time, I'd say like -- I can't remember
15 the last time. But then again we're in
16 unprecedented territory.

17 Power has meaningfully recovered
18 at least off of the lows in the last few
19 months. Clearly not back to 2008 highs, but
20 again, we'll take what we can get.

21 And I think the point is dark
22 spreads are real at this point. We actually

1 have something to be spoken for here.

2 I think, you know, and that's not
3 just -- so not just out East. So I use
4 eastern dark spreads here to kind of
5 illustrate even in the more challenged markets
6 we have positive dark spreads.

7 So I think the point is we're
8 living in a fairly for coal generators. It
9 may not necessarily feel always that way, but
10 at least from the outside when you're looking
11 at the profitability, it's there.

12 I also interject here a certain
13 element of optimism around the Illinois Basin
14 thesis. There too you obviously have positive
15 sparks, or rather dark spreads. Pricing
16 itself is relatively modest.

17 So I think from, again, I'm taking
18 the other side of the view here. Modest
19 pricing in my view keeps dark spreads positive
20 and keeps the coal gen going.

21 So we could go off on a tangent on
22 this, but I'm just going to keep at it. I'm

1 going to have a lot of different things
2 sprinkled on the slides. And then frankly, we
3 can talk about them afterwards.

4 But I think the other side of the
5 coin here is given how constructive the power
6 price environment has been of late -- and
7 again, I think this is a little
8 counterintuitive -- spark spreads are at
9 multi-year highs.

10 PJM sparks are now above \$20 a
11 megawatt hour. And to put that in context,
12 you're starting to hit what we call new
13 entrant economics for gas.

14 And in some senses you talk a lot
15 and we've talked a lot about coal to gas
16 switching over the last few years.

17 But I think the bigger point that
18 I would make is power prices relative to gas
19 are at a point in which you can actually begin
20 to articulate that the economics of investing
21 new capital.

22 So it's not just the arbitrage

1 between the daily fuels, but the ability to
2 earn a return on substantial capital invested
3 to build new gas is actually there.

4 And I think that's what's a little
5 bit -- in some senses that's the distressing
6 side of this. It's like to what extent can
7 economics get better.

8 Think about this in the coal
9 industry. Once we get to economics that
10 drive, that provide a meaningful return on
11 investment that's kind of by definition the
12 top of the cycle because folks are going to
13 respond. People are going to put, you know,
14 they're going to put the shovels in the ground
15 and start turning up dirt.

16 And the same example is here. The
17 analogy between the coal and the power
18 industry exists.

19 And so I show that first slide. I
20 show here an example of Calpine building on
21 brownfield economics in Pennsylvania.

22 Again, the return profile there is

1 exceptional. You're talking about a 20
2 percent return for equity, 11 percent
3 unlevered returns. I mean, those are -- I
4 mean, again, this is not the usual, this is
5 the exception, but I think it's worthwhile
6 noting that that's the kind of economics new
7 gas lines are seeing.

8 I think even more controversially
9 Exelon in the last couple of weeks here has
10 talked about building new gas-fired generation
11 in Texas.

12 And think about this. This is a
13 state without a capacity regime. And frankly,
14 where sparks have been meaningfully lower than
15 a lot of other states. Obviously they're
16 facing their own resource adequacy issues.
17 But I think here too you're seeing brownfield
18 economics on new gas plants work.

19 Again, it's more modest. What is
20 your threshold for investment in a market that
21 is as volatile as Texas? Is it really going
22 to be a 14 percent return? I mean, again,

1 these are the kinds of questions that at least
2 I struggle with day in and day out.

3 In this case, again, it's
4 worthwhile taking note that folks like Exelon
5 who don't have a big incumbency in the state,
6 who want to get bigger in the state are
7 ultimately making the decision, you know what?
8 That does meet our cost of capital thresholds
9 and we're moving forward with it.

10 So, it's not just a coal to gas
11 game in the Northeast anymore. It's spreading
12 elsewhere, predicated on not just cheap gas,
13 but more importantly some brownfield economics
14 coupled with relatively good power prices.

15 So, I also want to emphasize
16 another side of the equation here. And again,
17 this probably brings back to the some of the
18 discussion you all were having earlier.

19 And broadly over the sector the
20 last few months is it's not just Texas and New
21 York that are doing -- it's not just PJM and
22 the Mid-Atlantic and Texas, but a lot of other

1 markets are doing well.

2 And there's another dynamic at
3 play here. And I think it drives back to the
4 notion of fuel security.

5 Why is the Northeast power prices
6 up the most over the last few months? Why is
7 it through the roof in some respects?

8 Look at the jump in power prices
9 in Mass Hub, right, so that's Boston, New
10 York, Upstate. I mean, those are meaningful
11 increases. And it's really driven by gas.

12 Now, that's Algonquin gas. That's
13 end of the pipe kind of gas. And I think the
14 point being made here and some of the great
15 debates is really when do you actually get
16 these bottlenecks resolved. And frankly,
17 we're pretty concerned.

18 I don't necessarily see New
19 England getting its act together about
20 building out new pipe anytime soon.

21 In fact, let me make the punch
22 line here. Restructured power markets have

1 yet to address how they procure gas.

2 Let me make this point even
3 further. In the coal industry you all have to
4 pay for your transportation, and it's not a
5 given, and you've got to figure out where the
6 rail links are coming from.

7 In the gas industry from a certain
8 perspective we've been living on -- they've
9 been living on sort of borrowed time, living
10 on sort of borrowed preexisting
11 infrastructure.

12 I think the point is if you're
13 going to compete coal versus gas you've got to
14 reconcile who's paying for that pipe at the
15 end of the day and how is it getting, you
16 know, is that implicitly getting subsidized by
17 the ratepayer through a gas LDC and that's how
18 they're getting their supply funneled back
19 into the electric markets?

20 I think this is a really thorny
21 issue the competitive markets in general are
22 going to have to hash out.

1 And frankly, even in a
2 restructured market. Think about this. An
3 electric utility is going out to procure firm
4 transportation for a new gas plant.

5 Where is that coming up within the
6 context of these IRPs? Again, you want to put
7 this apples to apples. I throw it out there
8 as a major issue over the next few years. And
9 New England is the case in point.

10 Conversely, how are the economics
11 so attractive in the Mid-Atlantic? Frankly,
12 it's the cheap gas. You've heard it before.
13 You're seeing it here. And I emphasize the
14 recent trend here is a precipitous decline in
15 constrained gas.

16 The point I'm making is frankly,
17 at least from a consumption perspective it's
18 just not getting to where it needs to go. And
19 you're seeing a thesis not necessarily of
20 we're building pipelines to get gas out of
21 there, but it's a gas by wire thesis that is
22 taking effect. If we can't build a pipeline

1 we'll build a transmission wire and get it out
2 of here this way.

3 And so frankly, that's exactly
4 what you're seeing with the falling off of
5 Dominion South gas prices, TETCO gas prices.
6 And that's exactly why you're seeing so many
7 new gas plants being announced for late in
8 this decade.

9 In some senses you already see the
10 boom/bust already reflected in the gas
11 markets. So, big debate, gas pipeline
12 infrastructure. We'll move on.

13 I think in aggregate what you want
14 to realize is that new gas generation is
15 already meaningful across a lot of the Mid-
16 Atlantic. It adds about a B and a half a day
17 already. That's probably going to accelerate
18 to more than two B's very shortly.

19 And the question is does this gas
20 by wire thesis start to address the bottleneck
21 issues themselves. To what extent can you
22 continue to build more gas plants adjacent to

1 fields, and ultimately at what point do you
2 actually normalize your gas prices. That's
3 something you should be very -- I would be
4 focused on.

5 And I think from a timeline
6 perspective what's important just to realize
7 if you look at the years on that chart is that
8 we see the bulk of the retirements on the coal
9 side for MATS happening next year.

10 In some senses, at least in the
11 financial markets we're kind of assuming, it's
12 kind of been there, done that. We're kind of
13 presuming it happens. The question is what
14 happens after.

15 And what we're seeing, again, I
16 really want to emphasize commodities happen in
17 cycles and we're seeing the cycle right now.
18 I'm talking about the top of the power cycle.
19 We're talking about a lot of retirements next
20 year. That's going to drive a lot of positive
21 things for pricing.

22 But I think conversely when you

1 think about the power cycle, when you think
2 about the gas cycle you've got to recognize
3 the timing of new gas and coal does not match.

4 New gas is very meaningfully
5 weighted towards '17 and '18 and that's really
6 when you get the replacement coming in. So I
7 think it will be interesting to see what that
8 does on the margin for the economics of coal
9 two or three years down the line in a post-
10 MATS world.

11 And I think at the end of the day
12 you also want to talk about what that does for
13 gas prices two or three years down the line.

14 In some senses cheap gas prices
15 are not immediately internalized in these
16 markets and it takes some time for that demand
17 response to happen.

18 So, I move on. I make the point
19 coal to gas switching, conversions are
20 happening to a meaningful pace. We'll
21 continue to see that happen.

22 And then I wanted to talk about

1 another big subject, another controversial one
2 you all may have heard of, so-called capacity
3 markets.

4 I emphasize, and I wanted to just
5 hit an issue right off the bat because I think
6 it's a really interesting one.

7 Of late there's been a lot of talk
8 across these capacity markets. What do we
9 need to do to ensure that we actually have
10 adequate fuel supplies onsite?

11 After last winter we had the polar
12 vortex, et cetera, et cetera. The talk of the
13 town at least within the power world has been
14 we're going to reform these markets to
15 incentivize folks and have real penalties if
16 you're not there to perform.

17 And so I think one of the points
18 that I would encourage you all to be aware of
19 is by driving up prices today you're going to
20 see more new gas generation announced on the
21 back of a lot of these reforms.

22 So, it may help kind of in a

1 these markets to do it.

2 And so I think the reality is you
3 need to drive up consumption. And conversely,
4 some of the rules that are contemplated would
5 effectively result in a higher reserve margin.

6 So, anyway, it's not just PJM that
7 has a had a positive trend here.

8 And maybe the punchline in general
9 in capacity markets is that they are heading
10 upwards.

11 And for the most part you're going
12 to start to see the peak of the market here
13 too.

14 I think the theme that I want to
15 leave you with is pricing is actually
16 exceptionally good for power and is looking
17 quite good for capacity.

18 New York has peaked in some
19 senses. Prices have sort of doubled or
20 tripled off of their lows. And PJM similarly
21 has tripled off of its lows.

22 So I think the point, you know

1 again, it may not necessarily feel this way
2 but the reality is pricing trends are pretty
3 good.

4 If I were to include a price for
5 2018-2019 it would probably double again. So,
6 the reality is it looks pretty robust.

7 New York is improving, New England
8 is improving as well, have their own issues.
9 Again, the broader question I'd ask you in New
10 England and again, the point I made earlier is
11 how do you build a new gas plant in New
12 England if you don't have supply? And if you
13 don't build a new gas plant then what do you
14 do? Because it's not like you're going to do
15 more demand response in this market after
16 Order 745.

17 Or are you really going to do
18 strictly renewables? Again, I don't
19 necessarily think so. So, you've got real
20 issues there.

21 And I think you're going to see it
22 in pricing. You're going to see New England

1 pricing continue to trend up materially
2 higher.

3 And then lastly, I think MISO very
4 well for the coal world, you're going to
5 continue to see pricing improving here.

6 The reality is I think in some
7 respects it doesn't make sense to contract the
8 prices that exist out there currently.

9 And frankly, the bilateral markets
10 which are pretty opaque are meaningfully
11 higher than what we've seen sort of registered
12 in some of these more formal capacity auctions
13 that kind of reflect that supply-demand
14 dynamic.

15 So, I think 2015 through 2017 is
16 probably again going to be the peak of that
17 market.

18 And again, as you think about it
19 sort of intuitively, again, your MATS
20 retirements are around the corner.
21 Intuitively prices should peak around that and
22 subsequently when you have new gas coming in

1 in 2018 and 2019 prices will alleviate.

2 But I think in some senses we have
3 yet to see the full cycle of how good things
4 are going to get.

5 I emphasize this point, perhaps a
6 little bit too much of an acute point. For
7 you all it's more of a power point.

8 But I emphasize bidding rules are
9 what are really dynamic right now in the power
10 world.

11 And what do I mean by that? What
12 is a coal plant allowed to charge, allowed to
13 bid into energy markets and capacity markets
14 to recoup its investments?

15 I think that is very much under
16 debate at PJM, at FERC, at DOJ. At every
17 level of the institutions here you really want
18 to be asking this question.

19 Because again, if you're not
20 getting adequate consumption today and you're
21 asking well, why aren't we keeping these
22 plants around. Why are we not investing more?

1 You should be also looking at the underlying
2 constructs with which we're dealing with.

3 And I think the broader point here
4 is the bidding rules really dictate this.
5 This goes back to Power 101, how are you
6 allowed to bid it. And the reality is it's
7 effectively by definition for many coal assets
8 required to bid to basically a cash flow,
9 breakeven level, and frankly that's probably
10 unsustainable and we're going to see that
11 revised higher.

12 Beyond -- so transitioning a
13 little bit more to the regulatory side.
14 Again, it's kind of consistent with what we've
15 been talking about before.

16 Beyond MATS, what are the next
17 challenges for this industry? I think the
18 broader point I would leave you with is I'm
19 not as necessarily focused on eastern coal as
20 now I am on western coal. I think a lot of
21 the regs coming down the pipe are really going
22 to be focused on regional haze and 1-Hour SO2

1 and 1-Hour NOx.

2 I mean, to a certain extent you
3 can almost categorize the eastern portfolio as
4 having been largely -- as having sort of pro
5 forma for next year as being compliant from a
6 certain perspective.

7 The key question is for those
8 units that don't have SCRs or don't have
9 scrubbers in the West. And that's going to be
10 the real battleground. So, I think that's a
11 major point you want to pay attention to.

12 The carbon rules are obviously the
13 other side of this. There's been a lot of
14 debate about it.

15 I'd emphasize just a couple of
16 points.

17 I think the first is this is just
18 -- in some respects at a high, high level the
19 comment I would make is this seems like a
20 glorified coal to gas switching experiment.
21 It seems highly concentrated in areas that
22 have existing gas capacity.

1 And the question again comes back
2 to deliverability. If you're going to engage
3 in wide-scale coal to gas switching the
4 question is can you get the adequate fuel.

5 The focus is on the Southeast. I
6 think the comments before, again, I think
7 that's where you want to ask the questions.

8 And I think the broader question
9 that I at least -- the broader reaction. If
10 you're going to seriously sit down and say how
11 do I achieve this. And you're saying, well,
12 I can't actually improve my heat rate on my
13 plant, et cetera, et cetera.

14 Then you're going to back into
15 necessarily I need to plug my hole with
16 renewables. And that hole in some senses is
17 going to be the pricing point.

18 How expensive are renewables going
19 to be? What is the tax scheme going to be in
20 place at that point in time that I can get tax
21 credits out of PTCs or ITCs as it may be from
22 the government? I think that's going to be

1 the big question.

2 And then lastly, again I think the
3 question comes back to the westward retirement
4 thesis.

5 I mean in some respects, and again
6 I'll probably introduce the next slide here.
7 Well, we talk about specific companies. We
8 talk about what the rules are.

9 And I want to get to my Texas
10 slide. There it is. Because I think Texas in
11 some respects is now going to be the big focal
12 state for EPA.

13 And maybe you heard it here first.
14 Maybe I'm a few years early. But I think in
15 some respects the point I would make is the
16 Casper debate that we had a few years ago is
17 probably going to come back in some
18 manifestation.

19 Is it exactly Casper? Not
20 necessarily. Call it Casper v 2. Call it 1-
21 Hour SO2. Call it regional haze. Call it
22 what you like, some rule is going to have a

1 triggering effect. It's going to challenge
2 the state again.

3 And we're going to be back right
4 where we were in the Northeast talking about
5 what are the applicable rules, how do we think
6 about equitable impacts both from a state
7 perspective, at a federal level.

8 And I think ultimately when you
9 put it in the context of Texas it's going to
10 be a lot more challenging. You don't have
11 plentiful, cheap natural gas adjacent to your
12 plants like you did in the Northeast. It made
13 it -- let's put it palatable. Again, that's
14 a very broad term.

15 But especially relative to Texas
16 where you're already sort of on the friz with
17 the reserve margins, you don't have a capacity
18 compensation structure to kind of get you --
19 at least provide some element of visibility.
20 It's going to be a very thorny issue.

21 So, the timeline is clearly up in
22 the air. But I tell you, at some point this

1 is going to be the real triggering question
2 for the western states.

3 In some sense it's going to be the
4 focal point for a lot of the debates that are
5 going on out west. We saw it before in
6 Oklahoma, we've seen it in other states
7 already. But I think this will be the big
8 one.

9 So with that, I think the broader
10 point that we're focused on of late is a
11 question of industry restructuring. What is
12 the appropriate compensation?

13 You know, I throw it out there.
14 You should pay attention to what's going on in
15 Ohio with FirstEnergy and AEP and DPL and Duke
16 trying to seek compensation.

17 Pay attention to the nuclear rules
18 that are coming out in Illinois.

19 Because again, the point is the
20 states are reaching a point in which they're
21 saying enough's enough, we need to compensate
22 these guys. We want diversity and we'll see

1 if that happens.

2 Again, we'll see if it happens at
3 an executive level, we'll see if it stays true
4 in the courts, but you should definitely pay
5 attention there.

6 The consolidation theme is another
7 major trend we've seen. We're going to
8 continue to see bigger and bigger IPPs. We're
9 going to continue to see bigger and bigger
10 coal companies.

11 The reality is if I sit on a \$1
12 billion cost structure and if I can cut my
13 costs by 1 percent or 2 percent that is
14 meaningful for my bottom line.

15 And you've seen it time and again.
16 You can list a number of transactions. And
17 it's going to continue until the point at
18 which regulators say you cannot have further
19 consolidation. And that's going to be an
20 interesting question down the line.

21 Coal transportation. Are they
22 playing ball? I think that's another major

1 issue that at least we've seen in the past.
2 I would argue we've kind of been there and
3 done that.

4 And then ultimately I think the
5 bigger point I would leave you with is, and
6 again, kind of looking towards the future, are
7 we really talking about coal to gas anymore?
8 Yes, to a certain extent.

9 Or is this really becoming a coal
10 versus renewables thesis, and should you
11 really be paying attention to whether or not
12 the PTCs get extended later this year more
13 than almost anything else?

14 The growth in renewables just
15 under current RPS offsets national growth in
16 demand for electricity through the decade.

17 I mean, that's a pretty staggering
18 statement. Think about the repercussions.
19 Think about who's really cannibalizing whose
20 market share.

21 And the point is don't ignore the
22 examples that you've seen in the nuclear

1 industry from this cannibalization and the
2 impact on the nuclear economics in the last
3 few years.

4 So, I'm going to try to tie it all
5 up together. It's been already a few minutes
6 here.

7 So, the bottom line is coal is
8 going to face pressure. Is it necessarily
9 from gas? Yes, but I think the broader thing
10 you should focus on especially from a policy
11 perspective is to what extent renewables will
12 continue to gain market share.

13 At PPA prices net of PTC, at \$15
14 or \$20 a megawatt hour utilities are going to
15 continue to sign up for renewables
16 irrespective of RPS. In fact, you're going to
17 see them achieve renewable standards ahead of
18 RPS.

19 Because the reality is the
20 government is giving the incentive to do it.
21 It displaces their commodity sensitivity.

22 For them they're highly aware and

1 they're kind of acutely sensitive to having
2 fluctuation of bills. If I can sign up a 20-
3 year PPA I don't care what the fuel source is
4 for \$20 or \$15 a megawatt hour I'm going to do
5 that. That's an incentive.

6 So, a key point is gas is the
7 central issue. The top of the market. The
8 consolidation is a major one. The coal to gas
9 debate is now renewables.

10 And perhaps a fifth one there
11 would really be are we going to see this
12 debate about regs shift westward.

13 So, with that I'll open up to any
14 questions. I tried to throw a lot at the wall
15 and hopefully engender some questions. Thank
16 you all.

17 (Applause)

18 MS. GELLICI: Julien tends to take
19 one breath at the beginning of his
20 presentation and one breath at the end here.

21 So, we will entertain some
22 questions. Anyone with questions? One in the

1 back, there we go.

2 MR. STARK: Mike Stark with Stark,
3 StartReports out of the National Press Club
4 reporting on the intersection of climate and
5 energy.

6 We've seen a series of coal
7 bankruptcies in the past few years. I'm
8 curious looking at market caps today and do
9 you see any big ones in the immediate future?
10 When I say immediate future, next decade or
11 so.

12 And if so, what does that do to
13 the ancillary industries?

14 MR. DUMOULIN-SMITH: So, let me
15 just be clear. My role and my function is
16 more on the power side than it is on the coal
17 side directly.

18 Now, that being said, we've seen
19 coal power bankruptcies as well in recent
20 years.

21 And I think the quid pro quo there
22 is I'm telling you about consolidation for a

1 reason, right? There is a clear need to drive
2 cost savings.

3 And if you can't necessarily get
4 it from your revenue side -- yes, you may be
5 getting it of late. The point I would make is
6 you're going to continue to consolidate the
7 sector because you can drive a lot of savings.

8 We've seen hundreds of millions of
9 dollars in cost savings come out of the deals
10 that have been announced in the last few years
11 alone.

12 So the point I would make is do I
13 necessarily anticipate bankruptcies? No, not
14 necessarily.

15 Could you talk about some
16 restructurings? Absolutely. But I don't
17 necessarily think that is going to be
18 disastrous by any sense.

19 And I want to emphasize this too.
20 Of the bankruptcies that we've seen these
21 companies ultimately come out perhaps
22 healthier.

1 In some senses, let me emphasize
2 this. Edison Mission went into bankruptcy and
3 came out and is now owned under NRG. NRG now
4 has capital to make those plants work and
5 retrofit them accordingly such that, again, I
6 think bankruptcy has sort of a pejorative
7 connotation to it.

8 I insert the word "restructuring"
9 because ultimately by addressing an
10 overburdened situation, taking away some of
11 the liabilities, adding a company or merging
12 with a company that has a balance sheet, you
13 actually keep some of these units around.

14 So, it's been interesting to see
15 it from the restructuring side. It's also the
16 consolidation side that you're going to
17 continue to see.

18 MR. HOOKS: Steve Hooks, Coal and
19 Energy Price Report.

20 I'm just under the impression, the
21 model and the stats you gave that, well, I
22 mean this is obviously for existing, or

1 surviving, I should say, coal-fired power
2 plants, capturing this.

3 I mean, this doesn't even consider
4 that any new coal plants will be built, right?
5 Because that doesn't seem very likely unless
6 there's a drastic change in policy from
7 Washington.

8 Also, I need your email address.

9 MR. DUMOULIN-SMITH: It's on the
10 front of the presentation. It's literally on
11 the first page. It's julien.dumoulin-
12 smith@ubs.com.

13 And separately, to answer your
14 question, we're not necessarily projecting new
15 coal.

16 I mean, I suppose the question is
17 -- maybe on the margin the question that I ask
18 is down the line if you see a reversal in gas
19 prices are you going to see companies that
20 have converted their boilers from coal to gas
21 contemplate different angles down the line.
22 Can you go back? That's the only angle that

1 I really see even on the margin that you could
2 bring it back.

3 MR. NARULA: Ram Narula, Energy &
4 Environment Consultants.

5 As we heard before under the new
6 requirement we will hardly see any new coal.

7 At the same time we have developed
8 technology like advanced ultra-supercritical
9 which will raise the efficiency all the way up
10 to mid-forties.

11 Do you anticipate any conversions
12 of the coal from the older plants which are
13 less efficient to almost a one-third more
14 efficient technology of today?

15 MR. DUMOULIN-SMITH: Right. I
16 mean, maybe the question is -- and it goes
17 back to the coal to gas conversion, and the
18 unconversion, or your question is does that
19 trigger NSR considerations, right, new source
20 review.

21 That's really going to be -- it's
22 almost like a judicial question rather than

1 saying an economic one.

2 And I'm hard pressed to say that
3 under the current administration they wouldn't
4 go after you on an NSR basis. That's -- so
5 I'd say generally no, unless you had a
6 different interpretation of it. But I don't
7 see it.

8 MS. GELLICI: Julien, thank you.

9 MR. DUMOULIN-SMITH: Thank you
10 all.

11 (Applause)

12 MS. GELLICI: And I would
13 encourage you to email Julien and get on his
14 mailing list. He does some of the best
15 analysis work and is gracious enough to share
16 it with everyone. So thank you again, Julien,
17 for being here. Appreciate it.

18 Before introducing our final
19 speaker I wanted to acknowledge two of our
20 National Coal Council members who were
21 instrumental in putting together today's
22 program.

1 Jerry Oliver is unfortunately not
2 able to be with us here today, but I would
3 like to acknowledge that he's helping support
4 Jackie Bird.

5 Jackie is in the back of the room.
6 You're already standing so I don't need to ask
7 you, but please join me in thanking her for
8 support in putting this program together.
9 Thank you very much.

10 In fact, Jerry Oliver had
11 recommended inviting our next speaker, Ken
12 Medlock. Jerry had seen Ken speak at another
13 event and was so impressed with Ken's
14 presentation he said we just have to get him
15 on our program next. So, glad to have Ken
16 Medlock with us.

17 Dr. Medlock is the James and Susan
18 Baker Fellow in Energy and Resource Economics
19 at Rice University's Baker Institute as well
20 as a senior director of the Center for Energy
21 Studies.

22 In his spare time Ken serves as an

1 adjunct professor and lecturer in the
2 Department of Economics at Rice University.

3 He has served as an advisor to the
4 Department of Energy and is currently the vice
5 president for conferences for the U.S.
6 Association for Energy Economics.

7 His primary areas of interest are
8 in natural gas markets, energy use and the
9 environment.

10 Would you please join me in
11 welcoming Dr. Ken Medlock.

12 (Applause)

13 DR. MEDLOCK: Well, thank you for
14 having me here and I'll try to breathe a
15 little bit more during my presentation. It's
16 kind of like drinking water out of a firehose.
17 Very, very nicely done.

18 I was asked to talk about natural
19 gas. And it was sort of vague in terms of
20 what exactly I should address.

21 Now having seen what Julien just
22 presented I think I could actually say a lot

1 more, particularly around some of the comments
2 in the Northeast.

3 I tend to concur with a lot of
4 what he said in terms of the concerns about
5 capacity constraints becoming more binding.
6 But in general what that does is incentivize
7 pipeline construction.

8 So I think he's correct. I think
9 we're right on the hub of a new sort of
10 transition if you will in the Northeast market
11 where you're going to see prices get out of
12 hand a little bit, and then you'll see some
13 capacity expansion.

14 So, you'll have to see looping
15 because those systems are actually already
16 maxed out.

17 So, there will be some substantial
18 investment in the midstream, but at the end of
19 the day natural gas generation is really
20 what's going to be driving the power markets
21 in the Northeast going forward.

22 That's all I'll say about that,

1 because what I want to do is sort of take a
2 step back and go a little bit farther
3 upstream.

4 Because at the end of the day when
5 we start talking about what's going on over
6 the last decade, in particular with regard to
7 natural gas markets it's useful to kind of
8 understand where we were so we can understand
9 where we are. And maybe we can have an
10 inkling of an understanding of where we might
11 be going.

12 And certainly energy markets in
13 the last decade have just been more dynamic
14 than I think any time in the last 50 years
15 just in terms of what's happening.

16 A lot of that's really been a
17 U.S.-centric story.

18 You go back just a decade ago,
19 there were 47 different terminals that had
20 been certified to import natural gas as LNG to
21 the United States.

22 So, that's remarkable,

1 particularly against the backdrop of the
2 conversation today which is we're talking
3 about exporting LNG. So, we really did turn
4 on a dime so to speak. It happened very, very
5 quickly.

6 A lot of people didn't see it
7 coming. But there are a couple of things that
8 if you kind of put these into the conversation
9 you begin to understand why it happened.

10 None of this was driven by any
11 kind of policy directive. This was really
12 just fundamentally a commercially motivated
13 revolution if you will as it's sometimes been
14 referred to.

15 So, go back 10 years. We were in
16 a situation where, as I said, there was a lot
17 of interest in moving natural gas from far
18 away places to the United States.

19 We have to ask ourselves why was
20 that. Why didn't anybody see what's happened
21 in the last 10 years happening?

22 A lot of it has to do with the

1 fact that shale, first of all, is not new.
2 Everybody that had studied subsurface geologic
3 characteristics of basins all over the world,
4 including those in the United States, knew
5 shale existed.

6 It's long been deemed a source
7 rock that was not really something that was a
8 viable technical or commercial target.

9 So, when you looked at it in that
10 regard you said, okay, well we know there's
11 resource there, but we move on.

12 As a matter of fact when I first
13 really started looking in earnest at shale it
14 was back about eight years ago now.

15 I was actually picking up Ph.D.
16 dissertations that were written by geologists
17 at places like Penn State that were talking
18 about, well, what we now refer to as the
19 Marcellus shale, but in the literature it was
20 the Devonian shales in the Appalachian belt.

21 So, you sort of look at that and
22 you start to realize, wow you know, there's

1 really not a lot of geologic uncertainty here.

2 And so then you sort of fast
3 forward and you say, okay, so what happened.
4 What really drove the change?

5 There's a saying, and I think
6 Julien referred to this a little bit without
7 actually saying it in his presentation, but
8 the best cure for high prices is high prices.

9 So, what does that mean? Well,
10 typically when you see prices rising it
11 encourages responses on many margins.

12 One of those margins is on the
13 upstream side where you start thinking about
14 new supplies to market.

15 And so when you have a high-price
16 environment it encourages a lot of capital to
17 flow into the space that you can actually
18 develop new supplies and move those to market
19 and try to capitalize on that high-price
20 environment.

21 On the demand side, of course, you
22 know what high prices do, they sort of work in

1 the opposite direction. And this starts to
2 hint at why you see cycles in commodity
3 prices.

4 But when prices are high consumers
5 typically tend to high-grade efficiency or
6 conservation efforts. And that tends to
7 dampen demand growth.

8 And so these two things meet and
9 price typically comes down.

10 But when you go back to 2003,
11 between 2003 and 2006 the price of natural gas
12 in the United States was higher than anywhere
13 else in the world, plain and simple.

14 A lot of people don't remember
15 this. It's one of these things like, wow, how
16 can that be because we typically tend to root
17 ourselves in the current time, this myopia
18 that sort of infects us all the time.

19 So what happened? What drove
20 that?

21 Well, a lot of people kind of
22 refer to the nineteen nineties as being the

1 gas bubble era. That's an era where natural
2 gas was very abundant in the United States.
3 You saw dramatic growth in natural gas
4 consumption, particularly in industrial and
5 power generation uses.

6 It encouraged new innovations in
7 the power generation sector. Combined cycle
8 power generation came into its own sort of on
9 the heels of the gas bubble era and away we
10 went.

11 Well, one of the other things that
12 happened as we sort of moved out of the
13 nineties is we had these ideas about how we
14 could actually extract more resources from the
15 subsurface.

16 And George Mitchell with his
17 outfit Mitchell Energy decided in the early
18 two thousands as prices were rising and the
19 alarm bells were going off. We had the
20 electricity crises out West.

21 People started really focusing on
22 lack of supply and there were tremendous

1 concerns that the U.S. was a mature basin and
2 the sky was falling.

3 Well, he went up into the Fort
4 Worth Basin which is where the Barnett shale
5 sits, it's half under the city of Fort Worth,
6 and tried a few new things.

7 First, he actually drilled some
8 vertical wells, sort of standard approach in
9 upstream oil and gas.

10 And you have to realize something
11 first. When you drill into a shale you're
12 talking about contacting a resource that is
13 ultra low-permeability, ultra low-porosity.

14 So when I drill into that rock
15 there's -- nothing happens. So there's no
16 flow. There's hydrocarbon native to the
17 geologic feature, but I don't get any flow.

18 And so what I have to do is I have
19 to fracture stimulate. Now, that's where you
20 get into let's create porosity and
21 permeability by injecting lots of water and
22 sand downhole and cracking the rock

1 effectively.

2 So, tried that in a vertical well.
3 Ended up realizing, well, there's some flow
4 here. Maybe we have something.

5 But also realized, well, given the
6 cost and given the amount of production we're
7 getting out of a vertical well out of this
8 formation there's not a lot of room to run
9 here.

10 But what if we actually turned the
11 well-bore and moved horizontally or laterally
12 through the formation for about 500 feet? And
13 then we fracture stimulate.

14 Well, notice what we've just done
15 is we've increased the amount of contact we
16 have with the rock subsurface.

17 Did that. Lo and behold you
18 actually have productivity rates that make
19 this a commercial prospect.

20 Today wells that are drilled in
21 the Barnett will -- you're talking about a
22 formation that's 3,000 to 3,500 feet below

1 your feet. So straight down.

2 And then a pay zone with a
3 limestone intrusion that's about 300 feet
4 thick. So it's not, you know, it's kind of a
5 remarkable technological feat when you think
6 about what's going on there.

7 Then you move through that 300-
8 foot pay zone, now upwards of 3,000, 3,500,
9 4,000 feet in terms of the lateral.

10 And so this is what's triggered
11 the dramatic productivity increases that we've
12 seen in shale.

13 Now, hydraulic fracturing was not
14 new. So despite what you've seen written in
15 a lot of popular press it's new because the
16 public wasn't really aware of it.

17 But the commercial hydro-frac
18 occurred in 1949. It was done by Haliburton.
19 The first test hydro-frac was done in 1947.
20 So, this is not a new technology. This is
21 something that's been around for a long time.

22 Directional drilling was not new.

1 Go back in the early nineteen hundreds, there
2 were actually feuds between landowners in West
3 Texas. That's basically what prompted the
4 National Guard getting called into West Texas
5 because people were slant drilling and
6 "directional drilling" into other people's
7 lands and extracting their resources.

8 And you had these Hatfield and
9 McCoy type incidents going on. The National
10 Guard gets called in and the Texas Railroad
11 Commission is formed. That's when you end up
12 unitizing the fields and you end up in the
13 current type of environment where ultimately
14 what the RRC did was set production quotas.
15 So, does that sound kind of familiar with the
16 way we equate oil and gas markets to OPEC
17 today, right?

18 But all these things weren't new.
19 They were technologies that were maturing.
20 And it turned out all you needed was the kick
21 in the pants to really drive, you know,
22 driving these things together in what we call

1 a process innovation.

2 This unlocked a tremendous amount
3 of resource.

4 And so we fast forward to today
5 and those innovations have continued to
6 generate tremendous productivity gains.

7 What do I mean by that? Well,
8 when we go downhole and we start talking about
9 turning a well-bore in a relatively narrow
10 window you're talking about using some very
11 sophisticated geosteering techniques that
12 allow you to do that.

13 This is new technology. This is
14 stuff that's really literally just been
15 developed in the last 10 or 15 years. And
16 it's really become a technology unto itself
17 because of what's happened in shale.

18 And so you get to the point where
19 you start to realize, all right, we know how
20 to go get this stuff, but does that mean that
21 everything we do will be successful? No, it
22 doesn't. And this is where it gets very

1 interesting.

2 Because when we talk about shale
3 you have to realize, first of all, no shale is
4 created equal. And no well in an individual
5 shale plate is created equal.

6 There's a lot of heterogeneity in
7 the subsurface and therefore there's a lot of
8 heterogeneity with regard to productivity and
9 the commercial viability of every individual
10 well that's drilled.

11 So, what that leads you to
12 inevitably is the realization that every
13 single downhole venture into a shale formation
14 is an R&D expedition.

15 And this is something that not a
16 lot of people have really fully internalized.
17 But what that means is that I learn every time
18 I drill.

19 And you can actually see this
20 anecdotally. So for example, Devon Energy.
21 Active shale player in the State of Texas.

22 In the State of Texas everything

1 that happens at the well side is filed with
2 the regulatory agency on a monthly basis. So
3 you know everything that's going on.

4 These well files are then
5 digitized and they're made available. And
6 we've used this data to do tremendous amounts
7 of research on this stuff.

8 But the really interesting thing
9 that comes out of these well files is you know
10 where the location of the bit. So you know
11 the location of the well.

12 And you actually know the bottom
13 hole location. So you actually know exactly
14 the direction of the lateral and you can map
15 this.

16 Well, when you look at what Devon
17 was doing from roughly 2007 to 2009, they were
18 drilling wells, and their laterals were
19 shooting in every direction, and there was no
20 rhyme or reason for it.

21 Then around 2009 something
22 interesting happened. Their laterals started

1 to lay down like railroad tracks. You say
2 what happened? They figured something out.

3 Coinciding with that is a dramatic
4 increase in the productivity of every well
5 they drill.

6 So, what do I mean then when I say
7 every well drilled is an R&D exploration?

8 Well, basically what's happening
9 is you're learning things about the
10 subsurface. You're learning things about the
11 natural fracturation of the shale.

12 Once you can begin to digest all
13 of that information you can turn it into
14 something that increases productivity and
15 that's exactly what happened.

16 So, this exact same thing is still
17 happening in some of the newer shales. So, if
18 you look at the same kind of information in
19 the Marcellus, same kind of information in the
20 Haynesville, in some of the Woodford
21 groupings, in some of the Permian groupings of
22 shales you're seeing these same kinds of

1 things still unfolding.

2 So we're still -- if you talk
3 about the shale revolution being a nine-inning
4 game, we're still in like the third inning.
5 There's still a long way to go here.

6 So, I haven't even gone through
7 the slides yet, but I just want to draw your
8 attention to what's on this first slide. It's
9 a classic Earth at night picture.

10 Because ultimately what I just --
11 the reason I want to draw your attention to
12 this is what I just was talking to you about
13 was something that's transforming the way we
14 think about energy every bit as much as policy
15 is transformational.

16 And we're talking about something
17 that's really occurred absent any kind of
18 overt policy measure.

19 So, when you look at this picture
20 it's the classic Earth at night picture made
21 famous by National Geographic.

22 We've all seen this at some point.

1 So, we've all seen this at some point. Lots
2 of satellites floating around up there taking
3 snapshots as we go through time, taking
4 snapshots of the Earth.

5 We can take all the clear
6 photographs, merge them together and we get
7 this composite. It's the classic Earth at
8 night picture.

9 Now, as an energy economist why is
10 this valuable? Because when you look at it
11 from the global setting all the little white
12 dots, those are where the lights are on.
13 That's where we consume energy. It's really
14 that simple.

15 So, when you start to think about
16 that picture in that aspect, that particular
17 aspect, you start to understand why certain
18 flows of trade occur.

19 You start to understand why
20 certain resources get developed first,
21 preferentially actually to other resources,
22 because they actually enjoy a commercial

1 advantage in terms of there being cost-
2 effective delivery to certain areas where the
3 lights are on.

4 Now, when we go sort of beyond
5 that and think about where resources actually
6 exist around the world it's actually quite
7 interesting.

8 You think about where natural gas
9 resources are. And then when you think about
10 that what's actually happening in a dynamic
11 sense to this picture.

12 So, I'm going to fast forward
13 through a couple of slides here and show you
14 this one.

15 So, back in 2003 we can
16 superimpose on this picture areas where we
17 know to exist conventional natural gas
18 resources.

19 So those are the blobs of color
20 that range from a bright red down to a dim
21 purplish blue that disappears into the
22 background.

1 The brighter the color, the more
2 intensely endowed the region is with
3 conventional natural gas.

4 So, the thing that should jump off
5 the map at you is that the biggest, brightest
6 red spots are nowhere near where the lights
7 are on. Right? So, you've got to think about
8 how to connect the two up if natural gas is
9 going to be a viable fuel source for meeting
10 projected energy demands.

11 The other thing that should
12 immediately jump off the map at you, going
13 back to where the lights are on, is there's a
14 lot of dark on the picture.

15 So this speaks volumes to
16 something that is a major concern among a lot
17 of people that for some reason gets swept
18 under the rug when we start talking about
19 climate change. But it's still important.

20 It's the issue of energy poverty.
21 So what is energy poverty? It's just the
22 notion that there are lots and lots of people

1 who don't have access to modern energy
2 services.

3 So, you look at western and
4 central China. There's a lot of dark. As
5 much as we talk about all the rapid economic
6 growth we see in China, there's still a lot of
7 people in China that don't have access to
8 modern energy services.

9 You look at sub-Saharan Africa.
10 There's a lot of people that live in sub-
11 Saharan Africa, but there's just not a lot of
12 lights on.

13 You move away from northwest
14 India. Guess what? There's a lot of people
15 in rural India that do not have access to
16 modern energy services.

17 Those three regions alone that I
18 just named account for half the world's
19 population. It's a massive number of people
20 that are in the dark.

21 Now, to put this into perspective,
22 when we look at China alone. Just forget

1 about the rest of the world, let's just talk
2 about China.

3 All the rapid economic growth, the
4 rapid urbanization rates and all of the
5 environmental issues that we've seen that are
6 associated with rapid economic growth and
7 rapid increases in fuel demand, the go they're
8 in, there's still a massive population that is
9 not even what we would categorize as middle
10 class.

11 At current rates of economic
12 growth in China there are 400 million people
13 that will move into the middle class by 2030.
14 That's more people than are actually in the
15 United States altogether.

16 So, why does that matter? Because
17 ultimately when we start talking about energy
18 demand we have to understand that in
19 developing economies wealth is a constraint
20 that binds demand growth.

21 When you talk about countries like
22 the United States, countries in Western

1 Europe, Japan, South Korea, these countries,
2 wealth is not the binding constraint. Energy
3 is a foregone conclusion in terms of our
4 ability to access it for most people.

5 The binding constraint for us is
6 time. So in other words, I'll just use the
7 simple anecdote of the car. If we all went
8 out and got in our car and drove 24 hours a
9 day, 7 days a week, we'd still run out of the
10 amount of fuel we could ultimately consume
11 because we'd run up against a time constraint.

12 Well, we can't do that. But at
13 the end of the day the thing that really
14 drives our decision to get in the car and go
15 from point A to point B is the demand for us
16 to get from point A to point B and it's time
17 that bears the constraint, not wealth.

18 It's a really important point
19 because what that tells you when you start to
20 look forward and think about where fuel
21 demands are going to come from around the
22 world, you realize that where you see growth,

1 economic growth, if it's in the developed
2 world that's not really going to beget
3 tremendous growth in energy demand.

4 But if it's in the less developed
5 world, in places like China and India, that's
6 where you will see dramatic increases in
7 energy demand.

8 Now, why do I bring this point up?
9 Well, because if you look at global growth in
10 energy use projecting out to 2040. Do a lot
11 of work, do this by country, totally prime
12 energy demand is largely going to be a fossil-
13 dominated view. Now, that's coal, oil and
14 natural gas.

15 Why? Well, because it's cheap
16 relative to some of the alternatives, it's not
17 as technically complex relative to some of the
18 alternatives, and it's realizable.

19 It also just so happens that when
20 you look out over the next 20 or 30 years
21 there's a lot of infrastructure that's been
22 built in the last decade.

1 And when you build energy
2 infrastructure, a very capital-intensive
3 venture when we talk about the energy industry
4 in general, it's in place for the next 30, 40,
5 50 years. So you sort of lock yourself in to
6 certain types of fuel choice.

7 Oil demand. What drives the slope
8 in the picture by country? This is -- some of
9 the countries are actually identified. It's
10 actually what's happening at the bottom down
11 here with China and India.

12 And again, this goes back to the
13 point I was just making about economic growth
14 and wealth creation in those countries really
15 driving fuel demands.

16 Natural gas, similar kind of
17 picture. Names are redacted but you get the
18 point.

19 And here's the one that's really
20 interesting. Coal. So when you look across
21 the world, we talk a lot about the coal
22 industry in the United States. And it is a

1 big industry.

2 As a matter of fact, if you go
3 back just over a decade the United States was
4 the largest coal market in the world. We're
5 not even close anymore. China consumes about
6 two and a half times more coal than the United
7 States does today.

8 And guess what? Most of that
9 growth has occurred since 2003. So there is
10 going to be a very long-lived robust coal
11 industry globally largely because of what's
12 happening in the developing world despite
13 everything that's going on here.

14 So, just plant that seed in your
15 head because what that tells you is that lines
16 of trade, flows of communication along those
17 lines of trade in terms of how commodity
18 prices transmit everything else, are going to
19 be shifting. Plain and simple.

20 Now, shale happened in the U.S.,
21 sort of moving from where we were. So you go
22 back to this. You can see there's no red in

1 the U.S. This is why we were talking about
2 importing natural gas, why 47 terminals
3 received certification to import.

4 Then shale happened. Realized we
5 could make it work here. Then we realized
6 they're everywhere.

7 So now you say, all right, well
8 shale's everywhere, but can we make it happen
9 everywhere? That's a really fundamentally
10 important question.

11 The answer to that is not anywhere
12 near as quick. And so this is sort of an
13 interesting conversation to have because you
14 have to begin to highlight what makes the U.S.
15 unique.

16 One of the most important features
17 in the oil and gas industry that made shale
18 happen so rapidly in the United States. You
19 had great infrastructure, really deep service
20 sector, the ability to respond very quickly to
21 very small demands in the field. All of that,
22 fantastic.

1 But you know what? It all is
2 rooted on one very simple aspect or market
3 institution in the United States. Producers
4 can negotiate directly with landowners for
5 access to mineral rights. Everything else
6 falls from that.

7 That is unique to the United
8 States. It's not true anywhere else. It has
9 to do with property rights.

10 So you go outside the U.S., this
11 doesn't exist. And so what you do when you
12 start looking at the shale opportunities in
13 China, for example.

14 A lot of discussion about
15 developing shale in China. Massive resources
16 have been identified. These are technically
17 recoverable resource assessments. Nothing
18 about commerciality is in a technical
19 recoverable assessment.

20 But when you start to think about
21 those things. Well, shale could happen in
22 China. Yes, it could, but what's going to

1 keep it from happening? Regulatory and market
2 institutions. It will make it slow.

3 Some people say, well, the
4 government is going to make it happen. Well,
5 yes, they'll drive it, but they're not going
6 to be able to facilitate full-scale rapid
7 development the way we saw in the United
8 States.

9 So you hear things out of the
10 Chinese government, a target of drilling 200
11 wells in central China in the Sichuan Basin
12 and the shale groupings there in 2015.

13 Two hundred wells sounds like a
14 big number but you know what? It's not.

15 Just to give you an idea because
16 it's always useful to put it into context, in
17 the Barnett shale alone which is a much
18 smaller area geographically than central China
19 and the Sichuan Basin and the couple of shales
20 that are there, in the Barnett shale in early
21 2008, that was the height of activity in the
22 Barnett, over 3,200 wells were drilled.

1 You have to drill a lot of wells
2 in order to fully characterize the resource
3 and understand what you have at your feet.
4 It's because you don't contact that much rock
5 with every well you drill.

6 As a matter of fact, if you just
7 look at the Barnett since 2002 alone there
8 have been over 18,000 wells drilled. That's
9 a lot of activity.

10 The rig fleet, the service sector,
11 all of the things that are required for that
12 kind of activity to take place don't exist in
13 China. They exist in the United States.

14 So, real quickly, when we talk
15 about heterogeneity this is I think where I'm
16 going to finish. This is the last slide here
17 because I think this is kind of going to drive
18 a couple of points home.

19 You can look at the Barnett shale
20 which is what we did with this particular
21 analysis and then you can actually develop
22 type curves.

1 Now, the first thing to realize is
2 that typically when you talk about extracting
3 oil and gas from a conventional well we're
4 characterizing decline in that well in a
5 certain way.

6 Basically, pressure drives flow to
7 the well bore. As you deplete the reservoir
8 pressure drops. You get less flow unless you
9 do some enhanced recovery techniques to
10 enhance the pressure in the reservoir.

11 But pressure drops. Flow actually
12 begins to decline and you have a decline rate.

13 Well, when I drill into
14 conventional basin, the well-bore. Imagine
15 I'm the well-bore. I go into the conventional
16 reservoir. Molecules are flowing from
17 everywhere to the well-bore topside.

18 Well, pressure is driving that.
19 There is a model of physical flow that is
20 representative. It's called radial flow.
21 Literally molecules are coming from everywhere
22 because they have sufficient porosity and

1 permeability for that to happen.

2 And I don't need to drill a bunch
3 of wells because that pressure is going to
4 drive things from far away from the well-bore.
5 I don't have to do anything to enhance
6 permeability and porosity.

7 When I drill into a shale nothing
8 happens. I'm the well-bore, nothing flows to
9 me until I fracture stimulate. My arms are
10 fracture wings.

11 Now what happens is I get flow
12 along the wings of the fracture. They flow to
13 the well-bore. That's a linear flow regime.
14 So the physics of fluid flow in these
15 different types of basins are different. And
16 so that means when you characterize decline
17 it's different.

18 And so one of the things that
19 we've been involved in is a study to try to
20 actually understand those physics and turn
21 that into something meaningful with regard to
22 how you characterize decline.

1 This is a representation of that.
2 You look at all -- this is from a sample
3 looking at 16,000 wells in the Barnett. So
4 it's not all of them because this actually --
5 analysis carries us through 2013.

6 But you look at this and you can
7 see there are some really good wells that you
8 can drill, big production pop, steep decline.
9 You're going to get close to 3 bcf out of the
10 well. Given the cost to develop that well
11 it's going to give you a breakeven at south of
12 \$3.

13 This is the well you see on
14 Investor Relations Reports. Look what I can
15 do, right?

16 Well, you also -- for every well
17 you drill like this, you also drill a well
18 down here, a well that just doesn't produce
19 very well. Don't really know why, but it just
20 doesn't.

21 It's what we call a dog. Less
22 than 1 bcf. Given the cost to drill and

1 complete those wells you're talking about
2 prices north of \$8 to make this work.

3 And so this is where some people
4 will stop. They say see, you're drilling some
5 of these wells and you need a price north of
6 \$8. That means that's where the price of
7 natural gas is going to go.

8 There's a flaw in that. There's a
9 flaw in that because I have to drill lots and
10 lots of wells. And so what I'm really
11 interested in is the central tendency of the
12 distribution.

13 Why is that? Well, because every
14 operator has a portfolio of wells they drill.
15 They're going to drill some really good ones
16 and they're going to drill some really bad
17 ones.

18 So, when I go to the central
19 tendency of the distribution I look like this
20 red line here.

21 In the Barnett shale that tells me
22 that a price just south of \$5 is a price that

1 will sustain production for a long time.

2 So, you can do this for other
3 basins as well. We've done it for the
4 Marcellus, the Haynesville, the Fayetteville.
5 We've actually started to look at oil-
6 producing shales as well now and we're in the
7 process of that characterization.

8 But this distribution is different
9 everywhere. In the Marcellus the central
10 tendency is actually in the mid-\$3's which is
11 startling because that tells you there's a lot
12 of gas out there that's less than \$4.

13 The constraint on what that means
14 for pricing in the Southeast of the United
15 States is infrastructure, ultimately. So you
16 still have to transport it.

17 But the point is I can take this
18 kind of analysis and apply it to every shale
19 that I know about in North America and I
20 generate a supply curve with a set of
21 breakeven costs that looks like this.

22 So this is grouping every shale

1 that I know about in the United States -- not
2 North America, this doesn't include Canada --
3 but in the United States and looking at
4 tiering production buckets if you will within
5 those shales.

6 And you can call this a long-run
7 supply curve because basically what this is is
8 representative of a breakeven price for a well
9 drilled in each one of these tiers.

10 Now, these tiers are across a
11 multitude of different shales. Some of the
12 stuff down here is actually in the Marcellus.

13 But, here's the point I want to
14 draw you to. We can get up to about 1,400 tcf
15 of gas and not be north of \$6. That's a lot
16 of gas.

17 And we haven't even talked about
18 Canada. And guess what? There's a tremendous
19 amount of gas available in Canada at very,
20 very low prices.

21 The reason it hasn't actually
22 accelerated in terms of full-scale development

1 is because it's basis disadvantaged. It's
2 basically locked up because the price in
3 Canada is low.

4 Well, guess what starts to happen?
5 As you start to see stimulus on gas demand
6 which is coming not only from power generation
7 but also from the industrial sector.

8 It's coming in the form of LNG
9 exports. That's going to begin to open
10 avenues and actually change basis
11 differentials that will begin to support some
12 Canadian production.

13 And when you put all that together
14 you get a long-term shale forecast from the
15 United States that looks like this. It looks
16 like it kind of peaks out here. This is by
17 shale basin.

18 But what's actually happening when
19 you get up here, and I don't know if you can
20 really see it but there's a gray, sort of
21 light gray right here that flattens out. You
22 get enough price support by the time you get

1 to around 2020. You start to see those
2 Canadian shales come in.

3 And so that's the one thing you
4 have to realize is when you talk about the
5 U.S. gas market you have to go beyond the U.S.
6 because it is a very integrated market when
7 you talk about North America in general.

8 And to throw fuel to the fire if
9 you will, what's happening in Mexico has the
10 potential to unlock tremendous natural gas
11 resources as well.

12 So, I don't want to paint too dire
13 a picture, but there is a lot of natural gas
14 that is below our feet. It's really that
15 simple.

16 And so what you then have to think
17 about is what are the sort of frontier
18 technologies that can increase the
19 competitiveness of coal in power generation.

20 One that was mentioned was
21 supercritical.

22 But these things, changing the

1 heat rates and changing the nature of the
2 discussion along those lines is ultimately
3 what has to happen for coal to maintain a
4 reasonable market share.

5 Else coal is going to migrate out
6 of the U.S. It's going to become
7 predominantly an Asian story.

8 Why? Well, because it's expensive
9 to transport natural gas, very expensive.

10 When you talk about an LNG
11 infrastructure project, a greenfield LNG
12 infrastructure, something like on the west
13 coast in Oregon, like Oregon LNG or Jordan
14 Cove, either one of those facilities, or if I
15 go to north into British Columbia, those LNG
16 infrastructure projects, you're talking about
17 all-in field development through to the ship.
18 So delivered FOB to the ship.

19 You're talking about all-in
20 capital costs of anywhere between \$20 and \$30
21 billion. That's not cheap. This is exactly
22 why some of those developers want oil index

1 deals. They're looking for security in terms
2 of financing.

3 That's not going to happen. And
4 so what that means is that you have this
5 opening to think about shipping coal to Asia.
6 That's actually something that I think in some
7 of the work that we've done we actually see
8 happening as you move beyond this decade.

9 A lot of that is going to be
10 driven by environmental constraints that are
11 going to be placed on coal consumption in the
12 United States, but it doesn't mean coal goes
13 away.

14 It's still a very cheap source of
15 fuel. And when you constrain something on the
16 demand side it actually makes it cheaper.

17 And so what you'll actually see is
18 a lot of those avenues begin to open up.
19 Because as I showed you, there's a lot of
20 people in the dark still around the world.

21 And to those people, I'll just be
22 blunt, climate change is not an overriding

1 concern. It's just not.

2 And so that's where the rubber
3 hits the road. Because how do you enforce a
4 policy that's enacted in the U.S. and put that
5 policy on people around the world who don't
6 have access to modern energy services? You
7 cannot do it. And I don't see the United
8 States going to war over this.

9 So I'll stop there and answer any
10 questions.

11 (Applause)

12 MS. GELLICI: Thank you. We have
13 time for a question or two for Ken.

14 MR. NARULA: Thank you. This is
15 an excellent talk.

16 My name is Ram Narula again for
17 Energy Consultants.

18 As I understand, and I don't know
19 too much about this, there are two other
20 predominant constraints in the development of
21 shale gas is the excessive need for the water
22 and the real estate away from population

1 center which is a big issue in countries like
2 India. Could you comment on that?

3 DR. MEDLOCK: Sure. So, access to
4 water is a major issue, but it's one that has
5 a technical solution.

6 There's rapid shale development in
7 South Texas which is a drought-stricken area.

8 A lot of what's happening there is
9 -- there's actually two primary focuses that
10 have been undertaken by developers.

11 It's, yes, you can actually access
12 water through the sort of standard water
13 withdrawal from rivers and streams and move it
14 to the site. You can also truck it in from
15 other locations.

16 And then you can recycle. So,
17 there's a lot of development of new membrane
18 technologies that can target specific
19 contaminants and allow it to be purified to
20 the point where it's usable for recycling at
21 the next well.

22 In other places access to water is

1 not an issue. So, if I go up to Pennsylvania
2 there's water everywhere. That's not an issue
3 at all.

4 The issue there is water disposal.
5 So, there's lots of different things along the
6 water value chain if you will.

7 And that's actually what has led
8 to some of the concerns about seismicity
9 associated with shale.

10 So, you guys may not know this but
11 the most actively seismic state in the country
12 is Oklahoma now. Oklahoma, right? I didn't
13 even know there were faults in Oklahoma.
14 Well, there are. They were dormant faults
15 though.

16 The trouble is if I drill a deep
17 injection well for disposal, and these are
18 EPA-regulated wells. They approve these
19 sites. When I do that, if I drill into a
20 dormant fault zone I actually can end up
21 lubricating the fault and that creates
22 slippage.

1 So, these are issues. Again,
2 there's a technical solution to this, but they
3 have to be addressed.

4 When I go outside the United
5 States probably the area of the world where
6 water constraints are most prescient,
7 particularly where you have a lot of shale
8 resource identified, is in China.

9 The Chinese model though is
10 always, it's a brute force engineering model.
11 We don't have water. I'll redirect it.

12 The trouble is that's not met
13 without public discord. And most people don't
14 realize it, but there have actually been civil
15 conflicts in China over water resources, over
16 relocating people.

17 I mean, the Three Gorges Dam
18 project was a major one, but that's not the
19 only one.

20 So, there's a lot of things in
21 China that still have to be addressed.

22 But one of the ways that they're

1 looking to do that is through development of
2 desalination capability which they need on the
3 coast anyway for its population.

4 But if you over-scale that
5 capacity and actually create another market
6 for that water you can pipe it inland. And so
7 that's another avenue they're actually looking
8 at.

9 And in western China they're
10 looking at drilling into deep briny
11 formations, extracting water from there
12 because it's not palatable anyway, cleaning it
13 up to the point where it's usable in a down-
14 hole application and then drilling wells.

15 So, there are technical solutions,
16 but note, all these raise cost. Which feeds
17 into the point I made earlier about it'll
18 happen elsewhere in the world, but it's not
19 going to happen nearly as fast.

20 MS. GELLICI: Thank you. We're
21 going to have to cut the questions first.
22 Hopefully you can get with Ken afterwards to

1 kind of take advantage of his expertise. But
2 thank you so much for being here. Thank you,
3 Ken.

4 (Applause)

5 MS. GELLICI: I think we had a
6 great panel of speakers today. All of the
7 presentations will be put up on the NCC
8 website. Give us another week or so, but
9 they'll be up there.

10 Would you please join me in just
11 one final round of applause to thank all of
12 our speakers today who did an excellent job.
13 Thank you.

14 (Applause)

15 MS. GELLICI: The final portion of
16 our program will focus on brief business
17 reports from the National Coal Council.

18 I'd like to invite Amy Ericson to
19 come to the stage right now to provide us with
20 an update on the National Coal Council's
21 current study.

22 Amy is U.S. country president with

1 ALSTOM Power and she is presently serving as
2 chair of the National Coal Council Study.

3 Amy, thank you for being here. We
4 greatly appreciate it.

5 MS. ERICSON: Hi. I've been asked
6 to give an update on the study that the
7 National Coal Council is working on this year.

8 I will keep it very short. And
9 I'll start with what Secretary Moniz asked us.

10 This is an excerpt directly from
11 his letter which we received I think in June
12 if I'm not mistaken, around the June time
13 frame. It was after our May meeting.

14 So you can read directly what it
15 says. But his direct translation is actually
16 quite simple.

17 What he would like for us to do is
18 to assess the value that's been delivered in
19 CCS, carbon capture and storage, carbon
20 capture and utilization, and the value of the
21 technology that's been delivered and the
22 projects that are ongoing.

1 And then to further understand
2 what has been delivered versus what is needed
3 to get to any of the climate targets that we
4 hear out there. And there are a couple of
5 scenarios.

6 And finally, put together a set of
7 recommendations as to how we can accelerate in
8 order to meet the goals of 2030.

9 And this is, by the way, global,
10 not just the U.S.

11 So very quickly I just want to
12 show you at the leadership level it is typical
13 of how these reports have been structured in
14 the past.

15 In fact, I noticed in the packet
16 that there is a list of all the previous
17 reports that has been requested by the DOE.
18 There are 26 previous ones, so we're number
19 27.

20 And so we have the NCC chair, the
21 Coal Policy Committee chair and vice chair.
22 I am the study chair and Carl Bozzuto from

1 ALSTOM is the technical chair.

2 Many of you probably know Carl.
3 He's been in this industry for I'll say four
4 decades. We can decide whether it's above or
5 below.

6 The way we started this process is
7 we asked for volunteers. And we basically
8 brainstormed over several meetings a study
9 outline, what would be most efficient, what
10 would be the most productive.

11 We are going to keep this to a
12 100-page report. We figured nothing else will
13 really get read.

14 So we've come up with the
15 following outline. And I want to assure you
16 that we're going to take a look at what's been
17 done and what are the remaining gaps for
18 carbon capture, carbon storage, carbon
19 utilization which includes transport
20 independently as well as in terms of an
21 integrated effort and demonstration.

22 So, we'll start with a chapter on

1 the CCS/CCUS imperative. This is what --
2 we're not recreating the wheel here. This is
3 a scene-setter. It's a reminder that no
4 environmentally friendly scenario is going to
5 be met without CCS and CCUS.

6 We use third party analysis to
7 make this point. And it's just really a
8 reminder up front.

9 Then we move into the worldwide
10 look. It's basically a cataloguing of
11 projects and technologies. It's an exhaustive
12 list.

13 I think what I saw is that
14 currently in execution or operation or in
15 definition are projects of about 70 million
16 tons per annum of CO2 captured. Keeping in
17 mind though that the ultimate goal is actually
18 well above 1,000 billion tons of CO2 per annum
19 captured.

20 So, while there are a lot of
21 projects out there we certainly need to up the
22 effort.

1 And then the next chapter looks
2 specifically at the DOE programs. And we're
3 lucky here because we're getting a lot of data
4 from the DOE.

5 And what that data is helping us
6 do is understand what were the original
7 targets, where are we now. And we can really
8 do a granular analysis and readout.

9 The next chapter deals with what
10 deployment challenges have we run into along
11 the way with CCS/CCUS.

12 We are actually opening it up to
13 look beyond the technical here. So we've
14 brought in some expertise, legal expertise,
15 technical, obviously technical expertise, but
16 experts in public acceptance as well as
17 finance. Because those are obviously very
18 critical challenges.

19 And then we move onto the gap
20 analysis. And I'll show you who is running
21 each of these respective sections.

22 And then we wind up with a set of

1 recommendations.

2 So now I just want to show you the
3 names of who's working on this. And I'll just
4 mention the names of the lead authors.

5 So, for the first chapter we have
6 Holly of Shenua. She has already completed
7 her draft. In fact, all of these drafts are
8 completed at this point in time.

9 For the Chapter B which is the
10 global view of technology and projects we have
11 Pam Tomski of the Global CCS Institute leading
12 that.

13 As far as the DOE analysis we have
14 Shannon of Kirk leading that effort.

15 And just to make sure this wasn't
16 an all-female document we moved onto Chapter
17 D. Carl is leading that effort in terms of
18 the deployment challenges. And you can see
19 some of the expertise that he's brought in
20 there.

21 And then finally the gap analysis
22 is being led by Jeff Phillips of EPRI.

1 And I do want to mention that in
2 terms of the deployment challenges we have
3 utilized in industry a survey.

4 The Secretary is very specific
5 that he wanted the voice of industry in this
6 assessment. And so we have sent out a survey.

7 It is now closed. We're
8 collecting the results and analyzing them.

9 There were just nine questions.
10 It's not onerous. And the ratings for each
11 question is from highest rated to lowest rated
12 going from the number 1 to a number 5. We
13 tried to make it as simple yet relevant as
14 possible.

15 We think we have about a 25
16 percent hit rate which is typical for surveys.

17 We went to 240 participants and we
18 focused on obviously Coal Council members as
19 well as industry experts, and EPRI in terms of
20 the Fossil Fleet Program and the CCS Program.

21 And you can see the survey team
22 that we used for this effort.

1 And so now I just want to wind up
2 with where we are and where we're going.

3 All of the draft sections for the
4 chapters are in, excluding recommendations
5 because we can't write them yet until we
6 really understand the chapters and have an
7 integrated view.

8 Carl right now is preparing that
9 first integrated view and we'll move quickly
10 onto the next set of milestones which is the
11 first review of the integrated study. And
12 we'll generate an initial set of
13 recommendations from there.

14 And then we have a review period
15 for the leadership of both the National Coal
16 Council and its Coal Policy Committee. And
17 we'll revise once again.

18 And then we move onto a more
19 formal meeting with the Coal Policy Committee
20 which is yet to be scheduled.

21 And then finally we will issue the
22 report by the end of January. The initial

1 request had been more like mid-December but
2 since everybody is working so hard on the new
3 extended deadline for 111(d) which is December
4 1 we didn't want this to get lost or pushed to
5 the wayside.

6 So we have been given permission
7 to extend this final report around January 31.

8 So you see there is a study review
9 team, volunteers for that and additional
10 volunteers.

11 And I hope you can see by all the
12 names that we had out there we really made a
13 concerted effort to get a bunch of diverse
14 experiences and views represented for this
15 report.

16 If you have any interest in being
17 a reviewer or contributing in any way I just
18 remind you to contact Janet or myself or any
19 of these chapter leads.

20 And I think that's all I have in
21 terms of the update. Thank you very much.

22 (Applause)

1 MS. GELLICI: Thank you, Amy. I
2 appreciate your guidance and your leadership
3 on that effort. Thank you very much.

4 Next I'd like to present a brief
5 finance report. Our finance chair Greg
6 Workman with Dominion Energy unfortunately
7 needed to leave. He was here yesterday for
8 our board meeting but I'm offering to present
9 his report on his behalf.

10 So Greg is pleased to report that
11 we continue to make progress in improving the
12 National Coal Council's financing.

13 It's certainly not a process that
14 will happen overnight, but we are heading in
15 the right direction in getting our
16 organization back on sound financial ground.

17 As is the case with many other
18 coal-based organizations the NCC has recently
19 been struggling financially. We will likely
20 end this year with a slight deficit due
21 primarily to market conditions and industry
22 challenges.

1 The good news is that we do expect
2 the deficit for 2014 to be less than what we
3 incurred last year. So, again, we're heading
4 in the right direction.

5 As noted before the National Coal
6 Council is a self-sustaining organization. We
7 do not receive any funding from the federal
8 government. To finance the activities of the
9 Council NCC relies on annual voluntary
10 contributions from our members.

11 We also invest our Council
12 reserves and we rely on the generosity of our
13 sponsors.

14 We also rely on in-kind
15 contributions from our members in terms of
16 supporting our meetings and studies. The
17 study product of the Council is done on a
18 voluntary basis. Again, in essence saving DOE
19 money. So we like to point that out.

20 In your packets you will find an
21 acknowledgment of those NCC members who have
22 contributed financially to the Council this

1 year along with a list of in-kind supporters.

2 And on behalf of the NCC
3 leadership I'd like to thank those who over
4 this past year have paid your dues, or
5 sponsored an NCC event, or donated toward our
6 communications initiative. A big thank you as
7 well to those who provided in-kind support.

8 And of course we appreciate the
9 effort of those who assisted NCC by
10 contributing their expertise to our studies.

11 We do continue to take measures to
12 improve our financial position. On the
13 revenue side we have successfully raised
14 \$16,000 in donations to fund the purchase of
15 a member database which we've put in place.
16 And we're also redesigning our website.

17 Fund-raising efforts are underway
18 to continue to support our energy education
19 initiatives.

20 And in addition to revenue-
21 enhancing measures we're continuing to contain
22 expenses. We're holding the line on office

1 expenses.

2 Most notably, this month we'll be
3 sub-leasing our existing office space and
4 transitioning to an executive suite situation.

5 There's information on our new
6 address and new phone number in your packets.
7 But we're actually moving today. So, it's
8 amazing how Hiranthie and I can be in two
9 places at one time.

10 But this will significantly cut
11 our overhead costs in the coming years. So
12 it's a big move for us. And we appreciate
13 your patience through the transition period
14 here.

15 Our standard legal fees have been
16 cut significantly from prior years as have our
17 professional service fees.

18 And we continue to explore
19 opportunities to cut costs while we want to
20 continue providing you with the services that
21 you need.

22 Dues invoices for 2015 will be

1 emailed to members in November. You can elect
2 to pay them in 2014 or 2015. If you elect the
3 latter we'll be asking for payment in mid-
4 January. And we greatly appreciate your
5 prompt payment of those invoices.

6 I'm going to transition onto the
7 NCC Communications Committee. We did meet
8 yesterday to discuss communications-related
9 activities. Just a few things to highlight.

10 We have a new logo and we welcome
11 your feedback on that. But I think the logo
12 is representative of an industry that is
13 energetic, vibrant, modern and we're happy to
14 have that kind of new, fresh look.

15 The new logo is kind of a keystone
16 for the redesign of our website which is
17 expected to be completed and launched by the
18 end of the year.

19 I did want to acknowledge the
20 support of Arch Coal and Peabody Energy who
21 provided the financing support that's making
22 it possible for us to develop a new logo and

1 the website, and kind of bring us into the
2 21st century.

3 I think I mentioned at the last
4 meeting that our website is not accessible on
5 any mobile device so we will be fixing that
6 along with many, many other things on the new
7 site.

8 The Communications Committee was
9 instrumental in developing a series of seven
10 fact sheets for our last National Coal Council
11 study on the existing coal fleet.

12 These fact sheets are up on the
13 NCC website. There are hard copies of the
14 report outside of the room here.

15 And we are continuing to work on
16 distributing that study to various industry
17 stakeholders. And we'll begin developing a
18 rollout plan for the study that Amy was just
19 talking to us about.

20 The final item, in terms of
21 governance issues, I did want to again note
22 that invoices would be going out in November.

1 I think that was all I had to say
2 on that part of our business report. So, any
3 questions or comments on that at this point in
4 time?

5 Okay. With that this meeting is
6 duly authorized and publicized and is open to
7 the public. The public can submit comments to
8 the Department of Energy or if any individual
9 wishes to speak they may do so at this
10 meeting.

11 Those who wish to speak may do so
12 at this time. Do any members of the public
13 wish to speak?

14 Hiranthie, if you would get the
15 mike to Mark Carr, please.

16 MR. CARR: This is a request for
17 help.

18 I'm also very active in the
19 Transportation Research Board. In January
20 we're putting on a panel and I'm looking for
21 -- not for speakers on the panel, but for some
22 supporting presentations we're going to be

1 giving on the general topic of does the U.S.'s
2 change in the fuel mix, how it drives
3 transportation changes. And are those changes
4 permanent, are they temporary.

5 And if you have any interest in
6 helping with that effort, or providing facts,
7 figures, et cetera, I think I'm going to be
8 staying here for lunch and look forward to
9 exchanging business cards with you. Thank
10 you.

11 MS. GELLICI: Great. Thank you,
12 Mark. Any other comments from the public?

13 Seeing none I'd just like to
14 mention there is a conference evaluation in
15 your packets. If you could kindly complete
16 those and leave those with us at the desk or
17 you can just leave them at your place seatings
18 and we will pick them up.

19 I did want to thank our sponsors,
20 Joy Global for sponsoring our reception last
21 evening, and our break sponsors ADA, CSX, Fuel
22 Tech, PPL EnergyPlus and Tri-State Generation

1 and Transmission. Thank you very much for
2 your support.

3 Bob Wright, thank you as always
4 for your guidance and patience and assistance.

5 And then finally I would like to
6 thank Hiranthie Standford, our meetings and
7 membership manager, for the fabulous job that
8 you've done and doing it all with very good
9 cheer. So, thank you very much. Please join
10 me in thanking Hiranthie.

11 (Applause)

12 MS. GELLICI: If there is no other
13 business to bring before the Council at the
14 time we stand adjourned. Thank you. Lunch
15 will be in Annapolis 1 which is just out the
16 doors to your left. Thank you again for being
17 here.

18 (Whereupon, the above-entitled
19 matter went off the record at 12:29 p.m.)
20
21
22

A				
\$1 141:11	174:4 179:5 192:6	89:6 124:1 126:20	age 29:19 117:9	altogether 173:15
\$100 61:1	193:3,11,22	148:8 152:20	agencies 17:15 33:2	Alvin 56:13,14 57:3
\$120 60:14	accessible 212:4	210:6	40:5 43:17 44:3	57:11 71:8
\$15 143:13 144:4	accomplishments	addressed 18:13	agency 43:12 44:21	amazing 71:14,15
\$16,000 209:14	8:19	37:8 101:19	166:2	71:20,21 98:6
\$20 119:10 143:14	account 33:4 35:1	102:16 195:3,21	agenda 5:21 6:16	210:8
144:4 190:20	36:10 63:21	addressing 9:18	6:18	America 12:3
\$3 184:12	172:18	14:16 29:2 147:9	aggregate 126:13	186:19 187:2
\$3's 186:10	ACE 52:8	adds 78:19 126:16	aggressive 91:6	189:7
\$30 190:20	achieve 14:6 68:17	adequacy 94:20	ago 10:12 20:19	American 99:11
\$4 186:12	84:7 137:11	95:4 121:16	32:1 138:16	amount 62:12 68:1
\$40,000 53:20	143:17	adequate 89:22	154:18 156:14	68:2 70:3 73:11
\$5 185:22	acknowledge 82:15	129:10 130:14	agree 47:4	78:4 130:13 161:6
\$6 187:15	150:19 151:3	134:20 137:4	agreed 87:5	161:15 164:2
\$8 185:2,6	211:19	adjacent 126:22	agreements 8:1	174:10 187:19
\$800 69:8	acknowledgment	139:11	agricultural 15:7	amounts 166:6
\$9 69:10	208:21	adjourned 215:14	ahead 48:19 94:10	Amy 1:22 5:17
A-G-E-N-D-A 3:1	act 6:3,3 74:16	adjunct 152:1	143:17	197:18,22 198:3
a.m. 1:11 4:2 114:8	110:6,7 123:19	adjust 35:11	air 30:19 34:4 54:8	207:1 212:18
114:9	action 11:13,20,22	administration	74:15 88:8 98:19	analogy 120:17
ability 54:16 55:22	12:14 13:12,13	13:5 14:8,15	106:9 107:13	analysis 2:3 3:8 5:1
59:14 115:10	14:3 16:3,6,8 24:2	21:17 42:2 150:3	110:6,7 139:22	9:14 24:8 32:5,11
120:1 174:4	42:12 46:17 47:15	administration-...	Alabama 51:9	38:12 150:15
178:20	47:18 94:5 110:15	25:8	53:17 64:4 69:17	181:21 184:5
able 11:18 23:12	actionable 48:3	adopted 102:21	70:6 74:5	186:18 201:6
49:17 54:17 60:20	actions 8:1 47:3	adoption 6:17	alarm 159:19	202:8,20 203:13
74:13 94:21 151:2	91:9 105:19	advance 86:7 94:4	Algonquin 123:12	203:21
180:6	active 17:6 165:21	advanced 1:15	Ali 41:14,14,17	analyst 3:12 115:20
above-entitled	213:18	41:21 61:18 149:8	75:7,7	analysts 114:20
114:7 215:18	actively 17:5	advantage 19:11	aligned 45:2	analytical 28:4
absent 168:17	194:11	39:4 86:6 170:1	all-female 203:16	38:3,9
absolutely 66:3	activities 208:8	197:1	all-in 190:17,19	analyzing 32:22
81:4 93:15 117:6	211:9	advisor 4:15 9:9	all-of-the 18:19	204:8
146:16	activity 180:21	152:3	19:6	ancillary 145:13
absorption 41:18	181:9,12	advisory 3:4 6:2	all-time 60:6	anecdotal 22:9
abundant 65:22	actual 33:6 91:1	7:9,16 9:6 45:9	alleviate 134:1	anecdotally 165:20
159:2	acute 134:6	50:2	allow 16:17 93:9	anecdote 174:7
academics 99:18	acutely 144:1	AEP 140:15	164:12 193:19	angle 148:22
Academy 9:8	ADA 214:21	affairs 51:3	allowed 93:8	angles 148:21
accelerate 126:17	adaptation 20:9	affect 22:19	134:12,12 135:6	Annapolis 1:9
199:7	added 55:5,6 116:5	affiliation 6:14	allows 83:8	215:15
accelerated 41:21	adding 147:11	36:22	alma 57:15	anniversary 10:12
187:22	addition 61:8 78:11	affordability 31:10	ALSTOM 1:22	10:17,18,20
acceptance 202:16	209:20	affordable 16:16	5:18 198:1 200:1	announced 126:7
access 60:18 65:9	additional 14:6	52:13,22 54:13,14	alternative 79:12	129:20 146:10
98:7 172:1,7,15	64:21 78:13 206:9	54:18	alternatives 175:16	annual 1:5 53:20
	address 14:6 28:14	Africa 172:9,11	175:18	74:21 208:9

annually 73:21	81:11 82:17	assisted 209:9	174:15,16 203:9	Barry 69:18
annum 201:16,18	150:17 198:4	associated 30:7	B's 126:18	base 103:14
anomalies 109:1	207:2 209:8	173:6 194:9	bachelor's 51:5	based 64:1 93:13
answer 11:17,18	210:12 211:4	Association 1:18	back 30:15 46:12	96:17 103:4
24:3 61:3 72:4,17	approach 18:20	3:11 81:18 152:6	46:14 54:6,22	baseline 54:11 89:9
73:1 110:22	160:8	assume 68:12	56:3 60:7 61:15	91:1,12,13,22
148:13 178:11	appropriate 59:13	94:11	71:12 74:13 84:1	basic 12:2 84:22
192:9	140:12	assumes 68:14	85:22 108:18	basically 16:11
answers 83:14	approve 194:18	assuming 9:1	114:4 116:13	26:2 31:7 43:9,12
112:20	Arabia 66:2	127:11	117:19 122:17	135:8 163:3 167:8
Anthony 100:11	arbitrage 119:22	assumptions 89:15	123:3 124:18	182:6 187:7 188:2
anticipate 146:13	Arch 211:20	90:3	129:21 135:5	200:7 201:10
149:11	area 35:6 180:18	assure 200:15	137:1,14 138:3,17	basin 72:14 73:17
anticipated 80:10	193:7 195:5	Atlantic 126:16	139:3 145:1	73:18 74:1,2,8,14
antitrust 3:4 7:9,17	areas 41:22 67:2	attendance 81:6	148:22 149:2,17	75:1 118:13 160:1
7:21 8:6	69:9 101:14	attention 72:4	151:5 154:2,18	160:4 180:11,19
anybody 8:6 61:5	136:21 152:7	101:22 130:8	155:15 156:14	182:14 188:17
155:20	170:2,16	136:11 140:14,17	158:10 163:1	basins 156:3
anymore 11:4	arguably 103:19	141:5 142:11	170:15 171:13	183:15 186:3
48:12 122:11	argue 56:21 142:2	168:8,11	176:12 177:3,22	basis 9:19 28:19
142:7 177:5	Argus 79:4	attractive 125:11	207:16	93:3,3 103:6
anytime 123:20	arms 183:9	attributes 31:13	back-streamed	150:4 166:2 188:1
anyway 131:6	arrive 103:21	auctions 96:3	105:4	188:10 208:18
196:3,12	art 58:16 70:20	133:12	backdrop 155:1	bat 129:5
AP1000's 98:9	articulate 119:20	August 97:19	background	battleground
apologize 105:22	Asia 191:5	authorities 14:19	170:22	136:10
App 73:17 74:5	Asian 190:7	authority 52:3 97:6	bad 185:16	bcf 184:9,22
Appalachian	asked 105:10	authorized 213:6	baghouses 106:12	bears 174:17
156:20	109:15 152:18	authors 203:4	Baker 2:5 5:12	becoming 142:9
apparently 30:2	198:5,9 200:7	automated 63:17	151:18,19	153:5
109:18	asking 40:14 43:7	availability 23:18	Bakken 101:17	bedrock 84:16
applause 9:22	86:20 101:3	59:3,5	balance 147:12	began 56:6
36:15 50:9 51:15	134:18,21 211:3	available 8:6 39:4	balances 67:6	beget 175:2
72:6 81:9 82:20	aspect 169:16,17	56:10 59:15,18	balancing 53:2	beginning 35:8
106:3 113:22	179:2	65:21 76:14 79:21	ball 141:22	144:19
115:15 144:17	aspects 18:1	166:5 187:19	bankruptcies 145:7	begins 182:12
150:11 152:12	assess 93:12 198:18	avenue 196:7	145:19 146:13,20	begs 103:7
192:11 197:4,11	Assessing 14:15	avenues 188:10	bankruptcy 147:2	behalf 207:9 209:2
197:14 206:22	assessment 80:18	191:18	147:6	behold 161:17
215:11	179:19 204:6	Award 82:8	barge 29:12 35:5	Beijing 99:16
apples 125:7,7	assessments 179:17	aware 32:17 129:18	101:15	106:19,20
applicable 139:5	assets 135:7	143:22 162:16	barges 22:19 50:7	believe 37:16 55:12
application 196:14	assist 29:1	awhile 51:22	Barnett 160:4	61:4,4 64:11
apply 186:18	assistance 17:22	awkward 92:5	161:21 180:17,20	68:19 78:3
appreciate 6:17	18:17,20,22 19:20	eyes 7:2	180:22 181:7,19	believes 69:4,5
37:2 48:17 50:17	215:4	<hr/>	184:3 185:21	bells 159:19
52:7,15 80:20	Assistant 4:10	B	Barnich 82:8	belt 156:20
		<hr/>		
		B 2:4 126:16		

benefits 13:3 103:5	bit 12:7,9 20:2,7	111:3,6 112:2,16	brownfield 120:21	187:19 188:3
Bennett 2:8 3:4 7:7	23:6 24:13 25:14	113:21 114:2	121:17 122:13	Canadian 188:12
7:10	30:15 33:9,10	Bozzuto 199:22	brute 195:10	189:2
best 14:17 17:17	39:11 66:5 73:1,9	Brad 104:16	Btus 67:5,11	cannibalization
19:11 38:4 39:4	79:5,11 80:2	brainstormed	bubble 159:1,9	143:1
55:13 57:6 61:3	85:13 105:20	200:8	buckets 187:4	cannibalizing
99:9 150:14 157:8	107:20 115:21	Branch 57:4	budget 71:2 75:16	142:19
better 20:12 23:14	116:20 120:5	break 5:8 79:1	budgetary 47:6	cap 13:11 72:15
41:11 45:1 57:10	134:6 135:13	114:4 214:21	build 120:3 125:22	capability 196:2
62:21 64:12 65:1	152:15 153:12	breakdown 74:18	126:1,22 132:11	capacity 28:15 29:2
86:12 87:21 120:7	154:2 157:6	breakeven 135:9	132:13 176:1	73:11 95:6 96:3,7
beyond 135:12,16	166:10 168:14	184:11 186:21	building 20:13	103:19 104:2
170:4 189:5 191:8	bits 39:17	187:8	58:13 61:13 62:8	121:13 129:2,8
202:13	bizarre 34:19	breath 144:19,20	82:9 107:5 120:20	131:9,17 133:12
bid 134:13 135:6,8	blew 104:20	breathe 152:14	121:10 123:20	134:13 136:22
bidding 134:8	blobs 170:19	Brevitt 100:9	125:20	139:17 153:5,13
135:4	blue 170:21	brief 197:16 207:4	built 87:16 148:4	196:5
big 14:14 15:3 24:7	blunt 191:22	bright 52:11	175:22	capital 119:21
24:22 42:16 73:17	board 28:17 45:9	170:20	bulk 127:8	120:2 122:8 147:4
74:8,15 98:22	51:12,13 52:6	brighter 171:1	bunch 32:7 183:2	157:16 190:20
108:8,8 111:17	57:22 81:19 101:3	brightest 57:6	206:13	capital-intensive
122:5 126:11	207:8 213:19	171:5	Burke 107:18,19	176:2
129:1 138:1,11	boats 50:6	brilliance 115:10	burn 74:21 79:20	capitalize 157:19
140:7 145:9 177:1	Bob 4:17 215:3	brilliant 115:9	burning 72:14	caps 145:8
180:14 184:8	body 89:1	bring 7:13 105:11	business 3:17 5:15	capture 38:6,18
193:1 209:6	boilers 148:20	130:2 149:2 175:8	5:22 40:3 86:22	69:20,22 70:7,9
210:12	boom/bust 126:10	212:1 215:13	94:1 102:14 113:5	100:1 198:19,20
bigger 77:21	border 96:10 109:5	bringing 31:20	197:16 213:2	200:18
107:11 119:17	110:3	90:4 102:12	214:9 215:13	captured 201:16,19
122:6 141:8,8,9,9	bore 182:7	116:12	busy 31:3 37:3	capturing 58:20
142:5	boring 22:6 41:1	brings 103:15	buy 109:14	70:1 148:2
biggest 171:5	borrowed 124:9,10	104:17 122:17		car 174:7,8,14
biggest-ticket 16:2	boss 21:19	briny 196:10	C	carbon 12:3 38:4,6
bilateral 133:9	Boston 123:9	British 190:15	C 1:17	38:17 58:21 69:20
bill 63:6,21	Boswell 111:17	broad 19:17 94:14	call 7:6 20:10 53:9	69:22 70:6,9 84:8
billion 69:11	bottleneck 126:20	139:14	101:8 119:12	100:1 136:12
141:12 190:21	bottlenecks 123:16	broader 15:6,20	138:20,20,21,21	198:19,19 200:18
201:18	bottom 63:9 141:14	18:18 42:12 132:9	163:22 184:21	200:18,18
bills 144:2	143:7 166:12	135:3,18 137:8,9	187:6	card 40:20
binding 153:5	176:10	140:9 143:9	called 4:7 17:14	cards 214:9
174:2,5	bound 84:6	broadly 8:10 12:13	24:19 45:10 69:17	care 53:3 100:15
binds 173:20	boundaries 15:13	13:14 24:2 37:20	70:10 102:22	144:3
bio 8:17	boundary 110:6	42:1 105:1 122:19	117:9 163:4,10	career 67:15
biomedical 51:8	Boyd 1:17 3:10 5:5	brought 57:16	182:20	carefully 89:19
Bird 151:4	81:14,17,21 82:16	103:9,12 202:14	calling 26:10	Carl 199:22 200:2
Birmingham 70:6	82:19,21 83:6	203:19	Calpine 120:20	203:17 205:8
77:2	101:11 106:6,15	Brown 75:22	Cambridge 79:2,3	Carr 39:22,22
			Canada 187:2,18	

213:15,16	65:9 66:9,16	113:4 214:3,3	choosing 78:2	closed 101:6 204:7
carriers 79:17	67:20 71:8,10	changing 20:7 85:8	chore 83:2	closely 86:3
carries 90:21 184:5	77:19 78:18	96:2 189:22 190:1	Chorus 7:2	closer 60:17 95:12
case 122:3 125:9	101:22 154:12	Channel 40:1	circle 53:10,11	Club 99:17 145:3
207:17	201:21 207:13	chapter 200:22	circles 130:8	cluster 109:14
cases 55:18 64:11	certification 178:3	202:1,9 203:5,9	cities 98:20 107:11	co-chaired 49:2
67:9 87:21	certified 154:20	203:16 206:19	107:12	co-chairs 21:20
Casey 106:7	cetera 129:12,12	chapters 205:4,6	city 160:5	co-convening 9:4
cash 54:4 135:8	137:13,13 214:7	characteristic 57:1	civil 195:14	CO2 30:14 37:14
Casper 138:16,19	chain 194:6	characteristics	Claire 79:3	37:20,22 38:18
138:20	chair 1:11,13,14,19	156:3	clarification 89:3	39:7 41:18 59:6
cataloguing 201:10	3:2 4:3 5:6 6:20	characterization	clarify 75:15	70:2,3 110:13,14
catch 79:20	7:1,3,5 8:14 50:10	186:7	Clark 97:3	201:16,18
categories 33:13	50:13,16 51:13	characterize 181:2	class 98:19 173:10	coal 1:3,13,14,16
categorize 136:3	73:2 74:20 75:2	183:16,22	173:13	2:8 3:3,17,19 4:5
173:9	79:14 81:10,15,20	characterizing	classes 85:3	4:6,11 7:7 8:5
caught 45:13 99:4	114:1 198:2	182:4	classic 168:9,20	9:16 13:21 15:22
cause 35:9	199:20,21,21,22	charge 134:12	169:7	25:14 26:9,12,16
causing 27:16	200:1 207:5	charges 61:1	clean 4:11 18:13	26:17,20 28:9,20
cautious 109:11	Chair-Committee	chart 43:10 127:7	19:22 23:17 29:6	29:6,13,14,18
113:7	1:18	chase 67:5	41:14 52:12,22	30:12,21 34:11,16
CCS 198:19 201:5	chaired 80:17	chasing 67:10	54:14,17 70:14	34:17 35:19 39:15
203:11 204:20	chairing 5:19	cheap 122:12	74:15 75:7 76:5	43:2 49:14 50:14
CCS/CCUS 201:1	chairman 4:5 52:7	125:12 128:14	110:6,7	51:18 54:20 55:2
202:11	110:18	139:11 175:15	cleaner 29:7 58:6	56:3,6 58:6,16,17
CCUS 201:5	chairs 49:4	190:21 191:14	cleaning 196:12	59:4,9,9 60:21,21
cede 97:5	challenge 40:8	cheaper 191:16	clear 91:9 97:14	61:8 65:18,22
center 9:2 53:11	93:21 139:1	cheer 215:9	103:16 117:2	66:2,8,12,15,18
70:7,9 151:20	challenged 68:11	chemistry 82:5	145:15 146:1	68:2,6 70:14 72:8
193:1	73:4,9 118:5	chief 1:16 2:1 5:4	169:5	72:10,12,14 73:15
central 34:15 73:17	challenges 79:7,15	50:19	clearly 83:15	73:19,21 74:4,5,6
74:5 116:19 144:7	80:6 113:16	China 76:3 82:12	116:15 117:19	74:11 76:5 79:20
172:4 180:11,18	135:17 202:10,18	83:22 97:19 99:13	139:21	80:3,14,19 82:17
185:11,18 186:9	203:18 204:2	99:16 106:9	climate 2:2 3:6	84:10 89:13 91:5
centric 154:17	207:22	112:14 172:4,6,7	4:21 9:2,9,12	92:13 101:5,6,16
century 212:2	challenging 139:10	172:22 173:2,12	11:13,20,21,22	101:20 102:2
CEO 56:12,13 57:4	Chamber 99:11	175:5 176:11	12:4,14 13:2,6,11	106:10 107:7,11
certain 83:18 87:17	chance 99:8	177:5 179:13,15	13:13,16,16 14:3	110:3,19 111:4,14
118:12 124:7	change 9:9 12:5	179:22 180:11,18	14:6 16:3,6,8	112:7 116:13
136:2,6 142:8	13:6 14:6 20:21	181:13 195:8,15	20:17,20 21:19	118:8,20 119:15
169:17,20 170:2	23:2 73:15 85:9	195:21 196:9	22:13,22 23:1,9	120:8,17 122:10
176:6 182:5	99:19 148:6 157:4	Chinese 180:10	24:2 33:16 42:12	124:3,13 127:8
certainly 15:5 17:4	171:19 188:10	195:9	145:4 171:19	128:3,8,19 130:1
19:9 22:12 38:16	191:22 214:2	choice 64:12 65:2,3	191:22 199:3	130:19 133:4
39:9 52:10,20	changed 25:17	65:3 91:1,12	close 31:14 48:13	134:12 135:7,19
55:11 56:22 57:22	72:13 88:11	176:6	59:5 68:9 112:11	135:20 136:20
59:18 60:12 63:15	changes 96:2 99:5	choices 62:22	177:5 184:9	137:3 141:10,21

142:7,9 143:7	coming 25:13	communication	complicated	conservation 158:6
144:8 145:6,16,19	32:12 87:9 91:8	87:4 177:16	101:18	consider 7:19
147:18 148:4,15	95:11 106:10	communications	complying 97:9	148:3
148:20 149:6,12	116:7 124:6 125:5	3:20 209:6 211:7	composite 169:7	considerations
149:17 150:20	128:6 133:22	212:8	comprehensible	149:19
175:13 176:20,21	135:21 140:18	communications-...	115:11	considering 17:6
177:4,6,10 189:19	155:7 182:21	211:8	comprehensive	26:14 113:4
190:3,5 191:5,11	188:6,8 210:11	communities 20:14	14:9 22:10 24:15	consistent 88:3
191:12 197:17,20	comment 3:22 6:7	companies 58:22	25:9	135:14
198:2,7 199:21	46:9 49:22 136:19	61:12 112:18	conceivable 96:16	Consol 107:19
204:18 205:15,16	193:2	138:7 141:10	conceivably 93:19	consolidate 146:6
205:19 207:12	comments 32:18	146:21 148:19	97:10	consolidation
208:5 211:20	93:15,16 137:6	company 1:14 2:1	concentrated	141:6,19 144:8
212:10,11	153:1 213:3,7	3:9 5:5 50:20	136:21	145:22 147:16
coal-based 207:18	214:12	52:20 53:9 55:12	concern 89:3,14	constrain 191:15
coal-fired 28:7	Commerce 99:11	55:22 56:12 57:4	90:7,7 171:16	constrained 125:15
148:1	commercial 156:8	57:17,19 60:1	192:1	constraint 23:19
coal-generating	161:19 162:17	61:17 67:4 68:3	concerned 17:4	96:19 173:19
89:7	165:9 169:22	68:21 70:7 71:7	95:16 123:17	174:2,5,11,17
coast 40:6 59:5	commerciality	72:1 75:10 76:12	concerns 29:3	186:13
64:17 190:13	179:18	80:12,17 85:16	90:17 94:19 153:4	constraints 28:10
196:3	commercially	147:11,12	160:1 194:8	153:5 191:10
coin 119:5	155:12	Company's 50:22	concerted 8:1	192:20 195:6
Coinciding 167:3	Commission 1:20	compare 92:1	206:13	constructed 98:10
cold 60:4 77:9	5:7 81:16 163:11	compared 64:12	conclude 5:14	construction 51:2
coldest 104:15	commissioner 1:19	compensate 140:21	114:5	71:19 153:7
collaborative 14:10	5:6 81:14 97:3	compensation	conclusion 174:3	constructive 119:5
colleagues 88:8	100:9,10,11,12	139:18 140:12,16	concur 153:3	constructs 135:2
98:11	Commissioners	compete 28:1	conditioning 54:8	construed 8:2
collecting 204:8	1:18 3:11 81:19	124:13	conditions 22:13	consult 41:13
collectively 47:4	committed 52:11	competition 8:2	207:21	Consultants 149:4
color 170:19 171:1	59:8	30:9	Confederation	192:17
colors 110:21	committee 3:18,19	competitive 124:21	82:1	consulting 41:15
Columbia 190:15	3:20 6:2 7:16	competitiveness	conference 82:4	75:8 107:20
combined 68:12,16	50:2 81:20 199:21	189:19	214:14	consume 169:13
159:7	205:16,19 211:7	complete 6:9 185:1	conferences 152:5	174:10
come 19:19 28:12	212:8	214:15	confident 37:18	consumers 64:9
46:21 47:14 71:17	commodities 28:20	completed 39:15	confidential 86:21	65:7,8 97:10
86:15 91:15 93:10	40:4 116:17	80:13 203:6,8	conflicts 195:15	158:4
96:13 138:17	127:16	211:17	confusion 91:12	consumes 177:5
146:9,21 174:21	commodity 117:8	completing 61:14	congratulations	consuming 73:21
189:2 197:19	143:21 158:2	complex 175:17	10:18	consumption 69:13
200:14	177:17	compliance 86:2,8	Congress 47:2	108:22 125:17
comes 15:6 100:4	communicate	86:13 87:10 88:3	connect 171:8	131:3 134:20
137:1 138:3 158:9	63:14	89:10 92:1 93:20	connotation 147:7	159:4 191:11
166:9	communicating	110:11	cons 26:20	contact 161:15
comforting 63:12	88:15	compliant 136:5	consecutive 114:22	181:4 206:18

contacting 160:12	conversation 93:9 102:11 103:18 155:2,8 178:13	7:7 9:7,17 21:19 21:22 37:5 39:15 45:18 49:3 50:14 51:18 82:17 150:20 197:17 198:2,7 204:18 205:16 208:6,9,11 208:17,22 212:10 215:13	create 58:19 160:20 196:5 created 104:7 165:4,5 creates 108:22 194:21 creation 176:14 credit 92:12,14,18 92:20 credited 91:10 credits 137:21 crises 159:20 crisis 87:15 critical 9:18 14:5 202:18 critter 110:13 cross 110:2 cross-state 109:4 crosscutting 33:15 33:16,17 crude 27:15 29:11 29:18 35:21 crunching 24:12 CSX 214:21 culture 57:1 curbing 14:4 cure 157:8 curious 145:8 current 9:1 14:15 64:1 142:15 150:3 158:17 163:13 173:11 197:21 currently 5:16 9:11 81:15 133:8 152:4 201:14 curtail 79:19 curve 186:20 187:7 curves 181:22 cushion 95:9 customer 53:13 85:3 customers 52:14 53:7,12,20 55:14 56:10 59:16 60:10 60:22 61:4 62:21 63:3,5,15,18 64:8 65:15 68:1,5 85:5	85:5 105:10 cut 141:12 196:21 210:10,16,19 cutting 12:2 cycle 94:2 107:15 107:15 120:12 127:17,18 128:1,2 134:3 159:7 cycles 127:17 158:2
contaminants 193:19	conversely 125:10 127:22 131:3	Council's 8:5 197:20 207:12	credited 91:10	<hr/> D <hr/>
contemplate 148:21	conversion 149:17	counsel 2:8 3:4 7:7 8:9	credits 137:21	D 203:17
contemplated 130:11 131:4	conversions 128:19 149:11	counter 54:3	crises 159:20	daily 9:18 116:5 120:1
contentious 91:2	converted 64:19 148:20	counterintuitive 119:8	crisis 87:15	Dakota 92:16,19 108:12
context 13:17 16:1 18:13 21:6 26:8 30:18 38:2,20 42:10 116:8 119:11 125:6 139:9 180:16	converter 100:5	countries 76:3 173:21,22 174:1 176:9,14 193:1	critical 9:18 14:5 202:18	Dam 100:6 195:17
continue 5:3 61:6 74:3,6 80:1 126:22 128:21 133:1,5 141:8,9 141:17 143:12,15 146:6 147:17 207:11 209:11,18 210:18,20	COO 3:9	country 1:22 5:18 22:18 32:15 36:7 64:16 65:11 85:17 95:10 108:7 175:11 176:8 194:11 197:22	critter 110:13	damaging 22:16
continued 16:15,21 66:15 78:4 164:5	cooling 22:19 63:13	counts 116:1	crosscutting 33:15 33:16,17	dampen 158:7
continues 74:12	coordinate 25:1 45:1 46:19,20	couple 29:9 58:11 62:10 69:15 76:6 100:17 121:9 136:15 155:7 170:13 180:19 181:18 199:4	crude 27:15 29:11 29:18 35:21	dams 29:22 30:2
continuing 52:17 209:21 212:15	coordinated 25:2 45:6	coupled 122:14	crunching 24:12	Dan 49:4
contract 133:7	coordination 46:7 47:7,8	course 17:19 18:7 32:13 33:14 55:5 61:14 62:1,16 81:1 157:21 209:8	CSX 214:21	dark 117:21 118:4 118:6,15,19 171:14 172:4,20 191:20
contracts 62:4,8 74:5	copies 80:16 212:13	courts 141:4	culture 57:1	data 14:16,16 41:2 41:9 48:8 166:6 202:3,5
contributed 208:22	copy 8:5	Cove 190:14	curbing 14:4	database 209:15
contributing 206:17 209:10	core 69:4	cover 12:11 14:11	cure 157:8	David 1:17 3:10 5:5 71:9 81:14 82:19 106:4,5 112:11
contributions 82:8 208:10,15	corner 133:20	covered 37:9	curious 145:8	day 52:12 54:12 55:15 67:10 72:19 72:19 91:14 99:7 106:18 122:2,2 124:15 126:16 128:11 153:19 154:4 174:9,13
contributor 75:21	Corps 40:6,8	covering 114:17	current 9:1 14:15 64:1 142:15 150:3 158:17 163:13 173:11 197:21	deal 23:18 26:22 80:2 85:7 89:12
controls 69:11	correct 153:8	covers 92:8	currently 5:16 9:11 81:15 133:8 152:4 201:14	dealing 13:15,16
controversial 129:1	corresponding 40:5	cracked 103:17	curb 157:8	
controversially 121:8	cost 38:11 59:15 60:21 68:6 90:21 97:8 103:4,6 122:8 141:12 146:2,9 161:6 170:1 184:10,22 196:16	cracking 160:22	curtail 79:19	
convened 14:22	cost-effective 90:15	cranes 64:18,20,20	curve 186:20 187:7	
conventional 34:4 170:17 171:3 182:3,14,15	costs 16:20 38:4 95:19 141:13 186:21 190:20 210:11,19		curves 181:22	

91:16 109:20 110:8,12 113:9 135:2 deals 146:9 191:1 202:9 dealt 25:6 dear 37:7 debate 126:11 130:6 134:16 136:14 138:16 144:9,12 debates 123:15 140:4 decade 69:7 126:8 142:16 145:10 154:6,13,18 175:22 177:3 191:8 decades 58:12 200:4 December 206:3 decide 96:20 200:4 decided 159:17 decision 37:17 43:3 48:22 49:1,1,7 53:12 122:7 174:14 decisions 54:12 88:2 90:10 94:13 decline 125:14 182:4,12,12 183:16,22 184:8 dedication 71:21 deemed 156:6 deep 178:19 194:16 196:10 deeply 35:14,16 55:13 deficit 207:20 208:2 defined 110:7 definitely 23:7 34:22 42:3,11 43:22 98:15,21 109:4 141:4 definition 120:11 135:7 201:15	degree 51:6,8 degrees 77:4,15 78:12 delay 94:8 delegation 100:8 deliverability 137:2 delivered 190:18 198:18,21 199:2 deliveries 28:19 73:3 79:16 delivery 43:5 72:10 80:7 99:3 112:7 170:2 demand 23:15 60:5 104:6,8,11 128:16 132:15 142:16 157:21 158:7 173:7,18,20 174:15 175:3,7,12 176:7 188:5 191:16 demands 171:10 174:21 176:15 178:21 demonstration 69:20,22 200:21 denying 92:19 department 1:1 2:3 8:9 17:13 44:21 152:2,4 213:8 depend 52:12 112:3,6 depends 43:16 111:14 deplete 182:7 deployment 202:10 203:18 204:2 Deputy 2:2 3:6 4:10,21 9:12 desalination 196:2 described 49:13 describes 45:12 design 40:1 61:18 designated 2:7 4:16 designed 89:17 desirous 59:6	desk 214:16 despite 162:14 177:12 destroying 41:19 destructions 35:21 detail 8:7 21:7 detailed 8:17 determined 89:21 develop 14:8 25:8 157:18 181:21 184:10 211:22 developed 57:17 149:7 164:15 169:20 175:1,4 developers 112:17 190:22 193:10 developing 12:18 173:19 177:12 179:15 212:9,17 development 3:15 69:9 70:11 180:7 187:22 190:17 192:20 193:6,17 196:1 developments 112:14 device 212:5 Devon 165:20 166:16 Devonian 156:20 devoted 48:20 dialogue 94:15 98:3 101:3 102:13 105:21 108:15 dictate 135:4 diesel 64:18 different 21:14 22:17 23:20 30:10 40:15 42:15 43:16 88:16 103:9,18 109:7 110:12 115:21 116:21 119:1 148:21 150:6 154:19 183:15,15,17 186:8 187:11 194:5	differentials 188:11 difficult 53:7 68:17 85:7 digest 167:12 digesting 83:12 digitized 166:5 dim 170:20 dime 155:4 dioxide 38:5 dipping 95:13 dire 189:12 direct 112:21 198:15 directing 87:16 direction 103:22 158:1 166:14,19 207:15 208:4 directional 162:22 163:6 directive 155:11 directly 145:17 179:4 198:10,14 director 1:20 2:2 3:6 4:21 5:10 9:12 57:12 114:15 151:20 directors 51:12 81:19 dirt 120:15 disadvantaged 188:1 disappears 170:21 disastrous 146:18 discharge 22:20 discord 195:13 discuss 211:8 discussed 101:19 discussion 122:18 179:14 190:2 discussions 7:14,19 7:22 49:5 dispatch 68:9 89:15,17 90:5,18 90:19,20 displaces 143:21 displacing 29:14	disposal 194:4,17 disputes 96:14 dissertations 156:16 distance 106:21 distressing 120:5 Distributed 102:7 distributing 212:16 distribution 15:16 26:7 185:12,19 186:8 diverse 61:2 206:13 diversity 83:18 140:22 document 203:16 DOE 3:8 10:11 11:8,8 12:12 15:9 16:10 17:3 18:21 24:19,19 25:6 38:20 42:14 44:14 46:9 49:21 58:11 70:8,12 97:22 199:17 202:2,4 203:13 208:18 DOE's 4:15,22 9:13 11:12 13:20 48:22 DOE-funded 97:20 dog 113:12 184:21 doing 12:13,13 17:12 20:5 21:4 25:19 26:1,2 27:6 28:4 29:4 31:8 32:3,5,6 33:1,18 34:14 39:7,10,11 42:18 58:8 69:16 71:4,15 72:11 80:5 113:5 122:21 123:1 166:17 215:8 DOJ 134:16 dollars 146:9 domestic 38:7 49:3 dominated 175:13 Dominion 126:5 207:6 donated 209:5 donations 209:14
---	--	---	---	---

door 103:17	183:4	169:4,7	207:3 209:9 214:6	enabled 74:9
doors 215:16	driven 78:21	easier 19:1	efforts 158:6	enacted 192:4
dormant 194:14,20	123:11 155:10	east 64:17 87:15	209:17	encourage 129:18
dots 169:12	191:10	118:3	eight 156:14	150:13
double 132:5	drives 123:3	eastern 73:5 118:4	eighties 61:16	encouraged 159:6
doubled 131:19	174:14 176:7	135:19 136:3	Eighty 92:9	encourages 157:11
doubling 79:17	182:6 214:2	easy 71:4,5 76:19	either 190:14	157:16
downhole 160:22	driving 129:19	93:6	elect 211:1,2	Ended 161:3
164:8 165:13	153:20 163:22	ebbs 84:21 112:5	electric 1:21 16:16	endowed 171:2
downstream 15:2	176:15 182:18	economic 54:12	42:21 46:3 58:3	energetic 211:13
DPL 140:15	drops 182:8,11	65:3 68:8 85:1	62:2 64:20 65:12	energy 1:1 2:2,3,4
Dr 81:17,21 82:16	drought-stricken	90:19 150:1 172:5	68:10 85:9 114:15	2:4 3:7,7,15 4:16
82:21 83:6 101:11	193:7	173:3,6,11 175:1	114:18 115:20	4:22,22 5:11 8:21
106:6,15 107:18	drove 157:4 158:19	176:13	124:19 125:3	9:3,13,13 13:2,9
111:3,6 112:2,16	174:8	economics 2:5 5:11	electricity 1:19	13:15,17 15:10,14
113:21 114:1	dual 105:8	74:10 91:21	33:11 52:13 53:1	16:21 17:3,13
151:17 152:11,13	due 24:11 111:3	119:13,20 120:7,9	55:1 56:6 58:19	18:1,4,6 19:10,21
193:3	207:20	120:21 121:6,18	60:9 62:20 64:11	20:20 21:11 22:3
draft 93:13 94:11	dues 209:4 210:22	122:13 125:10	65:4,6,16,20 67:1	22:12,21 24:6,7
203:7 205:3	Duke 140:15	128:8 143:2	68:1 69:13 76:5	24:15,20 25:5,6
drafts 203:7	duly 213:6	151:18 152:2,6	81:20 83:20 100:4	25:10,16 26:2,5
dramatic 159:3	Dumoulin-Smith	economies 173:19	103:6 105:16	26:13 27:12 30:11
162:11 167:3	1:20 3:13 5:9	economist 169:9	108:3,5 142:16	30:11 31:12 33:22
175:6	114:14 115:14,16	economy 20:15	159:20	35:17 40:3 41:14
drastic 148:6	115:19 145:14	60:7 65:14,19	electrification	42:9 44:11,14,20
draw 168:7,11	148:9 149:15	edges 99:14	65:13	45:6 55:7 56:1
187:14	150:9	Edison 42:21 147:2	element 118:13	62:16 64:12 65:8
drill 160:11,14	Duncan 52:1	educated 62:21	130:10 139:19	65:10 66:13 72:8
165:18 167:5	Durham 1:14	education 209:18	elements 53:3	75:7 82:2 92:8
181:1,5 182:13	50:13,16 81:10	effect 125:22 139:1	eliminate 66:17	97:22 99:5,16
183:2,7 184:8,17	114:1	effective 170:2	eloquently 85:18	107:19 110:19
184:17,22 185:9	dynamic 123:2	effectively 131:5	email 116:4 148:8	112:14 134:13
185:14,15,16	133:14 134:9	135:7 161:1	150:13	145:5 147:19
194:16,19	154:13 170:10	effects 27:16,17	emailed 211:1	149:3 151:18,20
drilled 160:7	E	35:9	embarked 55:21	152:4,6,8 154:12
161:20 165:10	E4 130:15	efficiency 2:2 3:7	embarking 63:16	159:17 165:20
167:7 180:22	earlier 34:1 79:18	4:22 9:13 12:22	emissions 1:15 14:4	168:14 169:9,13
181:8 187:9	122:18 132:10	18:4,6 55:7 62:17	14:15,18,20 15:17	171:10,20,21
drilling 40:13	196:17	65:11 67:13 149:9	30:20 66:20 69:12	172:1,8,16 173:17
162:22 163:5,6	early 49:18 61:16	158:5	emitting 14:12	174:2 175:3,7,10
166:18 180:10	67:15 138:14	efficient 54:19 58:7	emphasize 122:15	175:12 176:1,3
185:4 196:10,14	159:17 163:1	68:22 149:13,14	125:13 127:16	192:6,17 207:6
drinking 152:16	180:20	200:9	129:4 134:5,8	209:18 211:20
drive 120:10	earn 120:2	effort 14:5 17:10	136:15 146:19	213:8
127:20 131:3	earned 51:5,7 82:5	25:8 200:21	147:1	EnergyPlus 214:22
146:1,7 163:21	earnest 156:13	201:22 203:14,17	employees 52:10	enforce 192:3
180:5 181:17	Earth 168:9,20	204:22 206:13	enable 16:20 38:6	enforced 8:11

enforcement 110:15	201:4	evening 214:21	exist 28:22 133:8 170:6,17 179:11 181:12,13	206:3
engage 137:2	EOR 30:14 37:20 38:1,18 39:7	event 105:15 151:13 209:5	existed 156:5	extent 12:15 120:6 126:21 130:6 136:2 142:8 143:11
engaged 112:22	EPA 16:4,7,12 17:9 17:19 18:18 66:21	events 115:8	existing 14:18 66:20 74:4 80:14 80:19 136:22 147:22 210:3 212:11	extra 93:7,16
engagement 36:2	89:5,9 91:17	Eventually 88:4	expansion 67:19 153:13	extract 159:14
engaging 12:5	92:22 93:8 96:15	everybody 7:12 8:3 19:4 43:13 156:2 206:2	expect 63:9 79:7 208:1	extracting 163:7 182:2 196:11
engender 144:15	97:14,15 108:2,15	everybody's 35:14	expects 120:18	extreme 20:21 22:22
engineer 67:3	109:3 138:12	evolved 92:3 93:2	expensive 60:19 68:7 137:18 190:8 190:9	extremely 108:6
engineering 51:1,6 51:8 195:10	EPA's 66:16	exact 84:20 103:22 111:7,15 167:16	experience 8:21 9:15 82:13	
engineers 40:6,9,9 67:7	EPA-regulated 194:18	exactly 126:3,6 130:9 138:19 152:20 166:13 167:15 190:21	experienced 59:19 77:9	F
England 123:19 125:9 132:7,10,12 132:22	EPRI 9:7 57:21 58:1,10 82:4 203:22 204:19	example 15:22 18:5 23:16 29:15 34:3 35:4,18 48:8 64:14 89:4 120:16 120:20 165:20 179:13	expectation 73:10 98:19	fabulous 215:7
enhance 182:10 183:5	EPRI's 51:11,13	examples 12:6 28:6 69:15 142:22	expected 113:6 211:17	FACA 7:16
enhanced 9:4 37:5 38:5 39:16 59:1,6 182:9	EPSA 2:3	excellent 83:2 98:1 192:15 197:12	expedition 165:14	face 83:6 113:7 143:8
enhancing 209:21	equal 165:4,5	exception 121:5	expenses 209:22 210:1	faces 51:22
enjoy 8:13 169:22	equate 163:16	exceptional 114:11 121:1	experts 202:16 204:19	facilitate 180:6
enjoyed 4:12	equation 122:16	excerpt 198:10	experiment 136:20	facilities 30:7 90:4 101:21 190:14
enough's 140:21	equipment 110:9	excessive 192:21	expert 72:18 81:4 106:15	facility 58:15 70:5 70:8,11,18,19,20 71:15,16,20 100:1 110:10 111:18
ensure 56:8 80:3 129:9	equitable 139:6	exchange 99:8	expertise 9:15 18:5 197:1 202:14,14 202:15 203:19 209:10	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
enter 92:6	equities 26:12 33:3 49:12	exchanging 214:9	experiences 206:14	factoring 66:8 84:4 87:11 121:16
entered 62:4	equity 1:21 114:15 121:2	excluding 205:4	experienced 59:19 77:9	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entering 62:6	equivalent 70:2	excuse 10:22 11:4	experiences 206:14	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entertain 144:21	era 159:1,1,9	executing 48:4	experiment 136:20	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entire 32:21 33:2	Ericson 1:22 5:17 197:18 198:5	execution 201:14	expert 72:18 81:4 106:15	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entirely 96:16 112:6	escape 56:16,18	executive 1:16,20 5:9 40:10 47:3 50:19 114:14 141:3 210:4	expertise 9:15 18:5 197:1 202:14,14 202:15 203:19 209:10	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entities 99:15 112:18	especially 110:22 139:15 143:10	excuse 10:22 11:4	exposed 68:5	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
entrant 119:13	essence 208:18	excuse 10:22 11:4	exposing 68:5	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
environment 2:2 3:7 9:12 119:6 149:4 152:9 157:16,20 163:13	essentially 66:17 67:6 68:18	excuse 10:22 11:4	extended 206:7	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
environmental 4:21 8:21 26:15 31:9 40:11 51:3 65:2 66:10 69:9 69:11 83:12 90:20 173:5 191:10	estate 192:22	excuse 10:22 11:4	extended 142:12	fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
environmentally	esteemed 81:21	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	estimated 63:22 64:6	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	et 129:12,12 137:13 137:13 214:7	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	EU 84:7	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	Europe 174:1	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	Europeans 84:6	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12
	evaluation 214:14	excuse 10:22 11:4		fact 19:6 25:21 54:22 60:6 63:1 63:19 65:17 68:15 74:10 82:11 100:22 114:21 123:21 143:16 151:10 156:1,12 177:2 181:6 199:15 203:7 212:10,12

famous 168:21	figured 96:21	169:20 182:1	focused 7:14 9:17	55:3
Fanning 71:10	104:3 167:2	196:21 203:5	13:5,21 15:1,9,11	forward 52:17 66:7
fantastic 178:22	200:12	205:9,11	15:17 42:13 58:6	73:11 81:6 85:21
far 60:7 63:22	figures 214:7	FirstEnergy	68:22 127:4	96:3 97:18 103:17
155:17 183:4	file 97:13	140:15	135:19,22 140:10	122:9 153:21
203:13	filed 166:1	fiscal 47:5	204:18	157:3 164:4
farther 154:2	files 166:4,9	fit 26:9 50:3 99:14	focuses 193:9	170:12 174:20
fast 157:2 164:4	fill 48:11	fits 21:22 22:2	focusing 15:15	214:8
170:12 196:19	final 94:8,9,11	fitting 61:20	54:13 67:10 83:10	fossil 4:16 97:22
faster 78:9	150:18 197:11,15	five 52:4 92:9 97:20	94:5 159:21	175:12 204:20
fault 194:20,21	206:7 212:20	99:14	folks 7:14 19:12	found 10:19 57:11
faults 194:13,14	finally 56:18 82:15	fives 93:19	21:11 40:17 70:12	four 25:20 26:3
favor 7:1	199:6 203:21	fixing 212:5	88:10 99:18,20	47:22 67:2 77:19
favorable 88:13	205:21 215:5	flattens 188:21	116:21 120:12	104:21 200:3
Fayetteville 186:4	finance 3:18	flaw 185:8,9	122:4 129:15	four-part 49:9
feat 162:5	202:17 207:5,5	fleet 54:20 60:21	follow 39:18 83:2	fracturation
feature 160:17	208:8	74:11 80:15,19	follow-on 21:4	167:11
features 178:16	financial 3:12	181:10 204:20	following 5:8	fracture 160:19
federal 2:7 4:16 6:2	115:11 116:11	212:11	200:15	161:13 183:9,10
7:15 17:15 24:21	127:11 207:16	flexibilities 16:19	follows 69:16	183:12
25:7 29:1 33:3	209:12	flexibility 31:10	fond 88:20	fracturing 162:13
43:12 97:6 139:7	financially 207:19	61:2,5,7 68:4	foot 162:8	frame 198:13
208:7	208:22	flexible 23:11 69:1	footprint 31:9 93:3	frank 98:2 107:18
feed 27:10	financing 191:2	floating 169:2	93:20	frankly 116:14
feedback 211:11	207:12 211:21	flooding 22:17	force 9:10 21:15	117:13 119:2
feeds 21:13 196:16	find 19:2 24:6 41:5	35:21	90:9 195:10	121:13 123:16
feel 38:20 87:8 94:7	41:9 57:5,9 66:3	Florida 53:17	forecast 188:14	125:1,11,16 126:3
116:3 117:11	66:13 75:18 111:7	flow 135:8 157:17	foregone 174:3	130:6,20 133:9
118:9 132:1	208:20	160:16,17 161:3	foreseeable 56:2	135:9
fees 210:15,17	finding 40:21 85:7	182:6,8,11,19,20	forest 42:4,9,18	free 116:3
feet 161:12,22	finds 60:1	183:11,12,13,14	forestation 42:3	freight 28:15
162:1,3,9 181:3	fine-grained 21:6	flowing 182:16	forests 41:17	fresh 211:14
189:14	finish 181:16	flown 37:10	forget 172:22	Friday 32:18 49:22
Fellow 2:5 5:11	finished 75:17	flows 84:21 112:6	form 188:8	Friedmann 4:11
151:18	fire 189:8	169:18 177:16	forma 136:5	38:16
FERC 96:14,19	fired 64:18	183:8	formal 133:12	friendly 201:4
104:7 134:16	firehose 152:16	fluctuation 144:2	205:19	fritz 139:16
feuds 163:2	fires 42:9	fluid 183:14	formation 161:8,12	front 14:2 66:11
fiddling 110:4	firm 109:18 125:3	flying 84:2	161:22 165:13	79:8 148:10 201:8
field 178:21 190:17	first 11:11 24:11	FOB 190:18	formations 196:11	frontier 189:17
fields 127:1 163:12	27:6 54:3 67:4	focal 138:11 140:4	formatting 10:5	fruition 93:10
fifth 144:10	68:19 71:4 73:2	focus 3:15 12:6	formed 163:11	fuel 1:13 40:3 61:1
Fifty-two 74:18	83:10 120:19	15:3,18 24:7	Fort 160:3,5	105:8,9 123:4
fight 38:21	136:17 138:13	40:10 42:16 63:3	fortunate 4:8	129:10 137:4
figure 34:9 36:4	148:11 156:1,12	70:15 107:8	Fortunately 60:16	144:3 171:9 173:7
48:11 86:3 88:5	160:7,11 162:19	115:22 137:5	Forty-eight 53:19	174:10,20 176:6
104:4 124:5	165:3 168:8	143:10 197:16	forty-something	176:15 189:8

191:15 214:2,21
fuels 33:12 34:18
 83:18 120:1
full 5:20 6:9 134:3
full-scale 180:6
 187:22
fully 165:16 181:2
function 91:11
 145:15
fund 209:14
Fund-raising
 209:17
fundamentally
 155:12 178:9
funding 208:7
funneled 124:18
further 79:5 124:3
 141:18 199:1
future 26:12 27:1
 27:11 56:2,10
 59:9 66:18 76:9
 81:7 86:4 94:4
 142:6 145:9,10

G

gadfly 84:2
gain 143:12
gains 164:6
game 122:11 168:4
gantry 64:17
gap 202:19 203:21
gaps 14:16 41:2
 48:8,12 200:17
gas 3:15 15:3,18
 33:12 55:6 59:12
 59:14,15,18 60:10
 60:13,18 61:9
 66:19 68:3,6 78:1
 89:15,18 90:1
 99:2,3,3 104:18
 105:2,4,16 110:3
 119:13,15,18
 120:3 121:7,18
 122:10,12 123:11
 123:12,13 124:1,7
 124:13,17 125:4
 125:12,15,20,21
 126:5,5,7,10,11

126:14,19,22
 127:2 128:2,3,4
 128:13,14,19
 129:20 130:3,19
 132:11,13 133:22
 136:20,22 137:3
 139:11 142:7
 143:9 144:6,8
 148:18,20 149:17
 152:8,19 153:19
 154:7,20 155:17
 158:11 159:1,2,3
 159:9 160:9
 163:16 170:8,17
 171:3,8 175:14
 176:16 178:2,17
 182:3 185:7
 186:12 187:15,16
 187:19 188:5
 189:5,10,13 190:9
 192:21
gas-electric 33:19
 89:20
gas-fired 121:10
gasification 58:12
 58:16
gasifies 58:19
Gaylord 1:10
Gee 100:14
Gellici 1:16 36:16
 36:19 39:14,20
 42:19 46:13 48:13
 50:8 75:5 76:10
 78:22 80:8 81:8
 106:4 112:11
 113:18 114:10
 144:18 150:8,12
 192:12 196:20
 197:5,15 207:1
 214:11 215:12
gen 118:20
general 44:20 73:1
 124:21 131:8
 153:6 176:4 189:7
 214:1
generally 25:22
 34:16 150:5

generate 164:6
 186:20 205:12
generating 99:15
 103:10 110:10
 111:18
generation 51:1
 55:2 61:17,21
 65:20 66:18 70:4
 85:10 87:12,16
 89:13 92:10,17
 94:13 95:3 98:21
 102:7,12 103:14
 107:8 108:12,21
 109:8 121:10
 126:14 129:20
 153:19 159:5,7,8
 188:6 189:19
 214:22
generators 86:8,11
 86:20 118:8
generosity 208:12
gentleman 56:11
 100:13
gentlemen 4:4
Geographic 168:21
geographically
 180:18
geologic 156:2
 157:1 160:17
geologists 156:16
George 159:16
Georgia 53:17 62:9
 62:11 63:20 64:4
 64:20
geosteering 164:11
getting 10:10 28:9
 32:16 43:13 48:1
 62:5 67:11 73:13
 80:7 85:21 110:1
 123:19 124:15,16
 124:18 125:18
 134:20 146:5
 161:7 163:4 202:3
 207:15
Giove 97:21 100:12
give 20:4 36:22
 40:19 43:19 57:8

64:14 72:9,21
 79:1 90:13 111:6
 180:15 184:11
 197:8 198:6
given 26:8 61:20
 98:6 119:5 124:5
 161:5,6 184:10,22
 206:6
giving 68:3 143:20
 214:1
glad 76:18 151:15
global 169:11
 175:9 199:9
 203:10,11 214:20
globally 177:11
glorified 136:20
go 11:15 19:13
 74:13 76:11,14,18
 79:5 89:11,17
 94:10 95:4,5 96:8
 97:14 103:17
 108:18 118:21
 125:18 145:1
 148:22 150:4
 154:2,18 155:15
 158:10 163:1
 164:8,20 168:5
 169:3 170:4 173:7
 174:14 177:2,21
 179:10 182:15
 185:7,18 189:5
 190:15 194:1
 195:4
goal 46:16 52:19
 90:8,11 201:17
goal-setting 109:1
goals 24:16 199:8
goes 33:7 84:15
 94:18 95:14 135:5
 149:16 176:12
 191:12
going 11:15,19 12:6
 12:9,10 13:9 20:1
 34:21 41:7 47:2,4
 47:10,11,13,18,19
 48:2,6 49:18 54:9
 60:7 71:11 72:20

78:12 83:3,8
 89:11 90:2 93:15
 94:10,11,21 95:8
 96:22 103:8
 104:12 105:14
 107:7 108:18
 114:3 115:20
 118:20,22 119:1
 120:12,13,14
 121:21 124:13,22
 125:3 126:17
 127:20 129:14,19
 130:2 131:11
 132:14,17,21,22
 133:4,16 134:4
 135:10,21 136:9
 137:2,10,14,17,18
 137:19,22 138:11
 138:17,22 139:1,3
 139:9,20 140:1,3
 140:5,14 141:7,9
 141:17,19 143:4,8
 143:14,16 144:4
 144:11 146:6,17
 147:16 148:19
 149:21 153:11,20
 153:21 154:5,11
 159:19 162:6
 163:9 166:3
 170:12 171:9,12
 174:21 175:2,12
 177:10,13,18
 179:22 180:4,5
 181:16,17 183:3
 184:9,11 185:7,15
 185:16 188:9
 190:5,6 191:3,9
 191:11 192:8
 196:19,21 200:11
 200:16 201:4
 204:12 205:2
 211:6 212:22
 213:22 214:7
Golden 117:9
good 4:3,17 7:18
 40:20 49:19 58:9
 82:21 98:14

100:18 115:16 117:6 122:14 131:16,17 132:3 134:3 184:7 185:15 208:1 215:8 Gorges 100:5 195:17 gotten 59:22 govern 6:3 governance 3:21 212:21 government 11:2 12:13 21:3 24:22 25:7 33:3 36:11 36:12 41:11 85:10 97:6 137:22 143:20 180:4,10 208:8 government-wide 24:18 governments 14:10 29:1 Governor 101:1 gracious 150:15 graciousness 80:9 grain 101:15 granular 202:8 grateful 63:12 gray 188:20,21 great 22:10 37:22 39:9 40:19 56:16 58:1 67:14 74:1 76:12,15 80:2 89:12 99:8 123:14 130:18 178:19 197:6 214:11 greater 90:4 103:20 greatly 198:4 211:4 Greene 2:1 3:9 5:4 50:19,21 51:4,11 51:14,16 72:16 75:13 76:17 77:13 80:22 81:11 greenfield 190:11 GreenGen 99:22	greenhouse 66:19 Greenwald 2:2 3:6 4:20 8:16 9:11,21 10:1,15 37:12 39:19 40:18 41:16 42:1 43:8 45:16 46:11,15 48:21 greet 54:2 Greg 207:5,10 Grid 100:2,3 ground 120:14 207:16 Group 1:21 40:1 grouping 186:22 groupings 167:21 167:21 180:12 groups 8:12 81:22 87:21 98:3 99:10 99:17 113:7 grow 113:13 growing 52:1 65:17 78:9 growth 98:18 113:10 142:14,15 158:7 159:3 172:6 173:3,6,12,20 174:22 175:1,3,9 176:13 177:9 Guard 40:6 163:4 163:10 guess 14:14 20:11 34:12 85:8 172:14 177:8 187:18 188:4 guests 4:9 6:5,7 guidance 207:2 215:4 guidelines 8:6 16:20 66:20 67:22 guy 20:7 guys 140:22 194:10	hall 7:20 hand 153:12 hand-cranked 30:3 happen 127:16 128:17,21 130:9 178:8,18 179:21 180:4 183:1 188:4 190:3 191:3 196:18,19 207:14 happened 155:4,9 155:20 157:3 158:19 159:12 164:17 166:22 167:2,15 177:20 178:4 happening 27:22 32:3 113:11 127:9 128:20 154:15 155:21 167:8,17 170:10 176:10 177:12 180:1 188:18 189:9 191:8 193:8 happens 127:13,14 141:1,2 160:15 166:1 175:19 183:8,11 happy 24:2 36:13 40:16 72:4 88:22 211:13 hard 10:8 71:12 98:13 150:2 206:2 212:13 hard-to-read 43:9 hardening 23:14 Harley 57:4 hash 124:22 hasty 90:9 hat 98:13 Hatfield 163:8 Haynesville 167:20 186:4 haze 106:22 135:22 138:21 head 43:11 177:15 heading 131:9 207:14 208:3	headlines 71:1 headwinds 66:8 healthier 146:22 hear 5:9,17 47:13 92:22 180:9 199:4 heard 48:14 56:14 76:22 77:5 79:18 108:14 125:12 129:2 138:13 149:5 heart 37:7 hearts 68:10 heat 54:7 67:6,11 67:12 77:6,20 78:2,21 117:3,3 117:12 137:12 190:1 heater 78:14 heaters 77:8 heating 78:13,14 101:14 104:19 Heaven 104:3 107:6 heavily 87:13 92:16 heels 159:9 height 180:21 held 6:1 Hello 72:7 110:18 help 19:12,15,18 93:11 104:3 112:9 129:22 213:17 helpful 17:7 93:16 helping 17:21 151:3 202:5 214:6 heterogeneity 165:6,8 181:15 Hi 41:16 42:20 79:2 107:18 198:5 hiding 112:19 high 49:13 60:14 60:16 110:2 136:18,18 157:8,8 157:22 158:4 high-grade 158:5 high-price 157:15 157:19 higher 68:5 78:1	131:5 133:2,11 135:11 158:12 highest 204:11 highlight 8:18 178:14 211:9 highlights 20:4 highly 68:22 136:21 143:22 highs 117:4,19 119:9 Hill 1:10 hint 158:2 Hiranthie 210:8 213:14 215:6,10 historically 74:14 history 37:22 hit 119:12 129:5 204:16 hits 192:3 hitting 117:3 holding 209:22 Holdren 49:4 holds 81:21 hole 137:15,16 166:13 196:14 Holly 203:6 home 104:18 181:18 honest 98:2 honor 83:1 Honorable 1:17 3:10 5:5 Hooks 72:7,7 74:17 74:22 75:4 110:18 110:19 111:5,22 147:18,18 hope 40:7 110:20 206:11 hoped 21:3 hopefully 19:3 24:5 32:17 36:2 49:16 144:15 196:22 horizontally 161:11 hosted 115:8 hot 22:20 63:13 Hotel 1:10
---	--	---	---	--

hour 119:11 138:21 143:14 144:4	II 56:17	improve 61:6 137:12 209:12	112:2	injecting 160:21
hours 174:8	III 2:4	improved 73:6 88:11	index 190:22	injection 194:17
house 9:9 21:17 25:3 44:2 49:1 70:5	Illinois 72:14 73:16 74:2,8,14,22 118:13 140:18	improving 94:17 132:7,8 133:5 207:11	India 76:4 172:14 172:15 175:5 176:11 193:2	inkling 154:10
Huaneng 99:21	illustrate 118:5	in-kind 208:14 209:1,7	individual 19:14 93:13,14 165:4,9 213:8	inland 29:19 196:6
hub 123:9 153:9	imagine 32:19 93:4 98:22 182:14	incentive 143:20 144:5	individually 87:20	inning 168:4
huge 60:5	immediate 111:12 145:9,10	incentive-based 14:19	industrial 85:5 99:18 159:4 188:7	innovate 57:7 66:14 90:14
hundred 29:21 180:13	immediately 109:17 128:15 171:12	incentivize 129:15 153:6	industries 145:13	innovation 56:7 66:6 69:3 164:1
hundreds 146:8 163:1	impact 143:2	incidents 163:9	industry 3:12,13 7:15 8:12 49:14 57:2 58:3,10 63:2 72:1 76:16 85:9 90:13 115:8 116:12 120:9,18 124:3,7 135:17 140:11 143:1 176:3,22 177:1,11 178:17 200:3 204:3,5,19 207:21 211:12 212:16	innovations 159:6 164:5
Hunter 52:9 76:20 76:20	impacted 105:17	include 41:21 47:3 132:4 187:2	inevitably 165:12	input 23:8 32:14,16 32:19 35:1 36:4 39:6 43:7,13 49:18
Hunton 2:8 7:8	impacting 83:20	included 8:17	infected 158:18	insert 147:8
hurricanes 35:21	impacts 12:4,10 20:17 35:16 102:17 139:6	includes 18:19 85:4 200:19	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	inside 99:2 105:15 109:21
hurry 48:15,16,16 50:4	imperative 201:1	including 4:9 5:15 7:20 15:7,22 17:18 19:21 50:22 82:1 115:5 156:4	infrastructure 20:15 21:21 23:14 26:6 30:4,7,14 33:22 124:11 126:12 175:21 176:2 178:19 186:15 190:11,12 190:16	insight 147:8
hurting 67:1	impinges 34:14	inclusive 36:9	infected 158:18	insightful 110:22
hydraulic 162:13	implement 97:15	income 53:20	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	installment 24:11 48:5
hydro 55:7 109:15	implementation 96:4	incorporating 38:9	inevitably 165:12	instance 108:11
hydro-frac 162:17 162:19	implementing 46:1 95:17	increase 27:15 35:12 38:7 167:4 189:18	infected 158:18	Institute 2:5 5:12 42:21 46:3 57:13 151:19 203:11
hydrocarbon 160:16	implications 30:8 30:21 47:6	increased 161:15	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	institution 179:3
hydropower 22:16	implicitly 124:16	increases 123:11 162:11 167:14 173:7 175:6	inevitably 165:12	Institutional 114:20
	import 74:6 154:20 178:3	increasing 67:1 68:2 69:13 73:19	infected 158:18	institutions 134:17 180:2
I	important 6:11 23:19 41:1 44:10 44:11 57:1 64:8 102:6 106:1 108:7 127:6 171:19 174:18 178:10,16	increasingly 85:6	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	instrumental 150:21 212:9
IBEW 52:9,16 76:21	importantly 122:13	incredibly 35:11	infrastructure 20:15 21:21 23:14 26:6 30:4,7,14 33:22 124:11 126:12 175:21 176:2 178:19 186:15 190:11,12 190:16	instruments 16:18
idea 7:18 24:14 33:5 45:3 46:18 46:20 47:17 48:5 48:9 63:8 68:8 87:9 98:14 110:4 180:15	importers 108:9	increments 27:1	infected 158:18	intake 22:19
ideas 14:1 99:8 159:13	importing 108:12 178:2	incumbency 122:5	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	integrated 44:11 46:21 87:14 189:6 200:21 205:7,9,11
identified 176:9 179:16 195:8	impossible 44:18 44:20	incurred 208:3	infrastructure 20:15 21:21 23:14 26:6 30:4,7,14 33:22 124:11 126:12 175:21 176:2 178:19 186:15 190:11,12 190:16	intensely 171:2
identify 48:10	impressed 112:13 113:8 151:13	independently 200:20	infected 158:18	intent 86:12
identifying 14:16 14:18 41:2	impression 147:20	indeterminate	information 17:17 19:2 22:9 31:5 38:4,11 39:4 41:4 44:6 46:8 48:15 63:18 64:7 86:7 87:1 88:16 167:13 167:18,19 210:5	intently 9:17
IGCC 99:22			initial 205:12,22	inter-system 104:12
ignore 142:21			initially 25:20	interaction 43:6
ignored 102:4,5			initiated 24:10	interagency 12:19 13:20 21:18 33:7 43:10 46:7
ignoring 108:3			initiative 9:5 80:17 209:6	
			initiatives 209:19	

interdependencies 33:19 34:1	introduce 8:15 50:14,18 81:13 138:6	22:11,17,21 26:19 26:21 28:11,11 29:13 30:16 34:3 34:16 35:5 41:4 77:7 84:4,14 86:4 87:4 89:5,18 90:22 97:18 98:20 100:15 104:1 106:1 110:14 113:2 116:6,9 121:16 126:21 132:8,20 173:5 195:1 212:21	Jones 100:10 Jordan 190:13 Journal 115:5 Joy 214:20 Judi 2:2 3:6 4:20 8:16 9:20 36:17 36:18 37:1 42:20 48:17 50:10 55:8	Ken's 151:13 Kenderdine 21:20 KENNETH 2:4 Kentucky 100:9 kept 104:12 key 18:8 35:9 41:7 69:2 116:9 136:7 144:6 keynote 3:5 4:20 5:2 8:16 50:15 keystone 211:15 kick 4:19 163:20 kicking 77:7 Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1
interest 16:10 17:20 18:8 37:22 38:21 39:1,9 94:16 152:7 155:17 206:16 214:5	introducing 150:18 intrusion 162:3 intuitively 133:19 133:21 invest 208:11 invested 57:19 69:10 92:16 120:2	100:15 104:1 106:1 110:14 113:2 116:6,9 121:16 126:21 132:8,20 173:5 195:1 212:21	judicial 149:22 Julien 1:20 3:13 5:9 114:14,17 115:7,12,14,19 144:18 150:8,13 150:16 152:21 157:6	keynote 3:5 4:20 5:2 8:16 50:15 keystone 211:15 kick 4:19 163:20 kicking 77:7 Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1
interested 13:22 18:9,10 21:10 22:7 27:14 29:17 35:7 37:5 38:17 39:10 58:4 99:19 113:1 185:11	investing 69:6 119:20 134:22 investment 90:10 120:11 121:20 130:4 153:18 investments 23:10 85:19 134:14	it'll 196:17 ITCs 137:21 item 16:2 212:20 iteratively 86:19 94:17	julien.dumoulin 148:11 Julio 4:11 38:16 jump 100:18 123:8 171:4,12 June 12:1 16:4,14 39:16 198:11,12 jurisdictional 96:14,22 109:20 Justice 8:9	Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1
interesting 13:7 20:6 22:9 35:3 42:14 43:15 77:18 83:6 87:3 93:21 96:12 97:3 98:17 99:6,20 104:13,22 108:1 128:7 129:6 141:20 147:14 165:1 166:8,22 170:7 176:20 178:13	Investor 114:21 184:14 invite 197:18 inviting 51:18 151:11 invoices 210:22 211:5 212:22 involved 13:19 14:22 42:5 43:13 109:5 130:7 183:19	it'll 196:17 ITCs 137:21 item 16:2 212:20 iteratively 86:19 94:17	jump 100:18 123:8 171:4,12 June 12:1 16:4,14 39:16 198:11,12 jurisdictional 96:14,22 109:20 Justice 8:9	Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1
interface 89:20 interject 118:12 intermediate 90:6 90:8,12 intermodal 35:5 internalized 128:15 165:16 international 12:11 82:1,9 108:5 109:16,22 internationally 12:5 interpretation 150:6 interpreted 8:10 interrelated 116:15 interrupted 105:8 interruptible 105:7 intersection 145:4 interstate 108:3	invites 197:18 inviting 51:18 151:11 invoices 210:22 211:5 212:22 involved 13:19 14:22 42:5 43:13 109:5 130:7 183:19 IPPs 1:21 141:8 iron 101:12 ironic 63:4 IRP 95:20 IRPs 125:6 irrespective 143:16 ISO 82:3 isolated 91:22 issue 15:5 19:21 25:6 90:18 100:21 101:4 102:4 104:5 108:19,20 124:21 125:8 129:5 139:20 142:1 144:7 171:20 193:1,4 194:1,2,4 205:21 issues 3:21 8:22 9:18 15:22 17:4	Jackie 151:4,5 James 46:2,2 151:17 Janet 1:16 36:19 82:22 206:18 January 24:10,11 32:2 77:2 205:22 206:7 211:4 213:19 Japan 174:1 Jeff 1:11,13 3:2 4:4 7:10 50:17 51:17 72:21 75:5 79:3 80:8 81:1 82:22 203:22 Jerry 151:1,10,12 Jim 52:9 76:20 77:13 job 24:22 197:12 215:7 Joe 97:21 100:12 106:19 John 49:4 join 9:20 51:13 82:19 115:13 151:7 152:10 197:10 215:9 joined 6:6	Julien.dumoulin 148:11 Julio 4:11 38:16 jump 100:18 123:8 171:4,12 June 12:1 16:4,14 39:16 198:11,12 jurisdictional 96:14,22 109:20 Justice 8:9	Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1
		J		K
		Jackie 151:4,5 James 46:2,2 151:17 Janet 1:16 36:19 82:22 206:18 January 24:10,11 32:2 77:2 205:22 206:7 211:4 213:19 Japan 174:1 Jeff 1:11,13 3:2 4:4 7:10 50:17 51:17 72:21 75:5 79:3 80:8 81:1 82:22 203:22 Jerry 151:1,10,12 Jim 52:9 76:20 77:13 job 24:22 197:12 215:7 Joe 97:21 100:12 106:19 John 49:4 join 9:20 51:13 82:19 115:13 151:7 152:10 197:10 215:9 joined 6:6	Kaptur 106:6,7 Karen 2:8 3:4 7:7 8:14 42:21 KBR 75:22 keep 94:16 102:3 105:5 118:22 130:1 147:13 180:1 198:8 200:11 keeping 54:7 59:9 95:17 134:21 201:16 keeps 118:19,20 Kellogg 75:22 Kemper 58:15 70:18 75:9 76:11 85:20 Ken 3:16 5:10 151:11,12,15,22 152:11 192:13 196:22 197:3	Ken's 151:13 Kenderdine 21:20 KENNETH 2:4 Kentucky 100:9 kept 104:12 key 18:8 35:9 41:7 69:2 116:9 136:7 144:6 keynote 3:5 4:20 5:2 8:16 50:15 keystone 211:15 kick 4:19 163:20 kicking 77:7 Kim 5:3 50:18 75:6 76:16,20 78:22 80:11 Kimberly 2:1 3:9 kind 11:15 19:20 24:1 25:17 29:7 33:12 35:8,10 43:19 45:3 46:17 56:22 72:9 79:17 84:1 86:4 93:9 98:16 103:17,18 106:12 109:17 113:13 116:10,12 118:4 120:11 121:6 123:13 127:11,12,12 129:22 133:13 135:14 139:18 142:2,6 144:1 152:16 154:7 155:8,11 158:21 162:4 163:15 167:18,19 168:17 176:16 181:12,17 186:18 188:16 197:1 211:14,15 212:1 kindly 214:15 kinds 15:6 22:20 23:10 34:15 35:19 96:11 122:1 167:22 Kirk 203:14 kitchen-table 54:12

knew 56:8 156:4	largely 136:4 175:12 177:11	led 194:7 203:22	117:7 148:10	long-run 187:6
know 10:12 11:1,2 11:7,14 12:1 14:21 16:12 20:11 25:5 27:20 28:11 30:5,10 33:8 34:9 36:3 37:6,22 38:15 41:8,17 42:17 44:16,17 45:4 49:10,21 50:1 71:1 76:14 76:22 77:1 86:14 86:16 95:2,7,11 95:13,22 99:13 105:14 107:10 113:12 117:13 118:2 120:13 122:7 124:16 131:22 140:13 156:10,22 157:22 162:4 163:21 164:19 166:3,9,10 166:12,13 170:17 179:1 180:14 184:19 186:19 187:1 188:19 192:18 194:10,13 200:2	largest 62:11 64:15 64:16 69:19,21 89:7 177:4	left 67:17 100:9,13 215:16	164:14 182:21	long-term 46:22 188:14
knowledgeable 107:17	lastly 84:12 97:2 133:3 138:2	legal 2:8 3:4 7:7 202:14 210:15	literature 156:19	longer 21:2
knows 107:6	late 48:14 61:15 119:6 126:7 129:7 140:10 146:5	legislative 47:1	little 12:7,9 20:2 22:6 23:6 24:13 25:14 30:15 32:10 33:10 39:11 63:4 66:5 73:1 79:5,11 85:13 87:14,18 95:2 99:4 102:8 105:20 107:20 109:11,18 115:21 116:20 119:7 120:4 134:6 135:13 152:15 153:12 154:2 157:6 169:11	look 17:1 19:10 22:8 31:9 35:15 37:19 42:7 51:21 52:17 71:12 78:7 79:13 81:6 85:21 95:8 108:18 123:8 127:7 130:18 156:21 166:16 167:18 168:19 169:10 172:3,9,22 174:20 175:9,20 176:20 181:7,19 184:2,6,14 185:19 186:5 200:16 201:10 202:13 211:14 214:8
Knoxville 51:5 52:2	laterally 161:11	legs 113:13	live 55:17 172:10	looked 156:9
Korea 174:1	laterals 166:18,22	let's 5:21 56:3 116:17 139:13 160:20 173:1	living 118:8 124:8 124:9,9	looking 19:12 21:5 21:7,9,15 22:3,14 28:13 30:6,8,13 30:17,19 33:21 35:4,13,20 37:13 37:21 38:2 43:1 76:5 86:5 94:4 108:21 118:10 131:16 135:1 142:6 145:8 156:13 179:12 184:3 187:3 191:1 196:1,7,10 213:20
<hr/> L <hr/>	Laughter 10:14 45:15 83:5 101:10 112:10	letter 101:2 198:11	LLC 1:21	looks 106:9 132:6 186:21 188:15,15 202:1
lack 41:3 83:18 92:13 159:22	launch 17:10	level 90:4 134:17 135:9 136:18 139:7 141:3 199:12	LNG 30:10 154:20 155:3 188:8 190:10,11,13,15	looping 153:14
ladies 4:3	launched 12:1 211:17	levels 22:15,18	Lo 161:17	lost 31:5 206:4
laid 16:8 17:9	law 97:15 109:19	leverage 58:2	load 64:21 77:6 78:9,10 103:14	lot 12:12,17,21 15:7 17:2 18:4,9 20:2,5 22:8 26:19 26:21 29:11 30:2 30:4 32:4,13 33:15,18 34:14,21 38:22 40:3 41:2,3 42:15 47:12 53:3
Land 34:2	laws 7:17,21 8:10	levers 28:22	local 18:16 19:19 21:15 53:14	
landowners 163:2 179:4	lawyers 96:21	liabilities 147:11	location 166:10,11 166:13	
lands 163:7	lay 167:1	life 53:10,12 101:9	locations 75:12 86:17 87:17 193:15	
language 115:11	layer 87:19	lifetime 69:1	lock 176:5	
large 54:10 64:17 76:4 89:1 111:18	LDC 124:17	light 16:7 23:1 83:17 102:16 188:21	locked 188:2	
large-breed 113:12	lead 203:4	lights 95:17 169:12 170:3 171:6,13 172:12	locks 29:21 30:2,3	
	leader 71:5 81:1	lignite 58:17 70:16	logical 92:6	
	leaders 71:8,9 98:4 99:18	likewise 73:18	logistical 100:15	
	leadership 38:17 52:7 80:13,20 113:19 199:12 205:15 207:2 209:3	limestone 162:3	logistics 44:9	
	leading 103:21 203:11,14,17	line 63:9 123:22 128:9,13 141:14 141:20 143:7 148:18,21 185:20 209:22	logo 211:10,11,15 211:22	
	leads 165:11 206:19	linear 183:13	long 11:1 55:18 114:19 156:6 162:21 168:5 186:1	
	leaning 40:15	lines 22:17 121:7 177:15,17 190:2	long-lived 177:10	
	learn 21:8 165:17	lingo 20:6		
	learning 30:1 167:9 167:10	LinkedIn 10:13		
	leave 130:5 131:15 135:18 142:5 207:7 214:16,17	links 124:6		
	lecturer 152:1	liquid 33:12 34:18		
		list 36:1 84:12 98:4 100:19 141:16 150:14 199:16 201:12 209:1		
		literally 59:4 67:10		

55:10 65:14 71:14 77:10 78:2,16 89:14 95:1 102:11 104:7,17 106:17 107:2,8 116:21 119:1,14,15 121:15 122:22 126:15 127:19,20 129:7,21 130:6,8 130:21 135:20 136:13 139:10 140:4 144:14 146:7 152:22 153:3 154:16 155:6,16,22 157:1 157:16 158:14,21 161:8 162:15 165:6,7,16 171:14 171:16 172:4,6,10 172:11,14 175:10 175:21 176:21 179:14 181:1,9 186:11 187:15 189:13 191:9,18 191:19 193:8,17 195:7,20 201:20 202:3	lows 117:18 131:20 131:21 lubricating 194:21 lucky 27:4 202:3 lunch 214:8 215:14 luxury 87:16	margin 128:8 130:15 131:5 148:17 149:1 margins 139:17 157:11,12 Mark 39:22 213:15 214:12 market 86:9 90:18 94:21 95:5,5 96:1 96:7 103:19 104:1 121:20 125:2 131:12 132:15 133:17 142:20 143:12 144:7 145:8 153:10 157:14,18 177:4 179:2 180:1 189:5 189:6 190:4 196:5 207:21 market's 95:7 market-based 16:17 market-challenged 115:12 marketed 104:8 marketing 77:20 markets 83:21 96:1 104:2 118:5 123:1 123:22 124:19,21 126:11 127:11 128:16 129:3,8,14 131:1,9 133:9 134:13,13 152:8 153:20 154:7,12 163:16 Maryland 1:10 Mass 123:9 massive 172:19 173:8 179:15 master's 51:8 match 128:3 matched 110:16 mater 57:15 materially 133:1 MATS 86:2,7,13 87:9 88:2 89:20 96:4 127:9 128:10	133:19 135:16 matter 87:5 106:17 107:3 108:6 114:8 156:12 173:16 177:2 181:6 215:19 matters 116:13 mature 160:1 maturing 163:19 maxed 153:16 MBA 51:9 McCoy 163:9 mean 11:3 28:2 29:15 30:12 43:11 44:13 83:19 87:6 110:6 116:15 117:7 121:3,4,22 123:10 134:11 136:2 138:5 142:17 147:22 148:3,16 149:16 157:9 164:7,20 167:6 191:12 195:17 meaning 25:17 84:20 meaningful 102:19 120:10 123:10 126:15 128:20 130:3 141:14 183:21 meaningfully 117:17 121:14 128:4 133:10 meanings 87:4 means 25:22 102:13 165:17 183:16 185:6 186:13 191:4 meant 25:21 measure 18:6 168:18 measures 209:11 209:21 mechanics 51:6 media 79:4 106:8 Medlock 2:4 3:16	5:10 151:12,16,17 152:11,13 193:3 meet 55:13 90:14 122:8 158:8 199:8 211:7 meeting 1:5 4:6 6:1 6:4,8,10,16 7:16 8:13 24:16 90:8 104:9 171:9 198:13 205:19 207:8 212:4 213:5 213:10 meetings 7:13 32:14 36:2,6 99:20 200:8 208:16 215:6 megawatt 111:20 111:21 119:11 143:14 144:4 megawatts 64:22 70:3 86:15 Melanie 21:20 member 51:11 81:17 209:15 members 6:15 9:17 82:16 150:20 204:18 208:10,15 208:21 211:1 213:12 membership 82:18 215:7 membrane 193:17 memo 16:7,11 memorandum 17:9 mention 12:20 29:9 43:3 102:8 104:14 203:4 204:1 214:14 mentioned 34:1,5 42:22 45:5 48:9 52:19 55:8 56:4 59:11 69:2 75:9 100:20 107:22 108:10 189:20 212:3 merge 10:4,8 31:4 31:6 169:6
	M			
lots 21:22 32:2 33:14 94:19 160:21 169:1 171:22,22 185:9 185:10 194:5 love 41:12 71:17 low 22:15 60:20 75:3 98:18 187:20 188:3 low-grade 58:17 low-permeability 160:13 low-porosity 160:13 lower 22:18 59:14 121:14 lower-cost 59:17 68:4 lowering 67:12 lowest 204:11	magazine 114:21 mailing 150:14 main 29:5 maintain 16:15 55:22 190:3 maintaining 68:22 maintenance 29:20 130:22 major 41:18 75:21 98:20 99:14 125:8 136:11 141:7,22 144:8 171:16 193:4 195:18 majority 74:1 making 13:5 17:6 23:15 31:3 38:3 39:3 44:2 54:11 59:8 93:15,16 122:7 125:16 176:13 211:21 man 57:12,16 72:19 115:9 manage 20:17 94:21 managed 69:8 manager 215:7 mandate 62:13 95:4 102:11 mandates 109:19 manifestation 138:18 Manitoba 109:14 109:15 manner 45:7 86:21 108:19 113:10 map 166:14 171:5 171:12 Marcellus 156:19 167:19 186:4,9 187:12			

merging 147:11	Minnesota 1:19 5:6	monitoring 112:5	multi-year 117:3	159:1,3 167:11
messed 10:5	81:16 82:6 89:8	Moniz 45:11,21,21	119:9	170:8,17 171:3,8
met 1:9 100:2	92:10,11 97:7	46:1 198:9	multipurpose	175:14 176:16
195:12 201:5	100:21 101:8,12	month 63:6,22 64:1	12:16	178:2 185:7
metering 63:17	102:10,16,20	210:2	multistate 91:17	189:10,13 190:9
methane 12:19	104:18 105:1,5	monthly 166:2	multitude 187:11	nature 190:1
13:20 14:5,9,11	108:13 109:9,13	months 63:13	myopia 158:17	NCC 3:4,19 5:19
15:5,17,20 34:5	110:21 111:10,11	116:10 117:19		197:7 199:20
methodology 103:1	minute 7:11 70:18	122:20 123:6	N	207:18 208:9,21
Mexico 189:9	98:4 114:4	morning 4:3 5:2,21	name 4:4 6:13	209:2,5,9 211:7
MICHAEL 1:14	minutes 6:9 143:5	50:18 51:19 72:4	36:22 54:3 56:13	212:13
Michigan 100:12	MISO 86:3,6,9,10	81:12 82:14,21	192:16	near 37:7 70:15
105:5	87:7,13 89:19	114:2,6,12 115:17	name's 107:18	171:6 178:12
microphone 6:12	93:11,19 94:21	morphs 84:21	named 172:18	near-term 94:5
81:3	96:7 133:3	mortals 115:12	names 111:7	nearly 60:6 74:11
mid 126:15 186:10	MISO-PJM 96:10	motion 6:17	176:17 203:3,4	196:19
211:3	mission 40:15	motivated 155:12	206:12	necessarily 19:13
Mid-American	97:20 99:7 147:2	motors 64:18	namesake 61:20	62:7 93:10 117:12
82:3	Mississippi 53:18	mountains 106:21	narrow 164:9	118:9 123:18
Mid-Atlantic	58:14,18 70:16	MOUs 76:7	NARUC 1:18	125:19 132:1,19
122:22 125:11	mistaken 198:12	mouth 59:4	113:19	135:19 137:15
mid-December	Mitchell 159:16,17	move 28:2 66:7	NARUC's 81:20	138:20 143:8
206:1	mitigating 13:6	93:22 97:18	Narula 149:3,3	146:3,13,14,17
mid-forties 149:10	mitigation 11:20	101:12 102:6	192:14,16	148:14
middle 63:7 98:18	12:7 20:3	126:12 128:18	nation's 29:21 70:8	necessity 27:3
107:5 173:9,13	mix 62:17 66:13	156:11 157:18	national 1:3,10,13	need 16:13,15
midstream 15:2,12	102:12 214:2	162:7 172:13	1:14,16,17 2:8 3:3	17:22 19:2,20
153:18	MMBtu 60:14	173:13 191:8	3:11,17 4:5,6 7:6	31:14 34:22 41:11
midwest 62:3 82:2	mobile 69:17 212:5	193:13 201:9	8:5 9:4,8,16 39:15	73:7,11,14 80:4,7
86:1 90:1 92:9	mobility 110:14	202:19 205:9,18	50:14 51:18 70:6	86:16 112:8 129:9
95:9 109:13	mode 80:2	210:12	81:18 82:17	131:3 137:15
migrate 190:5	model 102:14	moved 6:19 59:11	142:15 145:3	140:21 146:1
mike 50:13 51:17	147:21 182:19	73:16,17 74:7	150:20 163:4,9	148:8 151:6 183:2
51:22 52:5 82:22	195:9,10	159:12 161:11	168:21 197:17,20	185:5 192:21
145:2 213:15	modeling 32:7	203:16	198:2,7 205:15	196:2 201:21
milestones 205:10	68:13	movement 29:18	207:12 208:5	210:21
million 61:1 69:8	modern 172:1,8,16	movements 73:6,8	212:10	needed 28:9 56:8
73:21 74:18	192:6 211:13	moves 30:11	native 51:4 160:16	98:13 163:20
173:12 201:15	modest 118:16,18	movie 56:16	natural 3:15 15:2	199:2 207:7
millions 146:8	121:19	moving 29:11 69:3	15:17 20:16 33:12	needs 8:7 76:4
mind 53:13 66:21	modified 111:13	73:11 90:18	55:6 59:12,13,15	125:18
108:4 201:17	MOHN 6:19	111:13 113:14	59:18 60:10,13,18	negotiate 179:4
minds 57:6	molecules 182:16	122:9 155:17	68:3,6 78:1 89:15	negotiating 93:5
mine 59:4	182:21	177:21 210:7	90:1 99:2 104:18	neighborhood 75:3
mineral 179:5	moment 15:4 42:8	multi 92:6 93:4	105:16 109:6	net 103:4 143:13
minimal 31:9	55:18	multi-state 91:20	139:11 152:8,18	never 98:12 105:13
mining 101:13	money 208:19	92:1 93:5	153:19 154:7,20	106:20
			155:17 158:11	

new 11:1 61:17,21 66:16 71:18 94:22 100:22 102:10 103:8,19 107:8 119:12,21 120:3 121:6,10,18 122:20 123:9,18 123:20 125:4,9 126:7,14 128:3,4 129:20 130:3 131:18 132:7,7,9 132:11,11,13,22 133:22 148:4,14 149:5,6,19 153:9 156:1 157:14,18 159:6 160:6 162:14,15,20,22 163:18 164:13 193:17 206:2 210:5,6 211:10,14 211:15,22 212:6	111:11 northwest 172:13 notably 210:2 note 8:17 102:20 122:4 196:16 212:21 noted 98:11 208:5 notice 10:16 161:14 noticed 199:15 noticing 35:15 noting 121:6 notion 103:3 109:22 113:3 123:4 171:22 November 211:1 212:22 NOx 136:1 NRG 147:3,3 NSR 149:19 150:4 nuclear 55:6 61:9,9 61:13,22 92:11,12 100:6 107:6 109:8 110:3 130:19 140:17 142:22 143:2 number 4:8 21:13 63:10 98:3 115:7 141:16 172:19 180:14 199:18 204:12,12 210:6 numbers 72:22 78:17 89:10 numerous 108:22 115:4 nuts 32:10	obscure 107:1 obviously 15:10 54:13 86:15 89:9 118:14 121:15 136:12 147:22 202:15,17 204:18 occur 169:18 occurred 162:18 168:17 177:9 occurring 22:11 October 1:7 31:19 odd 29:21 off-ramp 97:7,16 off-topic 102:8 offer 18:22 offering 17:21 207:8 office 2:3 3:7 4:16 4:22 9:13 19:9 24:7 27:5 32:1 97:21 209:22 210:3 officer 1:16 2:1 4:17 5:4 50:20 offices 18:21 19:14 53:15 54:1 official 2:7 103:2 officially 49:21 officials 19:19 offline 84:10 86:15 89:8,13 offsets 142:15 oh 34:17 Ohio 140:15 oil 9:4 27:15,22,22 34:10 35:12 37:5 38:5,7 39:16 43:1 59:1,6 101:17 160:9 163:16 175:13 176:7 178:17 182:3 186:5 190:22 okay 31:1 75:4 100:15 156:10 157:3 213:5 Oklahoma 100:11 140:6 194:12,12	194:13 old 30:4 older 149:12 Oliver 151:1,10 once 32:3 63:5 120:9 167:12 205:17 one-third 149:13 onerous 97:10 204:10 ones 31:5 111:12 111:12 145:9 185:15,17 199:18 ongoing 102:13 104:5 198:22 online 63:18 91:8 onsite 129:10 opaque 133:10 OPEC 163:16 open 6:4 53:15 63:7 76:13 94:14 103:18 112:17,22 144:13 188:9 191:18 213:6 opening 8:16 191:5 202:12 opens 103:7 operate 93:20 operates 70:7 operating 1:16 2:1 5:4 50:20 75:10 75:15 operation 74:12 201:14 operationalize 44:5 operationalizing 39:3 45:17 operations 50:22 operator 185:14 opinions 88:18 107:21 opportunities 14:19 75:19 179:12 210:19 opportunity 3:22 6:6 11:17 50:17 58:1 59:2 84:9	91:18 92:20 96:9 98:2,7 106:11 opposed 7:3 72:15 103:5 106:13 107:9 opposite 158:1 optimism 118:13 optimistic 76:7 option 66:18 91:16 92:1 options 64:13 order 4:7 94:13 96:20 104:6 132:16 181:2 199:8 ore 101:12 Oregon 190:13,13 organization 40:11 40:13 82:2,18 207:16 208:6 organizations 115:4 207:18 origin 110:5 original 202:6 originally 92:17 OSHA-approved 98:16 OSTP 49:2 ought 39:7 outages 64:5 outcome 88:13 outfit 159:17 outline 47:1 79:11 200:9,15 outlook 116:11 outside 36:11 118:10 179:10 195:4 212:14 over-scale 196:4 overall 14:5 overarching 45:2 108:20 overburdened 147:10 overcome 79:14 80:5 overhead 210:11
	O			
newer 167:17 newest 5:16 82:16 news 208:1 nice 51:21 52:17 77:3 95:8 nicely 152:17 night 4:10,12 10:3 31:18 117:9 168:9 168:20 169:8 nine 204:9 nine-inning 168:3 nineteen 158:22 163:1 nineties 158:22 159:13 non 23:20 normalize 127:2 north 92:16,19 108:12 185:2,5 186:19 187:2,15 189:7 190:15 Northeast 60:14 122:11 123:5 139:4,12 153:2,10 153:21 northern 101:12				

overnight 207:14	131:11 213:2	PCAST 45:17,20	performance 16:18	piece 21:21 26:4,5
overreach 66:21	participants 58:10	Peabody 211:20	26:15 66:17	109:12
68:20	204:17	peak 60:6 77:1	period 49:22 59:21	pieces 48:2
overriding 191:22	participating 36:3	78:19 79:21	66:14 77:22 91:8	pile 111:15
oversee 84:17	participation 7:12	103:21 131:12	104:22 205:14	pillars 12:2 14:13
oversees 50:21	particular 9:16	133:16,21	210:13	14:14
overt 168:18	16:6,9 17:20 34:8	peaked 60:3,4	periods 79:22	pilot 56:17
overweight 53:5	41:4 42:5 43:1	131:18	permanent 214:4	pipe 123:13,20
overweighting	93:1 94:13 100:22	peaking 60:1	permeability	124:14 135:21
59:13	103:14 106:18	peaks 104:9 188:16	160:21 183:1,6	196:6
owned 147:3	110:9 154:6	peek 95:20	Permian 167:21	pipeline 30:14 35:5
ownership 99:3	169:16 181:20	pejorative 147:6	permission 206:6	58:21 90:1 104:17
Oxon 1:10	particularly 8:11	penalized 65:16	perseverance 71:21	125:22 126:11
	18:3 23:1 28:6	penalties 129:15	persevered 56:22	153:7
	42:13 64:16 67:2	penetration 78:5	71:7	pipelines 37:14
	68:21 70:15 77:11	78:21 102:18,19	person 54:2,5	60:18 104:21
	83:17 108:7 153:1	Penn 156:17	56:15 67:9	125:20
	155:1 159:4 195:7	Pennsylvania	perspective 3:12	pipes 105:6
P	particulate 106:9	120:21 194:1	13:2 73:20 74:7	pittance 130:22
P-R-O-C-E-E-D-...	106:17 107:3	people 10:17 13:22	84:14 115:22	PJM 87:15 96:3
4:1	parties 17:18	20:10 42:3 43:18	116:21 124:8	104:8 119:10
p.m 215:19	partner 57:21	45:22 54:11 55:10	125:17 127:6	122:21 131:6,20
pace 128:20	partnered 86:10	55:16 62:19 63:11	136:6 139:7	134:16
packet 199:15	partnering 75:21	65:9 68:10 71:14	143:11 172:21	PJM's 103:19
packets 8:18	76:3 88:7	76:14 78:2,12	perspectives 50:11	place 31:19 44:15
208:20 210:6	partnership 52:16	85:15 120:13	pertinent 116:11	89:16 137:20
214:15	58:9 70:12 83:7	155:6 158:14,21	petition 97:11	176:4 181:12
page 148:11	parts 10:2,6 22:17	159:21 163:5	Ph.D 57:14 82:5	209:15 214:17
paid 92:21 209:4	25:7 26:3 27:11	165:16 171:17,22	156:15	placed 191:11
paint 189:12	53:17 65:14 95:9	172:7,10,14,19	Phillips 203:22	places 21:22 77:11
palatable 139:13	party 201:6	173:12,14 174:4	philosophy 53:9	96:18 155:18
196:12	pass 45:13	180:3 185:3	phone 210:6	156:17 175:5
Pam 203:11	passed 106:16	191:20,21 192:5	photographs 169:6	193:22 210:9
panel 197:6 213:20	passive 61:18	195:13,16	photos 100:16	plain 158:13
213:21	patience 210:13	people's 18:11	physical 182:19	177:19
panels 9:7	215:4	163:6	physically 89:16	plan 11:13,20 12:1
pants 163:21	patient 56:20	percent 53:19 55:1	physics 183:14,20	12:14 13:12,13
paper 32:6,6,9 34:8	patterns 64:2	55:4 56:5 58:20	pick 214:18	14:4 16:3,6,8 24:2
34:11,18	pause 7:19	65:19,22 67:17	picking 73:10	41:20 42:12 46:17
papers 32:8	pay 124:4 130:8	69:12,14 84:8	156:15	47:16,18 48:3
paradigm 103:8	136:11 140:14,17	87:3 89:17 91:5,6	picture 19:4 38:13	91:15,17,20 92:5
parallel 32:4	141:4 162:2,8	92:9 100:3 121:2	61:10 168:9,19,20	92:7 93:10 94:6
part 7:15 11:11	211:2	121:2,22 141:13	169:8,16 170:11	94:12 97:5,13
13:10,11,13 14:3	paying 124:14	141:13 204:16	170:16 171:14	212:18
15:2,12 17:2 29:3	142:11	perception 83:11	176:8,17 189:13	plane 77:4
38:12 42:11 44:3	payment 53:15,22	perfect 58:12	pictures 76:15	planning 48:18
46:19 49:8 54:13	211:3,5	perform 129:16	100:7	51:2 94:2,8,16
58:18 61:9 62:17				
67:15 70:21 71:22				
72:1 77:5 86:8				
95:16 97:13 101:8				
109:19 111:11,18				

plans 28:14 75:11 86:21 93:5,5 94:17 95:2	119:17,19 123:14 124:2,12 125:9,16 127:1 128:18 131:22 132:10 134:5,6,7 135:3 135:18 136:11 137:17,20 138:15 139:22 140:4,10 140:19,20 141:17 142:5,21 144:6 146:5,12 164:18 168:22 169:1 174:15,15,16,16 174:18 175:8 176:13,18 186:17 187:13 193:20 196:13,17 201:7 203:8 208:19 213:3	portal 19:16 portfolio 61:3 62:13 85:10 91:7 136:3 185:14 portion 197:15 ports 30:20 64:15 position 9:2 209:12 positions 81:22 positive 28:21 118:6,14,19 127:20 131:7 possible 32:20 49:19 67:14 204:14 211:22 Possibly 15:21 post 128:9 potential 99:5 189:10 potentially 29:13 30:9 35:3,22 90:22 poverty 171:20,21 POW 56:17 Powder 73:18,22 power 5:18 16:3,17 18:13 19:22 23:19 26:16 28:8 29:6 29:15 46:3 54:18 62:12 63:20 64:20 70:11 99:12 103:4 109:7,14 112:17 115:22 116:12 117:10,17 119:5 119:18 120:17 122:14 123:5,8,22 127:18 128:1 129:13 131:16 134:7,9 135:5 145:16,19 148:1 153:20 159:5,7,8 188:6 189:19 198:1 Power's 99:22 111:10 PPA 143:13 144:3 PPL 214:22 practices 14:17	99:9 PRB 72:14 precipitators 106:12 precipitous 125:14 predicated 122:12 predominant 192:20 predominantly 190:7 preexisting 124:10 preferentially 169:21 premise 84:22 preparing 12:3 205:8 prescient 195:6 present 1:12 2:6 207:4,8 presentation 4:20 10:2 11:12 24:5 31:17 114:13 116:17 144:20 148:10 151:14 152:15 157:7 presentations 5:3 197:7 213:22 presented 152:22 presently 198:1 preserve 86:22 101:6 president 1:13,16 1:22 5:18 16:12 24:10 50:19 152:5 197:22 President's 11:12 11:20,22 16:5 45:7,18 President/CEO 1:15 Presidential 16:7 17:9 presiding 1:11 press 145:3 162:15 pressed 150:2 pressure 98:18 105:5 143:8 182:6	182:8,10,11,18 183:3 pressures 96:11 prestigious 82:7 115:4 presuming 127:13 pretty 78:6 94:1 105:2 116:5 123:17 132:2,6 133:10 142:17 prevalent 62:3 previous 199:16,18 price 72:8 110:20 119:6 132:4 147:19 158:9,11 185:5,6,22,22 187:8 188:2,22 prices 60:11,13 67:1 78:1 96:1,7 119:18 122:14 123:5,8 126:5,5 127:2 128:13,14 129:19 131:19 133:8,21 134:1 143:13 148:19 153:11 157:8,8,10 157:22 158:3,4 159:18 177:18 185:2 187:20 pricing 103:3,5 118:15,19 127:21 131:15 132:2,22 133:1,5 137:17 186:14 pride 71:13 primarily 78:20 91:7 104:18 207:21 primary 80:5 152:7 193:9 prime 175:11 prior 9:1 70:10 74:15 210:16 priorities 49:13 private 14:11 28:14 privilege 51:19 76:11
--	--	--	--	--

pro 136:4 145:21	152:1	103:20 120:10	139:9,13 155:8	quick 7:11 178:12
probably 16:2	profile 120:22	139:19 197:19	172:21 180:16	quickly 11:16
40:22 42:16 44:19	profitability	provided 6:7,15	188:13 192:4	113:15 155:5
50:3 72:22 80:1	118:11	91:17 209:7	197:7 199:6	178:20 181:14
85:12 91:2 100:18	program 4:19 5:8	211:21	209:15	199:11 205:9
111:15 116:20	5:14 41:20 50:13	provides 61:3	puts 74:7	quid 145:21
122:17 126:17	114:12 150:22	65:19	putting 58:21	quite 11:9 33:9
130:20 132:5	151:8,15 197:16	providing 17:17	150:21 151:8	35:13 44:8 83:1
133:16 135:9	204:20,20	43:22 64:7 116:8	213:20	85:18 88:21
138:6,17 195:5	Programmatic	210:20 214:6		131:17 170:6
200:2	47:5	provision 16:16	Q	198:16
problem 110:6	programs 65:11	84:18	QER 11:21 25:15	quo 145:21
problems 58:3 77:5	202:2	proximate 107:12	26:10 27:1,6,21	quotas 163:14
proceedings 94:9	progress 14:7	PTC 143:13	28:5 30:18 31:2,8	
process 17:8 21:1,4	207:11	PTCs 137:21	31:16 32:2 37:9	R
21:17 25:1,4	prohibit 7:22	142:12	37:13,20 39:13	R&D 46:9 165:14
32:21 33:8 36:9	prohibitions 8:4	public 1:19 2:5	43:1 46:5 48:20	167:7
43:10 109:2 164:1	project 190:11	3:22 5:7,12 6:4,5	49:6,8	radial 182:20
186:7 200:6	195:18	36:1 81:16 113:7	QERs 27:11 47:13	rail 27:16 28:1,2,10
207:13	projected 171:10	162:16 195:13	quadrennial 13:8	28:15 30:20 34:10
processes 21:14	projecting 148:14	202:16 213:7,7,12	15:14 22:2 24:6	34:11,18 35:5,12
23:16 95:21	175:10	214:12	24:20 25:16,18,21	43:1,2 72:10 73:3
procure 124:1	projects 70:1	publicized 213:6	26:2,13 45:6	73:6 79:16,16
125:3	190:16 198:22	publish 116:5	quality 86:22 98:20	100:19 101:16
procuring 130:13	201:11,15,21	pull 25:11 54:4	107:13	112:5 124:6
produce 26:4 28:21	203:10	63:20 64:4	question 19:17	railroad 163:10
184:18	promote 65:5	pulled 63:19	36:21 72:17 73:3	167:1
producers 99:13	prompt 211:5	pump 77:6 78:2	75:14 79:1,3 93:1	railroads 27:22
179:3	prompted 163:3	pumps 77:20 78:21	96:13 97:4 103:7	28:18
producing 56:5	propane 101:13	punch 123:21	109:6 126:19	rails 43:4
186:6	properly 91:10	punchline 131:8	127:13 132:9	raise 149:9 196:16
product 55:16 64:9	property 179:9	purchase 209:14	134:18 136:7	raised 97:3 209:13
65:8 103:19	proposal 66:22	purified 193:19	137:1,4,8 138:1,3	Ram 149:3 192:16
208:17	68:19 130:16	purplish 170:21	140:1,11 141:20	range 16:21 36:10
production 26:17	proposals 47:2	purpose 46:5 47:8	148:14,16,17	170:20
38:7 161:6 163:14	proposed 16:4,14	purposes 47:9	149:16,18,22	ranges 88:18
184:8 186:1 187:4	66:19	48:18 104:5,19	178:10 192:13	ranked 114:19,21
188:12	proprietary 57:19	pursue 14:9	204:11	115:2
productive 88:17	pros 26:20	pursuing 61:17,21	questions 11:10,17	rapid 85:9 172:5
200:10	prospect 161:19	62:14 98:21	22:4 24:3 36:14	173:3,4,6,7 180:6
productivity 26:16	prosperity 98:19	push 56:7	36:16 39:21 40:14	193:6
161:18 162:11	protecting 20:15	pushed 206:4	42:19 72:5 75:6	rapidly 113:11
164:6 165:8 167:4	proud 61:11 70:20	put 20:18 73:20	80:10 81:3 88:1	178:18
167:14	71:6,22	92:18 95:22 97:12	106:5 112:21	Ratcliffe 71:9
professional	provide 6:7 7:8	104:22 110:8	122:1 137:7	rate 67:11,12 87:2
210:17	36:5 52:12,21	113:18 119:11	144:14,15,22,22	137:12 182:12
professor 45:21	54:17 55:16 60:9	120:13,14 125:6	192:10 196:21	204:16
			204:9 213:3	rated 204:11,11

ratepayer 124:17	129:6 132:17	109:4	regions 103:10	rely 104:8 208:12
ratepayers 92:19	134:9,17 135:4,21	record 114:8	172:17	208:14
rates 84:19 117:3,3	142:7,9,11,19	130:17 215:19	registered 133:11	remain 111:1
117:13 161:18	144:11 149:1,21	recoup 134:14	regs 135:21 144:12	remaining 200:17
173:4,11 190:1	153:19 154:16	recoverable 179:17	regular 93:22 94:1	remains 86:18
ratings 204:10	155:3,11 156:7,13	179:19	regulation 110:21	89:12
reaching 44:1	157:1,4 159:21	recovered 117:17	113:2	remarkable 154:22
140:20	162:16 163:21	recovery 9:5 37:6	regulations 6:3	162:5
reaction 137:9	164:14,16 165:16	38:5 39:16 59:1,7	16:19 66:10	remember 45:8,9
read 30:22 60:13	166:8 168:17	182:9	regulator's 84:14	104:16 117:13,14
70:22 198:14	169:13 174:13,18	recreating 201:2	regulators 82:2	158:14
200:13	175:2 176:14,19	recycle 193:16	83:7,11 84:16	remind 7:12
readout 202:8	178:9,19 184:7,19	recycling 193:20	85:1,14 88:8,14	206:18
real 76:19 117:22	185:10,15,16	red 170:20 171:6	97:21 98:5 141:18	reminder 201:3,8
129:15 132:19	188:20 189:14	177:22 185:20	regulatory 1:18	remove 66:12
136:10 140:1	200:13 201:7	redacted 176:17	3:11 16:19 47:5	removed 90:11
181:14 192:22	202:7 205:6	redesign 211:16	81:18 82:3,9	renewable 62:13
reality 130:21	206:12	redesigning 209:16	135:13 166:2	67:20 91:6 97:8,9
131:2 132:2,6	reason 34:19	redirect 195:11	180:1	97:12 143:17
133:6 135:6	109:12 146:1	reduce 16:20 22:15	Relations 184:14	renewables 12:18
141:11 143:19	166:20 168:11	reduced 69:12	relationship 52:15	62:1,14 109:5
realizable 175:18	171:17 187:21	reducing 14:17,20	88:9,10	110:2 132:18
realization 165:12	reasonable 66:14	67:22	relationships 82:10	137:16,18 142:10
realize 126:14	67:18 84:19 190:4	reduction 67:17	relative 73:15	142:14 143:11,15
127:6 156:22	reasons 44:13	reductions 84:8	119:18 139:15	144:9
160:10 164:19	47:20 107:13	redundancy 106:1	175:16,17	reorganization
165:3 174:22	receive 63:6 68:1	refer 23:21 156:18	relatively 118:16	44:16
182:1 189:4	102:1 208:7	158:22	122:14 164:9	repeat 13:8
195:14	received 178:3	referred 155:14	released 92:17	repeated 84:4 90:3
realized 161:5	198:11	157:6	relevance 9:16	repercussions
178:4,5	reception 214:20	reflect 96:4 133:13	relevant 19:21	142:18
realizing 161:3	recipient 82:7	reflected 126:10	39:17 77:10	replaced 107:3
really 11:3,16	recognize 4:14	reforestation 41:22	204:13	replacement 29:20
12:10 19:4,9	71:10 128:2 130:2	reform 99:2 129:14	reliability 18:7,12	107:15 128:6
24:12,14 25:4,5,7	recognized 88:13	reforms 129:21	29:3 67:2 83:19	replicate 75:11
29:8 35:15 36:7	recommendation	refrigerator 54:8	90:22 94:20 96:18	report 20:18 22:6,8
44:2,8,10,10,15	45:5,20	refurbishment	105:15 130:15	23:3 28:18 33:7
44:19,22 47:15	recommendations	29:20	reliable 16:16	72:8 110:20
55:12 72:20 74:8	41:1 46:17 47:12	regard 29:19 86:13	52:13,22 54:14,18	147:19 200:12
74:10 77:8,18	47:14 199:7 203:1	154:6 156:10	54:19 80:3 84:18	205:22 206:7,15
78:5 83:10 88:11	205:4,13	165:8 183:21	86:18 95:15	207:5,9,10 212:14
98:1,6,12 102:15	recommended	regime 121:13	reliance 16:21	213:2
102:19 108:1	151:11	183:13	83:18	reporting 43:4
112:3,19 113:9	recommending	region 21:7,7 105:2	reliant 105:16	145:4
117:2,5 121:21	45:22 47:16	171:2	relief 97:11	reports 3:17 21:16
123:11,15 124:20	reconcile 124:14	regional 21:6 91:16	relies 208:9	102:1 184:14
127:16 128:5	reconsidering	135:22 138:21	relocating 195:16	197:17 199:13,17

repowerings 89:22	151:18 156:11	127:8,19 133:20	114:22 157:10	139:5 140:17
represent 11:8	160:12 164:3	retrofit 106:11	159:18	run 60:21 68:10
representation	179:17 181:2	107:4,15 147:5	river 22:18 73:18	96:20 161:8 174:9
184:1	195:8	retrofits 86:17	73:22	174:11 202:10
representative	resources 5:11	107:9	rivers 193:13	RungePincockM...
182:20 187:8	19:11 20:16 56:1	return 120:2,10,22	road 192:3	106:7
211:12	56:9 58:2 69:1	121:2,22	roadmap 47:19	running 115:1
representatives	84:9 103:20	returned 82:12	Robert 2:7 4:15	202:20
100:14	159:14 163:7	returns 121:3	robust 57:19 65:10	runs 70:8
represented 206:14	169:20,21 170:5,9	revenue 146:4	132:6 177:10	rural 101:14
represents 58:1	170:18 179:15	209:13,20	robustness 31:10	172:15
request 206:1	189:11 195:15	reversal 148:18	rock 156:7 160:14	rushed 27:6
213:16	respect 89:20	review 13:9 15:14	160:22 161:16	
requested 199:17	respectful 202:21	22:3 24:6,20	181:4	S
require 67:22	respects 123:7	25:16 26:2 33:8	role 11:12 13:20	s 214:1
required 28:18	133:7 136:18	43:17 45:6 149:20	17:6,16 18:2	safe 52:13,22 54:14
135:8 181:11	138:5,11,15	205:11,14 206:8	145:15	54:17 84:18 95:15
requirement 149:6	respond 120:13	reviewer 206:17	roll 64:3	safer 20:14 65:3
requiring 86:7	178:20	Reviews 26:13	rollout 212:18	safety 26:15 31:10
research 1:21 46:3	response 7:4 23:15	Revis 46:2	roof 123:7	34:10
51:3 56:7 57:13	87:2 96:9 104:6,9	revise 205:17	rooftop 102:8	Saharan 172:11
57:20 69:8 114:15	104:11 128:17	revised 135:11	room 1:10 107:16	sake 94:12
116:3 166:7	132:15	revising 130:12	151:5 161:8	Samford 51:10
213:19	responses 157:11	revolution 155:13	212:14	sample 184:2
researched 70:13	responsible 9:3	168:3	root 76:1 158:16	sand 160:22
researchers 57:18	responsive 83:16	rhyme 166:20	rooted 54:18 179:2	Sanmen 98:8 100:6
reserve 130:14	rest 51:17 74:1	Rice 2:5 3:16 5:12	roughly 74:21	satellites 169:2
131:5 139:17	173:1	151:19 152:2	166:17	satisfied 63:4
reserves 66:1	restarting 111:2	rid 67:11	round 114:11	Saudi 66:2
208:12	restoration 40:11	rig 181:10	197:11	Savannah 64:15
reservoir 182:7,10	64:6	right 7:11 13:1	roundtables 15:1	saved 60:22
182:16	restraining 8:2	37:9,12 63:19	RPS 142:15 143:16	saving 208:18
Residential 105:10	restrooms 7:21	78:20 83:7 88:5	143:18	savings 146:2,7,9
resilience 11:21	restructured	89:11 93:12 107:6	RRC 163:14	saw 50:5 140:5
20:6,8,10 21:16	123:22 125:2	123:9 127:17	RTOs 85:15	159:3 180:7
21:19,21 22:4	restructuring	129:5 130:11,18	rubber 192:2	201:13
resilient 21:12	140:11 147:8,15	130:19 134:9	rug 171:18	saying 16:12 77:14
23:10,12	restructuringings	139:3 146:1 148:4	rule 16:4,13,14	84:16 116:13
resolve 92:22	146:16	149:15,19 153:9	17:6 18:19 85:11	137:11 140:21
108:16	result 79:10 131:5	163:17 164:19	88:6,20,22 92:18	150:1 157:5,7
resolved 123:16	results 28:21 204:8	171:7 178:7	93:13 94:8,9,11	says 198:15
resource 2:4 3:15	resumed 114:9	184:15 188:21	94:12 97:11 108:2	scalability 31:11
40:16 41:20 66:4	retired 96:17	194:12 197:19	109:5 138:22	scenario 201:4
68:5 70:15 73:14	107:19	205:8 207:15	rules 83:12 85:10	scenarios 32:7 33:1
94:2,8,12,16,17	retirement 96:18	208:4	89:21 95:17 130:9	199:5
94:20 95:2,3	138:3	rights 179:5,9	131:4 134:8 135:4	scene-setter 201:3
121:16 130:13	retirements 86:16	rising 98:18 114:19	136:12 138:8	schedule 31:16
				71:2 75:16 111:14

scheduled 205:20	123:18 126:9	senior 4:15 9:8	186:20 199:6	shortly 126:18
scheme 137:19	127:8 128:7,21	151:20	202:22 205:10,12	shovels 120:14
science 20:16 51:6	129:20 131:12	sense 59:16 62:15	setting 90:18	show 32:15 34:9
Sciences 9:8	132:21,22 133:5	65:5,14 107:2	169:11	63:21 78:5 98:3
scope 26:18 27:13	134:3 135:10	108:17 109:3	seven 56:18 212:9	105:13 120:19,20
28:16 29:10 37:15	140:22 141:2,3,8	130:1 133:7 140:3	seventies 61:16	170:13 199:12
37:17 49:7	141:9 143:17	146:18 170:11	shale 156:1,5,13,19	202:20 203:2
SCRs 136:8	144:11 145:9	senses 116:7 117:7	160:4,11 162:12	showed 191:19
scrubbed 74:12	147:14,17 148:18	117:10,12 119:14	164:17 165:2,3,5	shown 34:12
scrubbers 110:9	148:19 149:1,6	120:5 126:9	165:13,21 167:11	shows 106:8
136:9	150:7 153:11,12	127:10 128:14	168:3 177:20	shutting 101:21
season's 101:15	153:14 155:6,20	131:19 134:2	178:4,17 179:12	106:13 107:11
seasonalized 78:8	157:10 158:2	137:16 147:1	179:15,21 180:12	Sichuan 180:11,19
seatings 214:17	165:19 172:6	sensible 90:16	180:17,20 181:19	side 54:3 113:2
second 6:21,22	174:22 175:6	sensitive 144:1	183:7 185:21	118:18 119:4
10:7 13:10 46:14	177:22 184:7,13	sensitivity 143:21	186:18,22 188:14	120:6 122:16
49:8 77:7	185:4 188:5,20	sent 10:17 16:12	188:17 192:21	127:9 135:13
secondary 130:10	189:1 191:7,17	45:13 101:1 204:6	193:6 194:9 195:7	136:13 145:16,17
secondly 68:20	192:7 203:18	separately 148:13	shale's 178:8	146:4 147:15,16
Secretariat 24:19	204:21 206:8,11	September 63:8	shales 156:20	157:13,21 166:1
Secretary 4:10	seed 177:14	sequestration	167:17,22 180:19	191:16 209:13
14:22 19:5,8	seeing 52:18 81:7	69:20,22	186:6 187:5,11	sign 143:15 144:2
38:15 45:11,21	96:7 121:7,17	series 15:1 49:9	189:2	signal 130:3
46:1 47:21 198:9	125:13,19 126:4,6	145:6 212:9	shame 81:2	signed 76:6
204:4	127:15,17 167:22	serious 108:19	Shanghai 100:4	significant 78:6
sections 202:21	214:13	seriously 55:20	Shannon 203:14	106:22
205:3	seek 140:16	137:10	share 44:7 82:13	significantly 73:16
sector 14:11 15:3	seeking 89:2	serve 53:16	142:20 143:12	105:18 210:10,16
15:10 20:20 21:11	seen 17:11 29:12	served 9:6 51:12	150:15 190:4	similar 176:16
22:12,21 28:14	54:1 89:12 106:20	52:6 152:3	sharing 50:11	similarly 131:20
42:9 99:2,5	133:11 140:6	serves 9:11 81:15	88:15	simple 158:13
114:18 115:3	141:7,15 142:1,22	81:19 104:4	sheet 147:12	169:14 174:7
122:19 146:7	145:6,18 146:8,20	151:22	sheets 212:10,12	177:19 179:2
159:7 178:20	151:12 152:21	service 29:2 42:5	Shenua 203:6	189:15 198:16
181:10 188:7	162:12,14 168:22	42:18 53:15 72:10	Shidongkou 99:22	204:13
sectors 14:12	169:1 173:5	75:20 76:15 77:17	shift 144:12	simpler 87:14,18
Securities 1:21	segment 48:20	84:18 104:19	shifted 105:8	simply 84:9 86:12
3:14 5:10 114:16	seguewaying 24:4	178:19 181:10	shifting 54:21	108:21
security 123:4	seismic 194:11	210:17	177:19	single 91:21 165:13
191:1	seismicity 194:8	services 1:13,14	ship 190:17,18	sit 137:10 141:11
see 5:20 10:7 17:2	selection 65:6	51:2 172:2,8,16	shipping 191:5	site 193:14 212:7
34:20 35:8 49:13	self-sustaining	192:6 210:20	shock 63:5	sites 194:19
51:21,22 63:9	208:6	serving 198:1	shooting 166:19	siting 34:2
64:5 66:10,22	Senators 101:1	session 3:5 5:2	short 95:3 104:22	sits 160:5
72:1,11 78:8 79:7	send 116:3	114:5	198:8	sitting 72:18
84:13 85:2 92:20	sending 58:22	set 10:7 41:8 46:21	shortage 73:9	situated 59:3
96:2 108:16	sends 10:13	47:9,9 163:14	shortfalls 87:12	situation 87:17,20

98:16 101:18 107:22 112:5 147:10 155:16 210:4 six 116:10 sixties 55:1 56:4 size 111:14 skip 105:19 sky 160:2 slant 163:5 slide 31:1 32:15 34:12 117:2 120:19 138:6,10 168:8 181:16 slides 10:8 31:3 37:11 46:14 119:2 168:7 170:13 slight 207:20 slippage 194:22 slope 176:7 slow 180:2 small 111:9 178:21 smaller 111:20 180:18 smaller-scale 101:20 smith@ubs.com 148:12 snapshot 72:9 snapshots 169:3,4 so-called 129:2 SO2 135:22 138:21 soaring 60:11 society 41:12 solar 62:7,7,8,12 102:9,10,12,21,22 103:3 sold 109:9 solution 193:5 195:2 solutions 1:15 9:3 21:10 23:6 70:13 196:15 solve 58:3 someday 104:3 soon 32:20 49:15 123:20	sooner 49:16 sophisticated 113:9 164:11 sort 17:1,2 18:1 19:18 21:2 23:20 24:4 25:3 26:17 29:5 31:5,12 35:9 35:13 41:4 43:16 43:17 44:17 45:12 46:19 47:3,8,12 47:15 78:7 79:11 93:8 97:17 99:17 105:14 124:9,10 131:19 133:11,19 136:4 139:16 147:6 152:19 153:9 154:1 156:21 157:2,22 158:18 159:8,12 160:8 170:4 176:5 177:21 178:12 188:20 189:17 193:12 sound 20:16 163:15 207:16 sounds 37:2 180:13 source 41:18 66:16 110:8 144:3 149:19 156:6 171:9 191:14 sources 15:7,8 16:22 34:5 66:20 79:12 103:10 south 70:5 126:5 174:1 184:11 185:22 193:7 southeast 29:16 67:21 84:6 85:15 137:5 186:14 Southern 1:13 2:1 3:9 5:4 50:20,21 52:20 53:8 55:21 56:12 57:3,16,18 60:1 61:12,16 62:2 63:15 67:4 68:4 69:4 70:7 71:6 76:12 80:12	80:17 85:16 space 42:18 78:14 157:17 210:3 spare 151:22 spark 119:8 sparks 118:15 119:10 121:14 speak 6:12 11:8 50:6 151:12 155:4 213:9,11,13 speaker 8:16 50:18 81:14 115:7 150:19 151:11 speakers 50:15 83:2 114:11 197:6 197:12 213:21 speaking 49:21 52:1 speaks 171:15 special 4:9 specific 35:19 72:22 78:17 108:10 111:3 138:7 193:18 204:4 specifically 13:4 16:8 17:14 43:21 202:2 speed 28:19 spend 85:13 spending 130:21 spin 43:11 spoken 118:1 sponsored 209:5 sponsoring 214:20 sponsors 208:13 214:19,21 spots 171:6 spreading 122:11 spreads 117:22 118:4,6,15,19 119:8 sprinkled 119:2 stack 110:9 staffing 25:3 stage 197:19 staggering 142:17	stakeholder 32:14 35:1 stakeholders 32:16 94:15 212:17 stand 116:18 215:14 standard 62:13 91:7 95:12,14 97:8,9,12 160:8 193:12 210:15 standards 12:22 16:18 66:17 84:7 85:8 143:17 Standford 215:6 standing 151:6 stands 45:18 star 114:20,22 Stark 145:2,2,2 start 19:18 27:10 36:18 48:1,4,19 77:13 87:10 96:3 96:8 116:16 120:15 126:20 131:12 154:5 156:22 157:13 164:8,19 169:15 169:17,19 171:18 173:17 174:19 179:12,20 188:5 189:1 198:9 200:22 started 13:10 31:22 32:2 61:15 91:4 156:13 159:21 166:22 186:5 200:6 starting 18:9 27:5 119:12 startling 186:11 StartReports 145:3 starts 23:5 158:1 188:4 state 14:10 17:15 18:16 19:18 21:14 29:1 53:16 58:16 62:9,11,12 70:19 83:11 89:4 91:4	91:22 92:7,8,13 92:13,14 93:3,5 94:1 97:4,4,13,15 97:20 100:2,2 101:14 108:22 110:5,10 111:19 121:13 122:5,6 138:12 139:2,6 156:17 165:21,22 194:11 state's 89:10 state-based 91:15 92:4,5 97:5 110:11 state-owned 99:15 112:18 statement 142:18 states 17:7,10,19 17:21,22 18:22 19:1 60:15 66:2 82:3 87:11,20 88:8,19,19,21 92:9 93:13,14,18 108:8 121:15 140:2,6,20 154:21 155:18 156:4 158:12 159:2 173:15,22 176:22 177:3,7 178:18 179:3,8 180:8 181:13 186:15 187:1,3 188:15 191:12 192:8 195:5 stating 6:13 station 100:5 stationary 34:4 stats 147:21 status 30:13 statute 102:21 stayed 90:12 staying 214:8 stays 141:3 STB 43:4,6 steep 184:8 step 154:2 Steve 72:7 110:19
---	---	--	---	--

147:18	90:2 183:19	133:13	27:16 28:3 30:11	33:13 55:10 69:5
stimulate 160:19	197:21 198:2,6	support 80:20	31:13 35:17 50:22	111:19,20 117:8
161:13 183:9	199:22 200:8	151:3,8 188:11,22	62:2 70:11 86:18	121:1 127:18,19
stimulus 188:5	205:11 206:8	209:7,18 211:20	90:19,20 92:3,4,4	130:12 135:15
stock-pickers	208:17 212:11,16	211:21 215:2	93:2 96:19 103:13	139:4 142:7 154:5
115:3	212:18	supporters 209:1	103:15 105:1,2,15	155:2 156:17
stockpile 102:2	stuff 12:15 34:21	supporting 208:16	systems 2:3 3:7 5:1	160:12 161:21
stood 18:16	43:19 44:21 48:3	213:22	9:14 23:11,20	164:8,10 168:12
stop 185:4 192:9	164:14,20 166:7	supportive 40:7	24:8 63:17 153:15	168:16 171:18
storage 15:16 26:6	187:12	suppose 148:16		173:17 178:1
38:6,18 70:4	stumbling 113:14	supposed 36:8	T	185:1 190:16,19
103:12,12 198:19	sub 23:15 172:10	sure 13:5 17:7	tailor 16:19	212:19
200:18	sub-leasing 210:3	18:12 19:17 24:16	take 7:11 19:11	talks 23:3
stories 60:12	sub-Saharan 172:9	33:2 36:8,10 38:3	22:8 24:14 27:11	tall 100:13
storms 23:12 64:3	subject 7:17 129:1	38:10 39:3 43:21	33:8 36:10,14	tangent 118:21
story 31:7 85:16	submit 213:7	44:3,6 45:1 65:15	39:3 55:19 71:17	target 90:6,12,12
154:17 190:7	subsequently	75:14 79:14 84:17	76:14 84:10 94:15	156:8 180:10
straight 89:5 162:1	133:22	86:17 93:7 94:14	110:17 114:3,19	193:18
strains 95:22	subsidized 124:16	96:21 102:17,18	116:20 117:20	targets 199:3 202:7
Strategies 100:14	substantial 120:2	107:4,16 193:3	144:18 154:1	tariff 102:21 103:2
strategy 12:19	153:17	203:15	169:5 181:12	task 9:9 21:15
13:20 14:9 15:20	subsurface 156:2	Surface 28:17	186:17 197:1	tax 137:19,20
44:12 46:9	159:15 161:16	101:2	200:16 209:11	tcf 187:14
stream 38:10	165:7 167:10	surprised 41:5	taken 33:3 78:3	team 57:17 67:9
streams 193:13	success 43:5	49:11 63:10,11	takes 21:2 53:3	204:21 206:9
Street 1:10 115:5	successful 76:8	77:14 112:13,16	71:21 128:16	Tech 214:22
stress 105:1	164:21	113:6	talented 52:11	technical 17:17,22
strict 93:3	successfully 75:10	survey 86:11 204:3	talk 11:19 12:9	18:17,20,22 32:6
strictly 8:11 132:18	209:13	204:6,21	13:9 15:12 20:1	156:8 179:18
strip 78:14	sufficient 182:22	surveys 86:20	27:21 47:11,13	193:5 195:2
strong 56:6	suite 210:4	204:16	56:3 63:1 66:7	196:15 200:1
stronger 20:14	summer 59:22 60:3	surviving 148:1	70:17 78:17 83:9	202:13,15,15
strongly 60:8	63:13 78:9 100:8	Susan 151:17	93:17 94:3 99:1,9	technically 175:17
structurally 130:12	supercritical	sustain 186:1	100:18 103:8,13	179:16
structure 72:13	189:21	Sustainability 45:8	116:17 119:3,14	techniques 164:11
139:18 141:12	superimpose	swept 171:17	128:12,22 129:7	182:9
structured 199:13	170:16	switching 119:16	129:12 138:7,8	technological 162:5
struggle 11:7 122:2	supplemental	128:19 136:20	146:15 152:18	technologies 14:17
struggles 73:13	79:16	137:3	165:2 168:2 172:5	16:22 57:9 163:19
80:6	supplies 23:21	Sy 41:14 75:6,7	173:1,21 176:3,21	189:18 193:18
struggling 207:19	129:10 157:14,18	synthesis 32:5	181:14 182:2	201:11
studied 89:19	supply 69:14 73:16	34:22	189:4,7 190:10	technology 26:21
156:2	79:20 80:4 89:18	synthesized 32:12	192:15	58:13,16 75:19,22
studies 151:21	89:22 90:1 124:18	synthesizing 32:22	talked 34:6 66:5	76:8 98:22 149:8
208:16 209:10	132:12 159:22	synthomodels 67:5	67:20 99:10 104:2	149:14 162:20
study 3:19 5:16,19	186:20 187:7	system 13:15,17	119:15 121:10	164:13,16 198:21
25:19 39:15 80:13	supply-demand	18:1 24:15 27:12	187:17	203:10
			talking 28:3,5	

tell 19:3 25:14 54:5 73:5 84:3 87:10 139:22	thank 7:5,10 8:14 36:14 39:20 50:8 50:10,16 51:16,17 52:8 72:3,16 75:5 75:13 76:16 79:2 80:8,11,12,22 81:8,10 82:22 105:22 106:2,4,6 113:18,20,21 114:1,10 115:14 115:17 144:15 150:8,9,16 151:9 152:13 192:12,14 196:20 197:2,2,11 197:13 198:3 206:21 207:1,3 209:3,6 214:9,11 214:19 215:1,3,6 215:9,14,16	67:4 76:12 80:5 84:7,13 98:14 100:17 104:10 108:2 112:13 119:1 127:21 134:3 155:7 158:8 158:15 159:11 160:6 163:18,22 167:9,10 168:1 179:21 180:9 181:11 183:4,18 189:22 194:5 195:20 211:9 212:6	139:8 140:7,9 141:22 142:4,18 142:19 143:9 145:21 146:17 147:6 152:22 153:8,8 154:14 157:5 162:5 168:14 169:15 170:5,8,9 171:7 174:20 179:20 181:15,17 189:16 191:5,6 197:5 198:11 201:13 204:15 206:20 211:11 212:3 213:1 214:7	time 11:1 27:8 33:9 45:12,21 52:5,6 53:3 55:5 56:11 57:4,12 59:21 60:10 64:10 65:12 66:14 71:5 76:18 77:22 78:4 83:8 84:21,22 85:13 90:13 93:8,16 94:18 95:14 103:21 104:22 115:18 117:14,15 124:9 128:16 137:20 141:15 149:7 151:22 154:14 158:17,18 162:21 165:17 169:3 174:6,11,16 186:1 188:22 192:13 198:12 203:8 210:9 213:4 213:12 215:14
telling 145:22	thank 151:7 215:10	think 8:3 11:14 12:21 13:1,14 16:9 18:9,11 26:19,21 27:2,3,7 27:9,19 28:10 31:3 34:13,16 35:14 38:14,19,21 39:2,7,8,17 41:6 44:9,10,16,19 49:15,17 50:1,2 55:9 59:12 61:19 76:11 80:9 84:15 87:7 89:2 91:11 91:19 93:6 96:2,6 104:1 106:17,19 107:7,14 108:1,20 110:3 112:1 116:14,18 117:1 117:21 118:2,7,17 119:4,7,17 120:4 120:8 121:5,8,12 121:17 123:3,13 124:12,20 125:2 126:13 127:5,22 128:1,1,7,11 129:5,17 130:6,10 131:2,14,22 132:19,21 133:3,6 133:15,18 134:2 134:15 135:3,17 135:20 136:10,17 137:6,6,8,22 138:2,10,14 139:5	thinking 17:5 27:10 33:11 48:19 157:13	timeline 127:5 139:21
tells 174:19 177:15 185:21 186:11	thanks 10:1 37:1 54:7 58:9 75:4 80:9 81:5	think 168:4 201:6	thinks 19:9	times 56:18 59:17 64:6 83:7 106:20 113:14 177:6
temperature 105:11	theme 131:14 141:6	thorny 124:20 139:20	thinly 96:8	timetable 111:2,22
temporarily 101:6 101:21	theoretically 84:11	thought 25:20 53:4 67:16 98:4 99:17 108:14	third 168:4 201:6	timing 86:16 128:3
temporary 214:4	thermostats 105:12	thoughts 18:11	thousand 168:4 201:6	tired 10:5
tempt 11:10	thesis 118:14 125:19,21 126:20 138:4 142:10	thousands 52:10 159:18	thorny 124:20 139:20	today 4:9,13,18 5:14 6:6 65:19 71:10,12 129:19 130:1,16 134:20 145:8 149:14 151:2 155:2 161:20 163:17 164:4 177:7 197:6 197:12 210:7
tend 33:15 153:3 158:5,16	thing 13:1 29:5 37:13 39:5 42:6 44:17 104:14 106:13 108:7 143:9 166:8 167:16 171:4,11 174:13 182:1 189:3	threaten 66:12	thousand 52:10 159:18	today's 6:16 150:21
tendency 185:11,19 186:10	things 10:9 11:2 12:12,17 16:9 18:3 26:14 27:13 28:1 29:7,10 32:3 32:4,10 34:6 35:10 37:4 39:6 42:15 48:6,13	three 12:2 14:13 37:19 61:12 100:5 110:2 111:9 114:22 115:3 116:10 128:9,13 172:17 195:17	thousand 52:10 159:18	Tom 71:10
tends 144:18 158:6		threshold 121:20	thousand 52:10 159:18	Tomski 203:11
Tennessee 51:5,7 52:2,3 57:15		thresholds 122:8	thousand 52:10 159:18	ton 34:20
tension 40:12		throw 71:18 125:7 140:13 144:14 189:8	thousand 52:10 159:18	tons 70:2 73:21 74:18 201:16,18
term 20:11 139:14		THURSDAY 1:7	thousand 52:10 159:18	tool 46:8,8,9 104:11
terminals 154:19 178:2		tie 143:4	thousand 52:10 159:18	
terms 22:22 33:6 59:3 73:13 78:13 86:2 87:9 95:19 152:19 153:4 154:15 162:9 170:1 174:3 177:17 187:22 191:1 200:20 203:17 204:2,19 206:21 208:15 212:20		tiering 187:4	thousand 52:10 159:18	
terrific 39:19 40:9		tiers 187:9,10		
territorial 96:13				
territory 53:16 75:20 77:12,18 111:10 117:16				
Terry 82:7				
test 162:19				
TETCO 126:5				
Texas 121:11,21 122:20,22 138:9 138:10 139:9,15 163:3,4,10 165:21 165:22 193:7				

top 102:3 115:2 120:12 127:18 144:7	141:21 213:19 214:3	72:20 155:3 167:13 183:20	139:8 142:4 146:21 147:9 163:13 168:10 173:17 174:10 186:15 190:2	192:7 195:4
topic 37:6 214:1	travel 100:7,16	turned 161:10 163:20	ultra 160:13,13	unitizing 163:12
topside 182:17	treated 85:3	turning 120:15 164:9	ultra-supercritical 149:8	units 84:10 89:16 106:13 136:8 147:13
totally 175:11	tremendous 64:21 159:22 164:2,6 166:6 175:3 187:18 189:10	TVA 61:12,14	uncertainty 157:1	universally 88:12
tour 71:17 98:12	trend 125:14 131:7 133:1 141:7	twenties 75:3	unconversion 149:18	University 2:5 3:16 5:12 51:7,9,10 57:14 82:6 152:2
town 129:13	trends 3:15 132:2	twenty-seven 65:22 73:22	underground 70:4	University's 151:19
track 130:17	Tri-State 214:22	two 10:2,6,12 29:21 50:15 61:12 80:4 83:2 88:15 100:14 101:1 112:12 114:11 126:18 128:9,13 150:19 158:8 159:18 171:8 177:6 180:13 192:13,19 193:9 210:8	underlying 135:1	unlevered 121:3
tracks 167:1	tribal 18:16	twos 93:18	understand 28:7 46:4 72:13 82:11 86:12 87:22 88:6 91:20 113:17 154:8,8 155:9 169:17,19 173:18 181:3 183:20 192:18 199:1 202:6 205:6	unlocked 164:2
trade 96:9 108:3,6 169:18 177:16,17	tried 31:6 56:18 70:14 86:2 144:14 160:6 161:2 204:13	type 68:18 163:9,13 181:22	understanding 116:19 154:10	unprecedented 67:19 117:16
traded 96:8	trigger 105:14 149:19	types 78:13 176:6 183:15	undertaken 193:10	unproductive 90:9
trader 117:8	triggered 162:10	typical 199:12 204:16	underway 5:16 209:17	unsustainable 135:10
trading 104:12	triggering 139:1 140:1	typically 106:22 110:7 157:10 158:5,9,16 182:2	underweight 53:6	unusual 108:2,4
traditional 23:21	trip 76:19 82:12 112:15	typical 199:12 204:16	uneven 43:20	unwittingly 97:5
train 27:15 32:8 50:5	tripled 131:20,21	typical 199:12 204:16	unfolding 168:1	unworkable 66:22 67:21 68:20
Trans-Canada 104:17	trouble 28:9 104:7 194:16 195:12	typical 199:12 204:16	unfortunately 151:1 207:6	update 3:19 5:15 197:20 198:6 206:21
transactions 141:16	truck 193:14	typical 199:12 204:16	unique 115:9 178:15 179:7	updating 38:10
transcriber 36:21	true 19:6 112:4 141:3 179:8	typical 199:12 204:16	underway 5:16 209:17	upper 92:9 109:13
transcript 6:11	try 48:14 75:18 83:9 105:20 143:4 152:14 157:19 183:19	typical 199:12 204:16	underweight 53:6	Upstate 123:10
transfer 109:10	trying 10:4 19:1 20:3 31:8 35:11 35:15 41:8 45:8,9 53:5 55:22 83:16 84:17 86:10,22 87:21 88:5 91:20 93:12 97:17 101:11,13,15,16 113:12 140:16	typical 199:12 204:16	uneven 43:20	upstream 154:3 157:13 160:9
transformational 168:15	try 48:14 75:18 83:9 105:20 143:4 152:14 157:19 183:19	typical 199:12 204:16	unfolding 168:1	upwards 131:10 162:8
transforming 168:13	TS&D 34:5 49:11	typical 199:12 204:16	unfortunately 151:1 207:6	urbanization 173:4
transition 74:3 153:10 210:13 211:6	tug 96:22	typical 199:12 204:16	unique 115:9 178:15 179:7	usable 193:20 196:13
transitional 130:1	Turkey 84:1	typical 199:12 204:16	unit 61:15 75:15 77:8 89:7 93:20 98:9	usage 64:2 65:5,17
transitioning 135:12 210:4	turn 48:6 50:12	typical 199:12 204:16	United 60:15 66:1 154:21 155:18 156:4 158:12 159:2 173:15,22 176:22 177:3,6 178:18 179:3,7 180:7 181:13 186:14 187:1,3 188:15 191:12	USDA 42:4,17
translate 115:10		typical 199:12 204:16	uniquely 59:3	use 6:12 11:4 16:17 23:14 34:2 56:1 58:22 59:6 60:20 62:19 66:3,15 68:4 70:14 73:19 75:19 109:14 118:3 152:8 174:6 175:10 201:6
translation 198:15		typical 199:12 204:16	unlucky 59:3	useful 56:9 154:7 180:16
transmission 15:16 22:16 26:6 51:1 126:1 215:1		typical 199:12 204:16	unit 61:15 75:15 77:8 89:7 93:20 98:9	
transmit 177:18		typical 199:12 204:16	unlucky 59:3	
transport 33:22 186:16 190:9 200:19		typical 199:12 204:16	unlucky 59:3	
transportation 28:17 40:2 79:8 101:2 124:4 125:4		typical 199:12 204:16	unlucky 59:3	

uses 58:17 159:5	viable 59:9,10 66:15 156:8 171:9	73:2 74:20 75:2 79:14	59:12 60:22 66:3 66:6,13 68:16	45:2,16 47:4,10 47:13,16,19 48:9
usual 121:4	vibrant 211:13	want 23:7 27:10	70:14 73:18 74:8	48:21 49:5 58:8
usually 63:10	vice 1:13,14,16,19	36:5 43:17,18	74:15 77:21 78:5	58:20,21 59:13
Utech 49:4	5:6 50:13,16,19	47:21,22 50:6	78:8 84:10 85:17	60:17 62:5,6
utilities 1:19,21 5:7	81:10,15 114:1	62:19,20 63:3	88:17 90:16 98:22	69:16 71:11 73:6
28:22 52:21 63:16	152:4 199:21	64:8 65:5,7,9,15	102:16 103:6	73:8 74:13 75:17
68:10 77:20 79:19	view 22:10 24:15	75:14 85:12	104:4 108:16	76:7 79:15,17
81:16 90:7 92:15	25:9 118:18,19	103:11,13 122:6	113:4 117:11	80:5 83:15,15
94:3 95:1 97:10	175:13 203:10	122:15 125:6	118:9 126:2 132:1	84:4 85:6 86:4
98:5 102:2,14	205:7,9	126:13 127:16	149:9 163:16	88:5,7 91:5,20
109:20 114:18	views 36:11 206:14	128:12 131:14	168:5,13 180:7	93:11 94:1,10,10
115:3,20 143:14	Vikings 110:21	134:17 136:11	182:5 199:9 200:6	95:16 97:17
utility 1:18 3:11,13	112:8	137:7 138:9	202:11 206:17	101:11,13,14
58:3 81:18 92:4	Virginia 57:13	140:22 146:19	ways 23:17 30:10	102:16,17 103:8
93:2 114:15,20	virtue 27:3	154:1 168:7,11	57:9 87:17 195:22	108:20 110:12
125:3	visibility 139:19	187:13 189:12	wayside 206:5	111:19,20 114:3
utility-related	vision 107:1	190:22 199:11	we'll 4:19 5:8,14,17	117:15 118:7
81:22	Vogle 56:13,14	200:15 203:2	10:6 15:21 26:3	122:9 123:17
utilization 3:15	57:3,11 61:19	204:1 205:1 206:4	26:14 27:7,21	125:20 127:11,12
26:20 198:20	71:8,18 85:21	210:19 211:19	34:22 36:4,5 48:7	127:15,17,19
200:19	voice 204:5	212:21 214:19	48:16 49:17,18	129:14 135:2,10
utilize 59:14	volatile 121:21	wanted 46:4 48:1	71:12 73:10,20	139:3 140:10
utilized 204:3	volumes 171:15	82:15 128:22	78:22 80:1 84:13	141:7,8 148:14
	voluntary 208:9,18	129:4 150:19	88:4 93:17 95:13	153:9 155:2 161:6
	volunteers 200:7	204:5	95:19 103:16	168:2,4,16 177:4
	206:9,10	war 56:16,17 97:1	104:3 105:19	182:3 186:6
V	vortex 59:20 80:18	192:8	114:13 117:20	196:20 199:18
v 138:20	101:7 129:12	warm 77:3	126:1,12 128:20	200:16 201:2
Vacating 104:6	vulnerabilities	Washington	140:22 141:2,3	202:2,3 204:7
vague 152:19	20:20 21:5,8	100:10 148:7	200:22 205:9,12	205:2 208:3
Valley 52:3	35:20	wasn't 60:16	205:17 210:2	209:16,21,22
valuable 169:10	vulnerability 22:13	162:16 203:15	211:3 212:17	210:7 211:13
value 80:19 102:22	42:8	wasted 67:11	we're 4:8 12:17	213:20,22
103:4,9,11,14,20	vulnerable 85:4	wastewater 23:16	14:13 15:15 18:8	we've 13:21 14:21
194:6 198:18,20		water 22:15,19	18:9,22 20:5 21:1	15:11 25:17 27:5
variety 116:6	W	23:17,18,21 40:2	21:5,9,10 22:14	27:6 28:3 29:12
various 23:15	wait 25:12 47:22	152:16 160:21	24:1,12 25:19	32:7,13,14 33:13
81:22 212:16	94:7,9	192:21 193:4,12	26:1,1,10 28:13	55:5,6,21 57:5,6,9
vehicles 65:13	waiting 46:15	193:12,22 194:2,4	29:4,17 30:6,13	58:6,11 59:11,22
vendors 70:13	48:21	194:6 195:6,11,15	30:17,19 31:8,8	61:5,6 69:10,11
venture 165:13	walk 54:1	196:6,11	31:20 32:3,5,6,22	71:14 76:6 79:21
176:3	walked 53:22	Waterfront 1:10	32:22,22 33:1,11	80:3 85:14 86:1
verbatim 6:10	WALKER 6:22	waterways 29:19	33:18,20 34:14	86:19 87:3 88:9
verbiage 110:16	wall 115:5 144:14	way 19:15 27:2	35:4,13,15,20	95:8 103:17 104:1
versus 124:13	Wallace 1:11,13	30:15 36:21 50:3	37:4,13 38:8,10	112:4 116:9
142:10 199:2	3:2 4:3,4 6:20 7:1	53:6 55:13 57:7	39:8 41:2,4 43:13	119:15 124:8
vertical 160:8	7:3,5 8:14 50:10			
161:2,7				
vertically 87:13				
viability 165:9				

133:11 135:14 140:6 141:7 142:1 142:2 145:6,18 146:8,20 161:14 161:15 162:11 166:6 168:22 169:1 173:5 183:19 186:3,5 191:7 200:14 202:13 209:15 wealth 173:19 174:2,17 176:14 wearing 110:20 weather 20:21 23:1 77:9 website 18:15 63:20 197:8 209:16 211:16 212:1,4,13 week 54:6,6 84:1 174:9 197:8 weekly 28:19 102:1 weeks 10:12 121:9 weighted 128:5 welcome 3:2 4:17 6:5 23:8 32:19 39:6 49:18 211:10 welcoming 9:20 51:14 82:19 115:14 152:11 well-bore 161:11 164:9 182:14,15 182:17 183:4,8,13 well-running 54:19 wells 160:8 161:20 166:18 180:11,13 180:22 181:1,8 183:3 184:3,7 185:1,5,10,14 194:18 196:14 went 57:11 77:2 104:19 114:8 147:2 159:10 160:3 174:7 204:17 215:19 weren't 72:18 89:17 112:19,20	163:18 west 41:19 136:9 140:5 159:20 163:2,4 190:12 western 73:8 135:20 140:2 172:3 173:22 196:9 Westinghouse 61:18 westward 138:3 144:12 wheel 201:2 whiffs 99:4 white 9:9 21:17 25:3 32:6 44:2 49:1 100:12 169:11 wholesale 95:5 wide-scale 137:3 wildfires 22:16 41:19 Williams 2:8 7:8 win 96:22 wind 62:2,4,5 91:7 92:16,18 108:11 109:7 202:22 205:1 window 54:2 95:20 164:10 wings 183:10,12 winter 59:19 60:2,4 77:1 78:8 101:7,8 102:6 104:10,15 129:11 130:17 wire 62:5 125:21 126:1,20 Wisconsin 28:8 109:10 wise 64:9 65:7,8 wisely 62:20 wish 6:12 213:11 213:13 wishes 213:9 withdrawal 193:13 withstand 23:12 wonderful 39:14	59:2 76:17 Woodford 167:20 word 25:17 147:8 words 84:20 87:4,6 174:6 work 10:16,18,20 12:8,10,21 13:6 16:13 20:3,5,9 21:4 23:7 24:20 28:4 31:20 33:6 33:16,18 34:21 38:3,9,10 39:12 42:7,13,18 43:19 44:14 50:5 66:13 71:15 76:3 86:2 121:18 147:4 150:15 157:22 175:11 178:5 185:2 191:7 212:15 worked 9:2 58:11 61:11 67:6 105:2 workhorse 65:18 working 8:21 12:17 31:17 32:8,9 33:1 42:3 52:3 71:15 83:15 85:14 115:6 198:7 203:3 206:2 Workman 207:6 works 13:17 20:7,9 world 30:5 56:17 66:1 82:10 84:5 88:2 94:22 128:10 129:13 133:4 134:10 156:3 158:13 170:6 173:1 174:22 175:2,5 176:21 177:4,12 191:20 192:5 195:5 196:18 world's 172:18 worlds 88:15 worldwide 201:9 worry 22:22 worsening 12:4 worst 104:11	worth 69:8 71:3,4 130:5 160:4,5 worthwhile 121:5 122:4 wouldn't 50:5 150:3 wow 156:22 158:15 Wright 2:7 4:15 215:3 write 205:5 writing 116:9 written 88:21,22 156:16 162:14	64:4 207:7 211:8 York 122:21 123:10 131:18 132:7
Z				
zone 162:2,8 194:20 zones 87:11				
0				
1				
1 31:18 95:12 138:20 141:13 184:22 204:12 206:4 215:15 1-Hour 135:22 136:1 1,000 111:19 201:18 1,400 187:14 1.1 26:10 1.2 26:11 49:8 10 3:6 95:12 155:15 155:21 164:15 10:41 114:8 100-page 200:12 101 135:5 11 10:3 114:5 121:2 11:05 114:9 111(d) 85:11 87:19 88:3,14,19 90:3 96:5,17 108:2 110:13 206:3 115 3:14 12:29 215:19 14 32:14 36:6 121:22 15 73:12 94:4 164:15 150 111:20 150,000 70:1 152 3:16 16 1:7 73:12 16,000 184:3 17 128:5 18 128:5				
X				
Xcel 92:8				
Y				
yards 30:20 year 10:11,21 15:11,15,19,21 16:4 20:19,19 24:11,12 26:3,5 26:11,18 27:4,7 27:14 29:8 32:1 37:18 49:17 55:2 60:2,3 70:4 80:14 89:9 91:13 127:9 127:20 136:5 142:12 144:3 198:7 207:20 208:3 209:1,4 211:18 years 8:20 25:20 37:19 47:22 52:4 54:16,21 57:18 58:5 62:10 71:7 71:12 77:21 91:8 94:3,4 114:22 119:16 125:8 127:7 128:9,13 138:14,16 143:3 145:7,20 146:10 154:14 155:15,21 156:14 164:15 175:20 176:5 210:11,16 yesterday 32:9				

18,000 181:8	26 199:18	8 77:4,15 78:11	
1947 162:19	26-27 74:22	80 69:12	
1949 162:18	260 53:14	82 3:10	
1991 74:15	27 199:19	85 55:1 56:5	
<hr/> 2 <hr/>	<hr/> 3 <hr/>	<hr/> 9 <hr/>	
2 49:6 94:3 138:20	3 94:3 184:9		
141:13	3,000 161:22 162:8		
2-4 1:10	3,200 180:22		
20 84:7 114:3 121:1	3,500 161:22 162:8		
144:2 175:20	30 8:20 175:20		
200 3:19 180:10	176:4		
2000 91:4	30-35 100:3		
2002 181:7	300 162:3,7		
2003 158:10,11	31 206:7		
170:15 177:9	35 64:22		
2006 158:11	<hr/> 4 <hr/>		
2007 60:7 114:18	4 3:2		
166:17	4,000 162:9		
2008 117:19 180:21	40 64:22 65:19		
2009 166:17,21	69:14 176:4		
201 1:10	400 173:12		
2010 115:1	46 91:6		
2012 39:16 89:8	47 154:19 178:2		
115:1	<hr/> 5 <hr/>		
2013 12:2 82:7	5 204:12		
184:5	5-year 94:5		
2014 1:5,7 4:6	50 57:18 58:5		
208:2 211:2	154:14 176:5		
2015 79:9 133:15	50-52 73:21		
180:12 210:22	500 161:12		
211:2	51 3:9		
2017 133:15	5e 99:16		
2018 134:1	<hr/> 6 <hr/>		
2018-2019 132:5	6 67:17		
2019 134:1	65 58:20		
2020 90:6 189:1	69 91:5		
2030 90:14 173:13	<hr/> 7 <hr/>		
199:8	7 3:4 174:9		
2040 175:10	70 89:17 201:15		
207 3:18	745 104:7 132:16		
211 3:20	<hr/> 8 <hr/>		
212 3:21			
213 3:22			
21st 212:2			
24 174:8			
240 204:17			
25 70:3 204:15			

C E R T I F I C A T E

This is to certify that the foregoing transcript

In the matter of: National Coal Council
2014 Annual Fall Meeting

Before: US DOE

Date: 10-16-14

Place: Oxon Hill, MD

was duly recorded and accurately transcribed under
my direction; further, that said transcript is a
true and accurate record of the proceedings.

Neal R Gross

Court Reporter

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701