ENHANCING ENERGY INFRASTRUCTURE RESILIENCY AND
ADDRESSING VULNERABILITIES
A Public Meeting on the
QUADRENNIAL ENERGY REVIEW
Friday, April 11, 2014
10:00 a.m.

United States Capitol Visitors Center
Congressional Auditorium
East Capitol Street, N.E. and First Street N.E.
Washington, D.C. 20001

Reported by: Natalia Thomas
Capital Reporting Company

1 C O N T E N T S

2 SPEAKER	PAGE
3 Melanie Kenderdine	4
4 Dr. John Holdren	8
5 Sec. Ernest Moniz	13
6 The Honorable Henry Waxman	18
7 Peggy Montana	28
8 Duane Highley	35
9 Joe Rigby	43
10 Andy Black	49
11 Gerry Cauley	54
12 Marty Durbin	97
13 Dr. Robert Hartwig	102
14 Robert Misback	112
15 Robert Blue	116
16 Barbara Tyran	153
17 Becky Harrison	155
18 Mollie Simon	158
19 Ron Edelsetein	161
20 Christina Cody	163
21 Dr. Karen Wayland	167

22

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

2 MS. WELSH: Good morning, everyone. My
3 name is Peggy Welsh. I'm with Energetics. We are
4 a support contractor to the Department of Energy
5 and it is my distinct honor today to be the
6 meeting facilitator, which means that I have the
7 time clock. We have a very tight schedule, as you
8 saw in your agenda that you picked up at the
9 check-in desk. And so, I want to read just a
10 couple of housekeeping notes. There will be very
11 little time for questions, but this panel, if
12 there is time, will take questions from the floor.
13 And if you wish to speak during the open mike
14 session, you need to sign in at the check-in desk
15 and let folks there know. So, please, do that if
16 you wish to speak.
17 But let me just read what we're trying
18 to accomplish today. The purpose of today's
19 meeting is to ask for your individual input or
20 your organization's input regarding Energy
21 Infrastructure Resiliency and Vulnerabilities, and
22 to provide a forum to exchange information amongst

1 panelists. To that end, it would be most helpful
2 to you for us, if you would provide these
3 recommendations and information based on your
4 personal experience, your individual advice,
5 information, or facts regarding the topics we're
6 discussing today. The object of this session is
7 not to obtain any position -- group position or
8 consensus. Rather, the Department of Energy is
9 seeking as many recommendations as possible from
10 all individuals at this meeting. This is pursuant
11 to the requirements of the Federal Advisory
12 Committee Act.
13 So, with that, let me introduce Ms.
14 Melanie Kenderdine. She is the Director of the
15 Department of Energy's Office of Energy Policy and
16 Systems Analysis and a counselor to Secretary
17 Moniz.
18 MS. KENDERDINE: Thank you. Thank you,
19 Peggy, and thank you for everyone here today and
20 those of you in cyberspace for your interest in
21 this process. The office that I direct, the
22 Energy Policy and Systems Analysis Office, is

1 supporting the Quadrennial Energy Review. We're
2 doing the analytical work and managing -- helping
3 to manage the interagency process. As most of you
4 know, the Quadrennial Energy Review is a process
5 led by the White House, and Dr. Holdren and
6 Secretary Moniz will talk a little bit more about
7 that today. I also want to acknowledge Dr. Karen
8 Wayland. She's a deputy director in our office.
9 She's been putting these meetings together. She
10 and her team have done a terrific job and she has
11 about 14 more to do across the country. They are
12 just an outstanding team.
13 I'm going to introduce the three
14 panelists for the first panel. I'm going to do
15 them in the order that they will speak. I'll
16 introduce them all at once. The first is Dr. John
17 Holdren. He is an Assistant to the President for
18 Science and Technology, Director of the White
19 House Office of Science and Technology Policy, the
20 co-chair of the President's Council of Advisors on
21 Science and Technology, and the co-chair of the
22 White House Task Force for the Quadrennial Energy

1 Review. He co-chairs that task force with Dan
2 Utech, who's with the Domestic Policy Council at
3 the White House. And I think Dan is at a wedding
4 today and could not be here. He would be here
5 otherwise. Among other things, Dr. Holdren was
6 also on the faculty of Harvard and UC Berkeley
7 prior to joining the Obama Administration.
8 Next, you're going to hear from the
9 United States Secretary of Energy, Dr. Ernest
10 Moniz. Prior to becoming Energy Secretary in May
11 of last year, Professor Moniz was the Director of
12 the MIT Energy Initiative and served on the
13 faculty of MIT for 40 years. I had the pleasure
14 of working with the Secretary both at the MIT
15 Energy Initiative. And when he served as a DOE
16 undersecretary in the Clinton Administration,
17 Professor Moniz or now Secretary Moniz, was the
18 last single undersecretary at the Department of
19 Energy. We now have three, and I can attest to
20 the fact that he does the work of three people and
21 is, I think, an outstanding secretary. He's my
22 fourth.

1 Finally, we'll hear from Congressman
2 Henry Waxman. Mr. Waxman is the ranking member of
3 the House Committee on Energy and Commerce and a
4 longtime representative of California's 33rd
5 Congressional District. Representative Waxman has
6 been a leader in the Congress on health care and
7 environmental issues. He is a primary author of
8 the Clean Air Act Amendments of 1990, and
9 sponsored the Safe Drinking Water Act Amendments
10 in 1986 and 1996. Mr. Waxman may not remember me,
11 but I was a young Hill staffer. I was Chief of
12 Staff to then Congressman Bill Richardson and had
13 the opportunity to work with him, Karen Nelson,
14 and Phil Schiliro and many others on his staff
15 many, many years ago. As you all know, Mr. Waxman
16 recently announced his retirement, and I would
17 like to say that the nation owes him a debt of
18 gratitude for his service. I think it's worth
19 giving Mr. Waxman a hand.
20 (Applause.)
21 And in closing, let me say something about Drs.
22 Holdren and Moniz. Secretary Moniz was a member

1 of the PCAST and that was led by Dr. Holdren at
2 the time in November of 2010 when PCAST issued a
3 report recommending that the Government conduct a
4 Quadrennial Energy Review to provide the nation
5 with a road map for energy policy based on data
6 and rigorous analysis. As Secretary Moniz likes to
7 say about the QER, he and Dr. Holdren were there
8 to toss the QER baseball at the beginning of the
9 inning and are now, in their current capacities,
10 on the other side of the pitch to catch the ball.
11 It is a pleasure to welcome these three
12 outstanding public servants, and let me turn this
13 over to Dr. Holdren.
14 (Applause.)
15 DR. HOLDREN: Well, thank you, Melanie,
16 and thanks to all of you for being here this
17 morning. It is certainly a pleasure to be here
18 with my friend, Secretary Moniz, to open the first
19 public stakeholder meeting for the Quadrennial
20 Energy Review. And I'm also very pleased, indeed,
21 that ranking member Waxman could be with at this
22 important meeting. He is, indeed, a giant among

1 legislators, and his contributions to the domain
2 environment that is so dear to my heart have been
3 immense.
4 The fundamental purpose of today's
5 session, of course, is to hear from you, to hear
6 from experts in the public outside of the
7 executive branch about the very important
8 challenges we face around energy infrastructure,
9 so I'm going to make my remarks very brief, not to
10 cut too deeply into the opportunity to hear from
11 you. I do want to say that the idea to have
12 regular reviews of national energy policy is even
13 older than the Department of Energy. As far back
14 as 1973, the former Atomic Energy Commission was
15 charged by then President Richard Nixon with
16 preparing a report on "our nation's energy
17 future." When Congress established the Department
18 of Energy, its organic act called for a biennial
19 publication of a national energy policy plan.
20 Those, however, were only produced sporadically
21 over the years. As Melanie has already noted, at
22 the outset of the current Administration,

1 President Obama asked his Council of Advisors on
2 Science and Technology, the PCAST, to review our
3 energy technology innovation system. The
4 President wanted PCAST to recommend ways to
5 accelerate a large- scale transformation of energy
6 production, delivery, and use to meet the
7 challenges of the 21st century, including, of
8 course, the challenge of climate change.
9 In response, PCAST formed a broad-based
10 working group that was led by the Vice President
11 of the National Academy of Engineering, Maxine
12 Savitz, and an obscure professor from MIT named
13 Ernie Moniz. The panel identified as its most
14 important recommendation a proposal that the
15 Administration should establish a new process to
16 forge a more coordinated and robust federal energy
17 policy through a Quadrennial Energy Review, which
18 we now call the QER. It envisioned that the QER
19 process would produce a multi-year road map that
20 would produce four key results. One, it would lay
21 out an integrated review of short, intermediate,
22 and long-term energy objectives. It would put

1 forward possible executive actions that could be
2 coordinated across multiple agencies to help
3 address those objectives. It would identify
4 resource requirements for the development and
5 implementation of the transformation of the energy
6 system, particularly with respect to the new
7 technologies that will be required, and it would
8 outline legislative proposals to go to the
9 Congress as needed and appropriate.
10 PCAST also recommended that the
11 Secretary of Energy provide an executive
12 secretariat for the QER, which, of course, it has
13 done. And you just heard from the leader of that
14 executive secretariat. And while the QER was
15 intended to be a product of the Administration and
16 ultimately the Government through the engagement
17 of the Congress, PCAST also recognized that
18 substantial input from the energy industry, from
19 academia, from NGOs, and the public at large would
20 be essential to its success. The President
21 embraced the PCAST recommendations, started
22 implementing them by having the Department of

1 Energy carry out a Quadrennial Technology Review
2 focused more narrowly just on the characteristics
3 of the technologies that were available and would
4 be becoming available. That was completed in
5 November of 2011. And last summer, as part of his
6 Climate Action Plan, the President called for the
7 next step, a full-fledged QER with the first
8 years' installment focused on energy
9 infrastructure. And I want to emphasize that
10 quadrennial doesn't mean that nothing happens
11 until four years from now. There's a moving
12 spotlight, and again, as you all know, this first
13 year's focus is on the challenges around
14 infrastructure. As envisioned, we're beginning
15 the process of collecting substantial input on our
16 energy infrastructure challenges and
17 vulnerabilities from a wide range of experts,
18 including the public at large, and that's what
19 this meeting is about.
20 As the science and technology advisor to
21 the President and one of the co-chairs of the QER
22 effort, I'm looking forward to listening to as

1 much of today's session as I can before I have to
2 return around midday to prepare for other meetings
3 focused on energy and climate change at the White
4 House. But my staff will be staying behind in the
5 audience to ensure that we hear directly from the
6 panels and the public, and of course, there will
7 be a record of this meeting compiled by the
8 secretariat.
9 At this point, I want to turn the podium
10 over to Secretary Moniz. Before I do, I want to
11 thank the Secretary and Melanie and all of the
12 staff for the executive secretariat at the DOE for
13 the extraordinary work that they have already been
14 doing. I'm very pleased indeed at the effort they
15 put into making this meeting possible, including
16 the hard work of Melanie Kenderdine and the
17 Director of Outreach for the QER, Dr. Karen
18 Wayland. With that, Ernie, the podium is yours.
19 (Applause.)
20 SEC. MONIZ: Well, thank you, John, and
21 thanks to Melanie. And I'd like to add my
22 gratitude and congratulations to Henry Waxman, our

1 very good friend. And has already been said,
2 enormous contributor to energy and environment
3 issues over decades. Since I was labeled as being
4 a professor for 40 years, I think we'll share
5 these age remarks in terms of decades of service.
6 And I know I am very confident that Congressman
7 Waxman will continue to make enormous
8 contributions to our energy and environmental
9 future just from a different perspective, one that
10 will free him from his legendary reticence. But,
11 Henry, thank you so much for what you've done.
12 So, John gave a history of how we got
13 here and what our major objectives are. I'll just
14 emphasize a few points in these remarks. One has
15 already been stated, but I want to reinforce. The
16 Department of Energy was charged by the President
17 in his presidential memorandum to provide the
18 executive secretariat. That will entail, also,
19 building, as we have done, with EPSA, the
20 analytical capacity, expanding that dramatically.
21 But having said that, I want to emphasize, this
22 has to be a multi-agency effort to succeed.

1 That'll be under the co- chairmanship, as already
2 stated, of John Holdren and Dan Utech. And as I
3 come to discuss a set of regional meetings that
4 were already mentioned, we are envisioning 14 or
5 15 regional meetings, that those will also engage
6 other agencies. I just want to make that clear.
7 That's not just a DOE activity.
8 The second point is that, you know, we
9 have a significantly altered energy landscape in
10 the United States, as we all know. And this
11 landscape has led to tremendous opportunity for
12 our economy, for our energy security, and very
13 importantly, of course, for addressing our
14 environmental challenges, most especially climate
15 change mitigation and adaptation over the next
16 years. But, by the same token, this also is the
17 origin of a set of challenges in terms of how the
18 system will be -- will evolve. Clearly, we all
19 understand the natural gas change, also oil
20 production from unconventional sources. But, in
21 addition, we are looking at expansion of
22 renewables. We are looking at electric vehicle

1 penetration, many other parts of what we see as a
2 transformation of our clean energy system. So,
3 that provides a backdrop, and these changes, we
4 have seen the challenges of infrastructure, of
5 course, just in the last months and certainly
6 years, whether it is the natural gas constraints
7 in New England or the propane constraints we've
8 seen recently, the issue of how do we catch up
9 with infrastructure to avoid methane emissions or
10 to move some of the tight oil. Of course, in the
11 climate context and we've seen extreme weather
12 events that have had major implications for our
13 energy infrastructure, whether it's Sandy. We
14 also saw the interdependencies of fuels, and
15 electricity or whether it's the California crisis
16 caused by wildfires. We see drought challenging
17 our power plants operation. So, we are seeing an
18 enormous set of challenges. And, of course, in
19 this QER, we will be wanting to take an integrated
20 look at all of these challenges and see what it is
21 that can guide investment in our future
22 infrastructure, determine, indicate what we in the

1 federal government can do in terms of guiding
2 those, mainly private sector investments, in a
3 direction that is important for tomorrow, but also
4 important for the decades ahead, characteristic of
5 the lifetime of these investments and recognizing
6 that even as we look at what the federal
7 government can do, that's going to entail
8 tremendous collaboration with the states, which
9 is, again, where a lot of the action will be
10 occurring. So that, of course, underpins why we
11 think stakeholder outreach is such a critical part
12 of this process. It involves the Congress. It
13 involves the states. It involves the public. And
14 this is he first, as we've already said now twice,
15 probably 14 or 15 meetings that we will be holding
16 across the country. Five of those meetings have
17 been announced specifically looking at
18 infrastructure constraints near the Baaken
19 Formation and in New England, looking at
20 transportation constraints in Chicago, electricity
21 transmission supply and distribution issues in
22 Portland, petroleum product transport and

1 distribution issues in New Orleans, and another
2 whole set of meetings including focus areas to be
3 announced in the near future.
4 So, that really summarizes what I wanted
5 to emphasize, including the importance of these
6 meetings. And, of course, we are open to other
7 forms of input from all the stakeholders, but
8 these meetings will provide, we hope, important
9 focused opportunities for us to address certain
10 issues. So, with that, I thank you, and we'll be
11 looking forward to your input.
12 (Applause.) And with that, I turn it
13 over to my good friend Congressman Waxman.
14 CONGRESSMAN WAXMAN: Thank you very
15 much, Mr. Secretary, Dr. Holdren. I appreciate
16 your inviting me today to give my perspective on
17 the Quadrennial Energy Review. And I won't be
18 reticent. Even though I'm still a member of
19 Congress, I will continue to speak out. And I
20 agree with you that this is the right time to
21 engage policy makers and the public in an
22 examination of our energy infrastructure. The QER

1 is an opportunity to look at where our energy
2 infrastructure is today and where it needs to be
3 tomorrow. There's no question that this is a
4 timely endeavor. A significant energy transition
5 is already underway in our country. State and
6 federal renewable energy policies are paying off.
7 We've doubled our capacity to generate renewable
8 electricity from wind and solar in just five
9 years. This has cut pollution and invigorated
10 clean energy manufacturing. The cost of renewable
11 energy, as a result, is rapidly declining. Cheap
12 natural gas is transforming our electricity
13 sector. This market reality is driving a shift
14 away from the use of coal to generate electricity.
15 New coal plants are simply not cost effective to
16 build today. They're not suffering from a war on
17 coal. They're suffering from the market system
18 that drives our economy. These changes are
19 positive developments, but we need to accelerate
20 the transition to a clean energy economy and
21 anticipate our future needs now. For decades to
22 come, our energy infrastructure decisions are

1 going to have to revolve around the question of
2 how we respond to climate change. Climate change
3 is the biggest energy challenge we face as a
4 country. We can't examine America's energy future
5 without also examining how we respond to climate
6 change.
7 Last week, the intergovernmental panel
8 on climate change released its multi-year report
9 on the state of climate science. The world's
10 leading scientists examined the peer-reviewed
11 science and confirm that energy -- that climate
12 change is already happening on all continents and
13 across the oceans. And we'll get much worse if we
14 do not act. The impacts of runaway climate change
15 will be severe, reduce crop yields, more heat
16 waves and disease, decrease water availability,
17 more extreme weather events, and the mass
18 extinction of many of the world's species. Our
19 only real choice is whether to respond now while
20 the costs are relatively low and the economic
21 opportunities high, or wait until the costs soar
22 and the opportunities diminish. That means we

1 need to scrutinize energy policy decisions that we
2 make today for their impact on climate change in
3 the future.
4 Every decision to build the new fossil
5 fuel infrastructure poses climate risks. We need
6 to understand and weigh those risks. Otherwise,
7 we risk locking in infrastructure that will reduce
8 carbon pollution for decades to come or creating
9 stranded investments that must be shut down before
10 they've served their useful life. So, this is
11 exactly the right time for a Quadrennial Energy
12 Review. The QER is an opportunity to offer a
13 vision of what our energy infrastructure will need
14 to look like to address climate change and the
15 transition to clean energy economy. It is, I'm
16 pleased to say, a key part of the President's
17 Climate Action Plan. President Obama has
18 committed to reducing our carbon pollution 17
19 percent by 2020, and then to bend the post 2020
20 global emission trajectory even further. The QER
21 can provide a blueprint for achieving those carbon
22 pollution reductions in the coming years and

1 decades. It can translate carbon reduction goals
2 into specific actions. The energy choices we make
3 today will determine whether we address the threat
4 of climate change or leave our children and
5 grandchildren with a climate catastrophe. The
6 Quadrennial Energy Review can help us make the
7 right choices.
8 So, I am pleased to be here to give you
9 that perspective, which I'm sure most of you
10 already share. And as I understand the program,
11 Melanie, we will now entertain questions.
12 MS. KENDERDINE: I think we have about
13 five minutes, if people want to ask questions of
14 the panelist? We'd be happy to take those. Thank
15 you.
16 CONGRESSMAN WAXMAN: Thank you all very
17 much.
18 (Applause.)
19 MS. KENDERDINE: So, if people would
20 like to come up to the microphones, we have two on
21 either side on the floor. If you'll introduce
22 yourself, we have a very few minutes and our

1 honored guests have agreed to take some questions.
2 Don't be shy.
3 Please introduce yourself.
4 MR. DIXON: Darius Dixon with Politico.
5 Just curious from the Administration folks if
6 there's a concern that the -- even the focus on
7 E&D is too broad. Is there any effort to kind of
8 narrow it down?
9 DR. HOLDEN: Well, certainly it's a big
10 challenge, and the focus is, indeed, not just
11 transmission and distribution, but transport of
12 liquid and gaseous fossil fuels as well as
13 electricity. So, yes, it's ambitious. But we
14 think the nature of the challenge requires looking
15 at it in an integrated way. We have a very capable
16 team and we're going to be gathering a lot of
17 insights from the wider community. So, we expect
18 notwithstanding the size of the challenge, we're
19 going to get it done.
20 SEC. MONIZ: I'll just add that we are
21 very aware of the scope of the challenge, but I
22 have to say that the group has been working at it,

1 EPSA in particular, with contributions also coming
2 from other agencies in terms of kind of preparing
3 background papers, et cetera. These will be
4 heavily influenced, of course, by what we get
5 back. It's a challenge. We're not denying, but as
6 Dr. Holdren said, I'll just reinforce, it's
7 ambitious, but we believe the payoff is big and
8 we're going to do all that we can to really make
9 this a coherent set of observations, findings, and
10 recommendations for action in major parts of our
11 infrastructure challenges, of electricity, but
12 also things like fuels resilience, where I should
13 have said, perhaps, there will have to be a very,
14 very strong regional focus to the analyses. Some
15 of the examples I gave, of course, very different
16 challenges, very different bottlenecks, very
17 different opportunities in different parts of our
18 country.
19 MS. WELSH: We have time for one more
20 question.
21 MS. WHIELDON: Esther Whieldon, with SNL
22 Energy. Since Darius broke the seal on press

1 asking questions, I thought I would. I was
2 wondering if this connects in any way to the
3 congestion studies on transmission congestion that
4 are apparently still ongoing. They were supposed
5 to be done for 2012, and if you expect to face any
6 of the same challenges that I've heard you faced
7 in the congestion study in getting data that can
8 actually be used that's public that can lend
9 itself to a study that can actually be put out.
10 MS. KENDERDINE: Well, we certainly will
11 be looking at all previous works and studies,
12 analyses, and we will be looking at transmission
13 congestion. Just so you know, we are in the
14 process of putting together a library that will be
15 on the QER website, which Karen can give you the
16 address. I can never remember it. And we will be
17 very focused on transmission and, as the Secretary
18 said, fuel resiliency issues as well.
19 SEC. MONIZ: I would just add to it
20 that, as was implied, I mean, frankly, the more we
21 can build on existing strong analyses, the better
22 we are, partly to address the first question that

1 was asked. And those congestion studies address
2 what are a subset of the issues involved in the
3 power system, because there are multiple issues,
4 congestion is one, but we have to look coherently
5 at cyber issues, physical threats, extreme
6 weather, interdependencies of different
7 infrastructures. So I think what we would hope to
8 do is to be able to do that knitting together of
9 different factors into a balanced approach. And
10 the congestion studies, again, are one important
11 part of a bigger picture.
12 MS. KENDERDINE: If I could just say,
13 too, we're also looking at ways -- at
14 infrastructure avoidance. The efficiency will be
15 one of the things we'll be looking at and ways
16 that we can avoid congestion and avoid building
17 new infrastructure with other options.
18 MS. WELSH: Melanie, you said five
19 minutes, so I'm going to thank you all. Please
20 join me in a round of applause for our
21 distinguished guests.
22 (Applause.)

1 We're going to now turn to our first panel. And
2 I'd like to invite those panelists to join me up
3 here on stage. While we're getting set up,
4 Melanie mentioned that there is a QER website.
5 That website, if you'd like to jot this down, is
6 www.energy.gov/QER. Additionally, the Department
7 of Energy is very interested in getting your
8 comments in writing, and there is an address for
9 that. That is QERcomments@hq.doe.gov. So, if you
10 have not been invited as a panelist or you do not
11 wish to make comments at these public meetings,
12 please feel free to submit your comments in
13 writing to that address.
14 Let me now turn to our first panel of
15 very distinguished speakers. The panel topic is
16 Resiliency and Vulnerabilities in Energy
17 Transmission, Storage, and Distribution. And as
18 you know, that is the primary focus of this
19 year's, Year One, Quadrennial Energy Review
20 Report. With us on stage, we have Peggy Montana
21 with Shell; Duane Highley with Arkansas Electric
22 Cooperative, Inc.; John [sic] Rigby, Chairman of

1 the Board and President and CEO of Pepco; Andy
2 Black, President and CEO of Association of Oil
3 Pipe Lines; and Gerry Cauley, President and CEO of
4 the North American Electric Reliability
5 Corporation.
6 Peggy, I'll let you start off, and then
7 just go down the line.
8 MS. MONTANA: All right, thank you,
9 Peggy. Good morning. I am Peggy Montana,
10 Executive Vice President for Pipelines and Special
11 Projects for Shell Downstream. My previous role
12 was Executive Vice President for Supply and
13 Distribution for Shell. And overall, I have 37
14 years of industry experience at both the national
15 and global level. I'm testifying today on behalf
16 of the American Petroleum Institute, a trade
17 association whose 590-plus members represent all
18 aspects of the oil and natural gas industry and
19 who own and operate much of the U.S. supply and
20 distribution system for oil and natural gas and
21 petroleum products from refineries to distribution
22 terminals. I'm here today to discuss the

1 resilience of the domestic oil and natural gas
2 industry's infrastructure.
3 Today, thanks to the invasion and
4 entrepreneurial spirit of the men and women in
5 America's oil and natural gas industry, this
6 nation is on pace to take the lead role on the
7 world's energy stage. The following facts bear
8 this out. In 2013, the U.S. became the world's
9 top producer of petroleum and natural gas
10 surpassing Russia and Saudi Arabia. This year,
11 that production is expected to set new records in
12 oil production, rising over 30 percent to 8.45
13 million barrels per day. U.S. refining capacity
14 has increased nearly 230,000 barrels of oil per
15 day from 2008 to 2013. And 70 U.S. refineries
16 today are operating at more than 90 percent of
17 capacity. An average of $4 billion in annual gas
18 processing investments will be made from the
19 period of 2014 to 2019. This oil and gas
20 production renaissance, when coupled with our
21 world class refining industry, provides the U.S.
22 with a level of energy security that we've not

1 seen in decades.
2 The oil and natural gas industry is
3 already making significant private investments to
4 further diversify our infrastructure in light of
5 this new energy reality. For example, cumulative
6 investment in U.S. crude oil pipelines of $37.8
7 billion between 2014 and 2025, with the majority
8 being invested during the first six years of the
9 forecast period. Total investment in NGO
10 pipelines over the forecast period is projected at
11 $23.9 billion from 2014 to 2025. And finally,
12 investment in crude-dedicated rail cars and both
13 crude-loading and unloading facilities was $3.8
14 billion in 2013. These investments should be
15 strongly encouraged, because they will strengthen
16 both our energy security and our economic
17 development. According to a recent study by IH
18 Global, an average annual energy infrastructure
19 investment of up to $95 billion would contribute
20 as much as $120 billion to USGDP, support as many
21 as 1.15 million jobs, and provide an additional
22 $24 billion in government revenues on average

1 annually, between 2014 and 2025.
2 As DOE undertakes this Quadrennial
3 Energy Review, the task force should be cognizant
4 of the following. First and foremost, the goals
5 of the QER should be clearly identified and
6 adhered to. Having been involved in events and
7 efforts such as these in the not-to-distant past,
8 I can say with certainty that scope creep will be
9 a constant threat. This study should draw on the
10 ongoing work by the National Petroleum Council,
11 NPC, that's building on the recent API report, Oil
12 and Natural Gas Industry Preparedness. I am
13 playing a lead role for the latest NPC study on
14 emergency preparedness for natural disasters that
15 impact the oil and natural gas industry currently
16 scheduled to be completed this coming August. We
17 have been very deliberate on what is included and
18 what is not included. This study will provide
19 advice on how the oil and gas industry and
20 government at all levels can better prepare and
21 respond to defined emergencies. Emergencies
22 considered in this study will include significant

1 disruptions to oil and gas supply chains which
2 might occur from severe hurricanes earthquakes,
3 floods, and other natural disasters, but not from
4 sabotage, cyber, or other terrorism-related
5 events.
6 This study will focus on aggregating
7 existing information to educate policy makers, the
8 industry, and the general public on the petroleum
9 industry infrastructure, market dynamics,
10 interdependencies, the challenges imposed when
11 adversely impacted by disaster events and the
12 framework to restore normal operations and
13 expeditiously supply consumers with fuel,
14 including refined products and natural gas.
15 Building on this foundation, the NPC will provide
16 advice on strategies and actions to enhance
17 communications between the petroleum industry and
18 government levels as well as interdependent
19 industries such as electricity and transportation
20 to enable informed decisions in a dynamic
21 environment and to improve emergency preparedness
22 and supply chain resiliency.

1 The QER should recognize the hardening
2 and resilience actions that the oil and natural
3 gas industry has undertaken in light of lessons
4 learned from previous events that were highlighted
5 in the DOE's August 2010 report, Hardening and
6 Resiliency, U.S. Energy Industry Response to
7 Recent Hurricane Season. These actions have
8 proven effective as witnessed by the industry's
9 ability to respond and restore service quickly
10 following major incidents such as Gulf Coast
11 hurricanes Ike and Gustav, and Tropical Storm
12 Sandy. Some of those actions include elevating
13 critical components such as substations and
14 control rooms, improving tank integrity,
15 conducting hurricane preparedness planning and
16 training, and prepositioning and prewiring
17 portable generators. The QER should identify and
18 discuss policies at both federal and state levels
19 that encourage further oil and gas development.
20 This will, in turn, enable this nation to harness
21 the power of the free market and to further
22 improve our energy security.

1 Some issues to consider include:
2 Approval of the Keystone Pipeline, streamlining
3 permit approvals for other private infrastructure
4 investments, allowing the export of natural gas
5 and crude oil. Crude oil exports could boost
6 domestic oil production by up to 500,000 barrels
7 per day by 2020, according to a recent study by
8 ICF International. Similarly, a 2013 ICF study
9 found that 16 billion cubic feet per day of LNG
10 Exports in 2035 would boost U.S. dry gas
11 production by over 12 billion cubic feet per day
12 and NGO production by 555,000 barrels per day.
13 Ultimately, the QER will best utilized when it not
14 only those issues that helped to ensure that the
15 U.S.
16 cements its status as an energy leader,
17 but also any mechanisms that can be used to help
18 get our country past any obstacles for
19 development.
20 In closing, let me assure everyone here
21 that we take our role seriously as we recognize
22 the products that we produce fuel the productivity

1 of our nation. We are keenly aware that any
2 disruption in service is not good for the nation
3 and not good for our industry. There's also the
4 recognition that safety has to be a key component
5 of everything we do. We should most certainly
6 provide energy in an efficient manner, but we
7 should also strive to do this without incident. I
8 look forward to engaging further on this issue and
9 thank you for inviting me to participate in this
10 effort.
11 MS. WELSH: Before we go on to our next
12 speaker, let me say that we'll hold our applause
13 until all of our speakers have given their
14 presentations, and their statements will be
15 uploaded to the QER website after this meeting.
16 And I just want to remind everybody to keep their
17 comments to five minutes. We have a timer there,
18 so if you'll just watch that, and we'd love to
19 hear from Mr. Highley next.
20 MR. HIGHLEY: Good morning. My name is
21 Duane Highley, and I'm the President, CEO and I
22 like to call myself the chief affordability

1 officer for the Arkansas Electric Cooperative
2 Corporation, which is a non-profit member-owned
3 power supply cooperative serving two thirds of the
4 land mass in Arkansas and over one million
5 ultimate consumers. I'm here today to represent
6 the perspective of cooperatives in other consumer-
7 owned utilities on the critically important topics
8 of (indiscernible) resiliency and vulnerabilities.
9 I want to talk a little bit about the
10 strength of the existing grid just to make sure
11 that we don't unnecessarily devalue what we
12 already have. Now, the primary mission of the
13 Arkansas cooperatives is to provide reliable power
14 affordably and responsibly. As a non-profit power
15 supply and services cooperative, we aren't in
16 business to make a profit. We exist solely to
17 improve the lives of our member owners and the
18 communities in which they live. So, I wanted to
19 take a moment to tell you where I've been this
20 past week. I just returned from Cuilco,
21 Huehuetenango, Guatemala, where linemen from
22 Arkansas electric cooperatives have been working

1 for the past two weeks to assist local villagers
2 in putting up poles, stringing lines to bring
3 electricity to remote villages in the mountains of
4 Guatemala that have never had it before. These
5 linemen volunteered their time to assist those
6 local villagers. These people were so grateful
7 when the lines were energized for the first time,
8 tears were streaming down their face. It was an
9 incredible experience for myself and all of us.
10 And it gives me a particular appreciation for the
11 high quality and reliable electric service we
12 often take for granted. It seems to be in vogue
13 these days to refer to the U.S. electric grid as
14 outdated, antiquated, obsolete, or even Third
15 World. Well, I have been to that Third World and
16 I can tell you there's nothing Third World or
17 antiquated about the grid we enjoy here in the
18 United States. We deploy the latest technology
19 and continually update our facilities to ensure
20 that our members have the highest and most
21 reliable quality of service. In fact, our first
22 mission is to be reliable. If you can't make the

1 power reliable, it doesn't matter what it costs.
2 Anyone who's lived through a long power outage
3 knows the value of electricity is far greater than
4 its price. But, in rural America where I come
5 from, affordability is particularly important. We
6 serve some of the poorest families in the country.
7 It's our responsibility to see that that energy is
8 delivered to them at the lowest possible cost.
9 Electric cooperatives face an additional
10 challenge in that we have higher investment per
11 consumer than other utilities. On average,
12 cooperatives serve only seven consumers per mile
13 of line investment. Even with this additional
14 burden, we manage to deliver energy at rates that
15 are comparable to those of other for-profit
16 utilities by focusing on efficiency and cost
17 instead of profit.
18 Now, besides my role as CEO for the
19 cooperative, I also serve as Vice Chairman of the
20 Electric Subsector Coordinating Council or ESCC,
21 which is a partnership between government and
22 industry to improve security, reliability, and

1 resiliency of the power supply system. We meet
2 regularly with representatives from the DOE,
3 Department of Homeland Security, and the White
4 House, and other government agencies to improve
5 information sharing and to develop action plans.
6 I believe the work of this council serves as a
7 model for other critical infrastructure areas in
8 the United States. Our partnership has been
9 great. For example, the ESC has worked with the
10 government to attain security clearances for
11 utility CEOs allowing them to be briefed on the
12 potential threats to the grid. This dialog has
13 allowed the utility leaders to better direct the
14 resources to anticipate those threats.
15 Also, utilities have partnered with the
16 government to deploy advanced technology to
17 protect power system networks from cyber threats.
18 To my knowledge, the electric sector and the
19 nuclear side of our industry is the only critical
20 infrastructure area which has mandatory,
21 enforceable standards for cyber security. These
22 standards are vetted by subject matter experts

1 through NERC standards development process and
2 approved by the NERC board of trustees and FERC
3 before becoming mandatory. Now, that process may
4 be slow and it's been criticized as being slow,
5 but the only way to assure reliability is not
6 compromised is to take our time and make sure we
7 do the process right.
8 Utilities are committed to working with
9 NERC to complete similar mandatory standard
10 development on the physical security as recently
11 ordered by FERC. Now, additional regulations may
12 enhance the security of our grid, but redundancy
13 is our first line of defense against all threats
14 natural or intentional. Our industry has direct
15 experience with threats such as occurred in
16 California at the Metcalf Substation or in three
17 incidents last year in Little Rock, Arkansas.
18 Initially, we did not know the source of those
19 sabotage incidents. A transmission tower was
20 pulled down. Substation control building was
21 burned. And transmission lines were cut.
22 Utilities worked directly with the FBI and other

1 government agencies as these events occurred. The
2 deliberate acts of sabotage failed to cause the
3 desired interruption of service primarily because
4 of the redundancy that was designed into the grid
5 from the beginning. This redundancy is a critical
6 aspect of grid resiliency.
7 When it comes to the electric sector
8 reliability, my primary concern, as someone
9 responsible for delivering reliable power, is the
10 impact that will come from proposed carbon dioxide
11 emission regulations. Because of those
12 regulations, we can no longer affordably build new
13 coal plants. In the GridEx II grid security
14 exercise hosted by NERC last fall, we simulated
15 the outage of a number of facilities which left
16 millions in simulated state without power. It
17 should be noted that in that proposed simulation,
18 there was more capacity removed from the grid --
19 there will be more capacity removed by the carbon
20 regulations than what was removed in that
21 exercise. And while I'm not saying that the grid
22 will immediately fail if we take coal out of the

1 grid, there will be reliability impacts. That's
2 inevitable. Steel in the ground is what gives you
3 grid reliability.
4 There's a lot of talk about the aging
5 grid and I appreciate the heightened concern about
6 resiliency, but I do want to push back on the
7 notion that our grid is not First World. We're
8 ready to handle the challenges of the 21st century
9 energy industry. We continue to be open to new
10 technologies when they can be shown to be cost
11 effective and benefit our consumers. Since we're
12 member owned and governed, we're very sensitive to
13 people with dreamy investments that don't provide
14 clear benefits. A lot of people would like to
15 have a government mandate to force us to put in
16 something that might provide a small measure of
17 benefit, but it's our job to balance costs and
18 reliability to keep the power reliable and
19 affordable.
20 Reflecting on my experience in Guatemala
21 this past week, I recognize what an incredible
22 benefit access to reliable, affordable energy is

1 to a society. Human health, national security, and
2 economic output all benefit. We should recognize
3 how far we've come.
4 I continue to remain optimistic about
5 the future. I've read studies that say it's not
6 possible to keep both a positive and a negative
7 thought in your mind at the same time. We have a
8 choice. I choose to be optimistic. I want to
9 applaud the DOE for hosting this panel on energy
10 policy and look forward to working together to
11 solve our issues. Thank you.
12 MS. WELSH: Mr. Rigby? And I apologize
13 for calling you John. It's Joe, and I'm delighted
14 to have you with us.
15 MR. RIGBY: Sure. I have an uncle named
16 John Rigby. He's 88 years old. He would be
17 shocked to know that he should have been here this
18 morning.
19 (Laughter.)
20 I want to thank you. I want to thank the
21 Secretary, Dr. Holdren, and the distinguished
22 members of the Quadrennial Energy Review Task

1 Force for the opportunity to address this very
2 important forum that was created by President
3 Obama. My name is Joe Rigby. I'm the President
4 and CEO of Pepco Holdings or PHI. We're an
5 electric utility delivering power to about two
6 million customers in the Mid-Atlantic region. I'm
7 also a member of the Board of Directors of the
8 Edison Electric Institute, which represents our
9 nation's investor in utilities. The electric grid
10 generates, transmits, and distributes electric
11 power to millions of Americans, and the utilities
12 sector has the engineering and the operational
13 expertise that keeps the grid running reliably in
14 the face of all hazards. Today, though the grid
15 continues to incorporate new technologies and ever
16 improving practices, the advanced age of many grid
17 components is contributing to vulnerability in the
18 face of new threats. This vulnerability coupled
19 with our increased dependence on electricity makes
20 grid resiliency investment an imperative. Severe
21 weather remains the leading cause of power outages
22 and these severe storms and other events seem to

1 be coming with increasing and intensity. In just
2 the past few years in our service territory, we
3 have experienced Snowmageddon, an earthquake,
4 Hurricane Irene, the Derecho, followed by a heat
5 wave, Superstorm Sandy, and a polar vortex. This
6 trend is compelling utilities and regulatory
7 commissions to look for grid strengthening
8 strategies that may have significant cost impacts.
9 And the most immediately impactful and cost
10 effective of these measures include hardening
11 transmission and distribution substation and
12 lines, raising or moving vulnerable
13 infrastructure, or building additional
14 infrastructure to increase redundancy, selective
15 undergrounding, or deploying new technologies that
16 enhance reliability and resilience by providing
17 advanced data management and power system control.
18 These new control and information technologies are
19 also making possible microgrids that may allow
20 independent operation during times of system
21 emergency. Though some believe microgrids are the
22 best path for security and consumer independence,

1 moving towards decentralization will increase
2 costs and may cause unintended cost shifts. So,
3 we believe policy makers should consider how the
4 grid will be safely, fairly, and efficiently
5 operated, who will be responsible for reliability
6 and safety, how reliability and safety standards
7 will be enforced, how cost of the grid and access
8 to backup power will be allocated, and how to
9 minimize unreasonable cost shifting among
10 customers. In the cyber realm, we know our
11 adversaries are pursuing capabilities to attack,
12 manipulate, or disable grid assets. Similarly,
13 the threat of a violent or deliberate attack when
14 utility infrastructure is very real. In the face
15 of these evolving threats, it is imperative the
16 government and industry leverage each other's
17 expertise.
18 The industry is also active in
19 initiatives like the Voluntary Cyber Security
20 Framework developed in response to the President's
21 executive order, the National Cyber Security and
22 Communications Integration Center, and the

1 Electricity Subsector Coordinating Council.
2 Individual utilities have also benefited by
3 applying federally developed cyber threat
4 detection technologies to their operations. In
5 the physical security arena, utilities are
6 actively expanding their view of the realm of
7 possible threats to include attacks such as
8 gunfire from remote location and intrusion via
9 explosive device. In addition, FERC has issued an
10 order requesting that NERC develop standards to
11 address physical security risk and
12 vulnerabilities. The utilities sector supports
13 this initiative in that it recognizes that each
14 utility based on its location, geography,
15 redundancy, system design, and need to harmonize
16 with local communities could have different
17 challenges when addressing physical threats.
18 Though much has been achieved in the
19 security realm, open issues do remain. For
20 instance, in the absence of federal legislation,
21 much is left undefined with regard to data privacy
22 and the liability associated with bi-directional

1 informations hearing. Similarly, without explicit
2 authorizations, forms to coordinate events
3 response may have unresolved jurisdictional
4 issues. In addition, as threats become more
5 sophisticated, and our investments grow
6 significantly, some systemized form of cost
7 recovery may be needed.
8 In summary, the grid has tremendous
9 value as an enabler of economic growth, of our
10 advanced standard of living, and of an all-of-the-
11 above energy strategy. But the grid is vulnerable
12 to emerging climatic physical and cyber threats.
13 These threats are best addressed through
14 public/private partnerships. Existing
15 partnerships should be expanded to allow for
16 better information flow, role clarity, and for
17 expanded coordination. New partnerships can be
18 developed to establish new financing mechanisms
19 for resiliency investment, and government policies
20 should be shaped to attract capital provide
21 regulatory certainty, and mitigate risks so that
22 risk operators can continue to meet the very real

1 need for a dynamic and resilient modern grid.
2 I want to think you again for allowing
3 me to provide input and I'll be happy to respond
4 to questions later.
5 MR. BLACK: Good morning. Thank you for
6 the opportunity to be here and congratulations to
7 DOE on an impressive first event. I see some very
8 able people and friends in this room. We're on
9 Capitol Hill. I remember the old line that if
10 you're looking for consensus, you get the right
11 people in the room and lock the door. Soon
12 enough, you might get it. If we were in pursuit
13 of that today, I think we've got a great grouping
14 of people here. So, thank you, and
15 congratulations, again.
16 I'm Andy Black, President and CEO of the
17 Association of Oil Pipelines. Liquid pipelines
18 that we represent, transport the crude oil,
19 refined petroleum products, and natural gas
20 liquids that American consumers and workers use
21 every day. Americans benefit from liquid pipelines
22 to heat their homes, fuel their vehicles, dry

1 their clothes, harvest and dry crops, manufacture
2 consumer goods, and more. Nearly every gallon of
3 gasoline American consumers put into their
4 vehicles travels, at some point, through a
5 pipeline. In 2012, liquid pipeline operators
6 delivered more than 14.1 billion barrels of crude
7 oil and petroleum products across more than
8 185,000 miles of pipelines in the U.S. Pipeline
9 operators are spending billions of dollars to
10 construct new pipeline infrastructure connecting
11 America to its changing and growing energy
12 supplies. We're connecting new -- we're building
13 new lines, expanding the delivery capacity of
14 existing lines, and reversing flow of other lines
15 to match our infrastructure to America's energy
16 needs. More than 10,000 miles of new liquid
17 pipelines have been added into service in the last
18 four years. A recent review predicts $9.4 billion
19 in pipeline infrastructure spending just this year
20 over 3,300 project miles.
21 Government policies play an important
22 role in assuring availability of needed pipeline

1 capacity to meet the needs of the American people.
2 FERC policies today appropriately incent liquid
3 pipeline operators to construct infrastructure
4 needed to respond quickly to America's changing
5 needs by shippers. It's also essential that
6 states make timely decisions on siting requests
7 for pipelines. Federal agencies process permits
8 for certain pipeline construction activities, and,
9 of course, forgive me, that the U.S. Department of
10 State efficiently grants presidential permits for
11 pipeline facilities crossing national borders.
12 Pipelines are the safest mode of
13 transporting large volumes of energy liquids. In
14 2012, greater than 99.9998 percent of the liquids
15 transported by pipelines reached their
16 destinations safely. When reviewing Keystone XL,
17 the State Department found that alternative modes
18 of transportation would result in 2.4 to nine
19 times more crude oil released to the environment
20 each year. Liquid pipeline operators are also
21 investing heavily to maintain and continue
22 improving the safety of liquid pipelines. They

1 spent over $1.6 billion in 2012 evaluating,
2 inspecting, and performing maintenance on their
3 pipeline systems. An extensive set of pipeline
4 safety laws and federal regulations administered
5 by PHMSA directs the safe design, construction,
6 and operation of pipelines. On a continuous
7 cycle, pipeline operators review their pipeline
8 systems, evaluate the risks the systems face, and
9 the condition of their pipelines, schedule and
10 undertake inspections to identify potential
11 problems and perform maintenance with a goal of
12 fixing any potential problems long before they
13 become an actual safety issue.
14 Pipeline operators are also engaging in
15 extensive efforts to improve industry performance
16 and minimize their safety vulnerabilities.
17 Industrywide safety groups continue to develop new
18 standards and recommended practices, developed
19 through the American Petroleum Institute, and in
20 many cases adopted by PHMSA through regulation.
21 Earlier this year, the liquid pipeline industry
22 launched the Pipeline Safety Excellence Initiative

1 to take these safety experts to the next level
2 focusing on key safety issues such as inspection
3 technology, crack management, leak program
4 management, emergency response, and more.
5 Liquid pipelines use pump stations often
6 powered by electricity to push liquids through a
7 pipeline. After Hurricane Katrina knocked out
8 power supplies needed for pipeline operations and
9 caused concerns about fuels in the Carolinas and
10 Mid- Atlantic, the pipelines themselves remain
11 intact and ready to make deliveries as power was
12 regained. After Sandy produced local flooding and
13 power outages causing reduced supplies of gasoline
14 and diesel fuel and other products in New Jersey,
15 pipeline operators worked with government and
16 local stakeholders to restore service. These rare
17 crises demonstrate the importance to Americans of
18 maintaining a robust and reliable pipeline network
19 and the resilience of the liquid pipeline sector.
20 Pipeline operators prepare for disasters
21 and emergencies through training and drills,
22 regular communication with first responders, and,

1 of course, coordination with government. Pipeline
2 operators also maintain protection against
3 potential cyber security attacks. EPI standard
4 1164 on pipeline SCADA security, provides
5 industrywide direction to protect pipeline
6 supervisory control and data acquisition systems
7 that control pipeline flows and pressures, open
8 and close valves, and otherwise operate the
9 pipeline. Liquid pipelines continue to invest in
10 safety, security, and resilience so that they can
11 continue to deliver the fuels American workers and
12 consumers depend upon. Thank you.
13 MR. CAULEY: Good morning, Gerry Cauley
14 with NERC. Also appreciate the opportunity to be
15 here today to share some thoughts on resilience
16 and what we can do going forward. So, the
17 question is, what is resilience? Some equate that
18 to an aging infrastructure, and I guess I
19 subscribe to the same concept as Duane. Aging is
20 not an issue. We have the most modern, reliable
21 grid in the world, and I don't think that's really
22 part of the issue. So, what is the issue? The

1 issue for me in resilience is, how do you manage
2 extreme types of risks? I was pleased to see in
3 the opening speaker's remarks that the Quadrennial
4 panel is looking to look at fact-based risks, so
5 we have some of those. NERC does an annual report
6 on assessing the performance of the power grid,
7 and we have data from the 2008 through 2012
8 period. We do have another report coming out in
9 May for 2013, but of the nine severe events that
10 occurred in that five-year period, six of them
11 were extreme weather- related events, Hurricane
12 Ike, tornadoes in April 2011, Hurricane Irene, the
13 northeast snowstorm in October 2011, the derecho
14 storms, and Hurricane Sandy. The main impacts of
15 those events, which is two thirds of the nine
16 events, was in distribution, and I think the way
17 to address those issues are companies working with
18 the state regulators and customers to ensure a
19 readiness and preparation. We have a very robust
20 mutual assistance program that we saw demonstrated
21 in Sandy and the other storms. But I think we
22 need to make sure, as Joe suggested, some

1 additional things we can do to deal with flood
2 issues and vegetation and distribution systems in
3 making sure that we're ready for those kinds of
4 events.
5 One of those nine events was a weather-
6 related event, but it was severe cold in the
7 southwest -- in Texas and the southwest in
8 February 2011. To me, that was avoidable, and
9 it's also an event that we have well mitigated.
10 We have made sure that generators and equipment --
11 transmission equipment, have winterized their
12 equipment. I think we saw much improved
13 performance during the polar vortex events of this
14 winter. Of those nine large-scale events in the
15 five-year period, two were operational failures,
16 the September 2011 southwest blackout and the
17 February 2008 southwest Florida blackout. Those
18 are the things that are in NERC's wheelhouse and
19 we're working very hard on those, human error,
20 situational awareness training, relay missed
21 operations, and equipment failure. So, I think
22 we've got, you know, that's NERC's principal role

1 and the things that we're focused on. I think
2 we're doing a good job of managing those risks.
3 So, we have risks that we haven't seen
4 of those nine events. I've not mentioned a major
5 cyber attack, major physical attack, or a solar
6 disturbance to cause the major outage, and that is
7 the case. But we still have to be concerned about
8 these extreme, if you will, the black swan events
9 that we have to be concerned about in the interest
10 of the public. We did have a Metcalf event, but I
11 would just remind everybody no load was lost
12 during that event.
13 So, what are we doing in GMD? We have,
14 with FERC's guidance, we've initiated a standard
15 on solar magnetic disturbance. There's been a lot
16 of technical work by industry to develop the
17 engineering and science to protect the grid from
18 solar magnetic disturbances since the March 1989
19 event that occurred in Quebec. We've produced the
20 first version of the standard, which is an
21 operational response, and we're getting the
22 technical standard to the commission by the end of

1 the year to deal with protecting transformers and
2 other equipment from large solar disturbances. A
3 lot has been said by the previous panelists on
4 physical and cyber security. I think these, too,
5 are well managed by industry through NERC and
6 through other organizations. We didn't start
7 yesterday. We didn't start last year. At
8 Metcalf, post-9-11, there's been a lot of work by
9 industry to secure both the cyber and physical
10 assets of the grid. We're the only -- along with
11 nuclear, the only critical sector that has
12 mandatory standards. We're in the fifth
13 generation of those standards. They're risk-
14 based, security-based. And I think they'll help
15 us manage where we need to get to in terms of
16 cyber security.
17 The Metcalf incident was serious. I
18 wouldn't call it a game changer, but it's enough
19 to raise the attention. I think prior to Metcalf,
20 the focus was on securing assets and securing
21 substation yards, but now we have to consider an
22 attack on a physical asset as a means of doing

1 harm to the grid or doing harm to the public that
2 it will give us a fresh new look at the things we
3 need to do. The FERC did issue us an order and we
4 intend to get that order in within the 90-day
5 period that FERC has requested. We've done -- I
6 think Joe and Duane mentioned the Security
7 Coordinating Council where we have CEOs from
8 industry working directly with government
9 officials. We're working on incident response,
10 information sharing, and getting tools out to
11 industry that can help be prepared for physical
12 and cyber security events. NERC operates the
13 Information Sharing and Analysis Center, which
14 provides real-time information regarding threats
15 and vulnerabilities out to industry. There are a
16 number of other activities, and I'll just put a
17 recap on the cyber, physical, and GMD area that I
18 think we have those well managed.
19 In closing, I'll add two additional,
20 what I consider resiliency large-scale risks, but
21 they're on the emerging side. One is, we
22 published a joint report with the California ISO

1 last year, last fall. It highlights a concern that
2 I have that if we approach 20 to 30 percent of
3 renewable or intermittent resources in a
4 particular region or area. We've diminished the
5 amount of baseload large rotating machines that
6 provide traditional resources for inertia,
7 frequency response, voltage control, voltage and
8 power stability. These are the inherent values of
9 the grid. And my concern is that as we reduce the
10 amount of generation, large baseload generation,
11 the large rotating machines that provide those
12 services, and we add more resources that provide
13 intermittence availability, but don't provide
14 those additional reliability services, the
15 equation is getting tipped. And I think the range
16 is 20 to 30 percent penetration for me. So, I
17 would highly urge, before we get to a regrettable
18 point in the introduction of renewables, is that
19 we understand the underlying reliability services
20 of the grid and make sure that these new emerging
21 services can provide them through technology,
22 provide these essential reliability services.

1 My other emerging risk that I think we
2 need to front is the increasing dependence of
3 electric power system on gas as a just-in-time
4 delivered fuel subject to catastrophic
5 disturbances, potentially. And as we saw during
6 the polar vortex, subject to competition with
7 retail gas and lacking really long- term
8 commitments and contracts to provide for
9 electricity fuel. With that, I'll close, and
10 thank you.
11 MS. WELSH: Thank you all. It seems
12 like we heard from all of you that your systems
13 are working, that they are robust, that we have a
14 good system to start as we begin to look at our
15 nation's infrastructure in transmission storage
16 and distribution. But I'd like to ask each one of
17 you if you would provide a specific recommendation
18 to the QER Task Force on any executive or
19 legislative actions that you think should be taken
20 to fill any of the vulnerability gaps. Gerry, you
21 talked about emerging risks, so why don't I let
22 you start?

1 MR. CAULEY: I had a few specific
2 recommendations I would offer. One was tied to
3 the last point about the variable resources. The
4 technologies are there to equip wind and solar
5 with frequency, power control, voltage control,
6 ride- through capability. So, I think we need to
7 encourage and set the right market incentives for
8 the deployment of those technical capabilities and
9 ensure that there's equivalent pricing signals for
10 the value of those reliability services.
11 I can't emphasize enough the value of
12 storage in getting -- in having a successful
13 transition to the social objectives that we've set
14 out for clean energy. Storage will be invaluable
15 from a reliability and an operational perspective.
16 NERC does not deal with gas, but FERC and I think
17 the Department of Energy can work with the gas
18 industry to ensure that we have sufficient
19 pipeline capacity in the right place that we're
20 able to get -- procure the market structures and
21 contracts that we need for a firm gas supply.
22 And one that didn't get mentioned in

1 terms of the physical security arena is, I think
2 there's a challenge in terms of spare equipment.
3 I know industry has done a substantial amount of
4 work in providing correctly located, strategically
5 located equipment, particularly large-scale
6 transformers. There has been work on a -- research
7 on a modular transformer. I fully encourage
8 further work on that and I think we have to get
9 over the hurdle of how do we invest in that?
10 Where's the capital for a strategic investment in
11 spare transformers? I encourage the Department to
12 continue investing in syncrophasor technology,
13 modernizing the high-level part of the grid.
14 There are so many uses for that that we don't even
15 know yet. If you think about all the electronics
16 we have in our communications world and our
17 entertainment world, once you have the technology
18 there, you can think of all the amazing things you
19 can do with it. And I think the syncrophasor is
20 one of those foundational, enabling technologies.
21 And finally, a recommendation would be -
22 - I mentioned that two thirds of the largest

1 events in a five-year period were storms at the
2 distribution and customer level impacting and
3 harming and causing pain to customers. We have to
4 figure out how to make the distribution system
5 more resilient. A dirty word that people don't
6 like to listen to sometimes is a lot of it has to
7 do with vegetation in the distribution area. But I
8 think it's also helping customers have greater
9 resilience and ability to get through those
10 events. And I think a lot of the lessons were
11 learned from Sandy, were well-documented in a DOE
12 report, deal with things like backup supplies to
13 fuel stations and things like that. There was an
14 enormous number of lessons that need to be
15 implemented from that DOE report, thank you.
16 MS. WELSH: Thank you. Andy?
17 MR. BLACK: I think we all mentioned
18 hurricanes. And that's a significant issue for
19 liquid pipelines when the power goes out. We've
20 all learned from the past hurricanes and power
21 outages. I commend to those working on the QER,
22 the Oil and Natural Gas Industry Preparedness

1 Handbook produced by API with many industry
2 partners. There they talk about government and
3 private sector working together. And an important
4 way they should work together in the pipeline
5 realm is the restoration of power service. It's
6 important to restore power to those pump stations
7 and those terminals if they have lost the power
8 for lifting in order to keep people assured that
9 there will be fuel supplies. So, prioritization
10 of pipelines and power in a more general sense,
11 while there's 185,000 miles of liquid pipelines in
12 the U.S.
13 today, they're not all where they need
14 to be because of the changing production trends.
15 Either we don't have pipelines where there's new
16 production of crude and natural gas liquids or
17 they're there and they're not in sufficient
18 capacity. So, in order to have the pipeline
19 network that we need in a time where there's great
20 competition and commercial risk in pipelines, it's
21 important to have the FERC policies and the
22 congressional policies and the agencies that are

1 involved with approving certain construction
2 activities all working together to make sure that
3 we have the robust pipeline network that we need.
4 MS. WELSH: Joe?
5 MR. RIGBY: Sure. I'll start with a
6 positive. I think that the relationship of the
7 industry and the federal government has evolved
8 very, very well. We had a really great road test
9 with the experience in Hurricane Sandy. I can
10 remember sitting in a conference room and having
11 the President on a call with us to bring to bear
12 the resources that the industry needed that could
13 only be accomplished through the federal
14 government. And I think that's a tremendous
15 example and one that I would hope we'd continue to
16 build on.
17 It was mentioned, I think Gerry
18 mentioned, as well as I did that the -- and Duane
19 also, that the Electric Sector Coordinating
20 Council is a very good construct to keep the
21 dialog going when we're not dealing with disasters
22 and we're in front of it and it's -- I think it's

1 going to serve the industry very well, so I'd --
2 hopefully, we can continue to build on that.
3 Just two comments that I would put more
4 into the recommendation category is, I feel
5 strongly that we need to have legislation that
6 provides for information sharing between the
7 utilities sector and the federal government with
8 regard to cyber threats. We'll only be as good as
9 the information that we can get in a timely way.
10 That provides, obviously, the basis for us to
11 prepare, to detect, to prevent, and then to
12 respond.
13 And then the other recommendation I
14 would make is that we really need to continue to
15 drill. I think Gerry made mention of the GridEx
16 exercise. That was -- it was a very good
17 experience. We learned a lot. We took some
18 confidence of the things that we were doing well,
19 but we also saw some real opportunities to
20 continue to develop. And I think at the very top
21 of that list is the ability to really understand
22 that in the moment what the roles and the

1 processes are, that you're not trying to create
2 them on the fly. We drill all the time within our
3 company the opportunity that I think NERC provided
4 to do a broader drill was extremely valuable and I
5 think it's something we need to continue doing.
6 MS. WELSH: Duane?
7 MR. HIGHLEY: I second that information
8 sharing comment related to the Electric Subsector
9 Coordinating Council. That council, I believe, is
10 the model for other critical subsectors. And I
11 want to applaud the government folks for working
12 so closely with industry as they've done so far in
13 providing the information sharing that they have,
14 but more could be done. Now, speaking as someone
15 that comes from the Midwest where our utilities
16 are coal-dependent, I would say we need to not
17 move too quickly to eliminate coal from the mix,
18 because as we have only one default baseload
19 supply to fall back on, when that's gone, and that
20 is natural gas. Too much reliance on gas is
21 reducing system reliability. We saw this already
22 this winter when, during the coldest days when we

1 needed the gas the most to power our plants, it
2 was either not available or it was priced and
3 offered to us at 1,000 percent above its normal
4 price. That's not 100 percent higher, that's
5 1,000 percent higher. If you could get gas at
6 all, you couldn't take it on the schedule when our
7 electric customers needed it. There's a huge
8 investment needed in gas supply infrastructure,
9 and if we move too quickly, we'll reduce system
10 reliability. We have a saying in Arkansas, the
11 (indiscernible) matters, got the sticker right
12 here on my iPad.
13 If you're planning an investment for
14 retirement, you would not take all your money and
15 put it in Walmart stock. No matter how much you
16 believe in Walmart, you would diversify your
17 investment. And the same way we wouldn't want to
18 take all of our kids' future power supply resource
19 for baseload power and put it in natural gas. We
20 want to diversity that investment. That provides
21 greater reliability and greater security, so we
22 want to be able to keep all options on the table

1 for the future power supply.
2 MS. WELSH: Peggy?
3 MS. MONTANA: When I think about the
4 study, I look at it from a risk-based perspective,
5 and I think you heard from all the speakers today
6 sort of the overarching one that cuts across the
7 energy and utility industry around cyber security,
8 cyber attack. So, I do think that that ought to be
9 a focus for work on this study and the potential
10 actions later.
11 In terms of responding to natural
12 disasters, from our sector, the single biggest
13 issues are power distribution, as Andy talked
14 about, restoring power. We've done a lot to
15 provide interim electric generators, but having
16 that interconnectivity between utilities and
17 energy, focus on the distribution systems and the
18 resilience of those, I think, is a key factor.
19 And lastly, one we haven't talked about
20 is the human element. So, we are a bit of a
21 graying industry in terms of the age of our
22 workforce. And, you know, in order to have the

1 level of competence and expertise that we desire
2 to have in these critical industries, we must
3 continue to address both the intellectual needs
4 from a stem standpoint, to drive the expertise in
5 the industries, but also a big gap in skilled
6 trades. And I would encourage the QER to reach
7 out to the National Associations of Manufacturers,
8 running currently a task force on skilled trade
9 development. That's all.
10 MS. WELSH: Thank you. Before I move on
11 to the next question, do any of you all want to
12 comment on what each other has said? I only heard
13 one specific recommendation on legislation
14 regarding information sharing on cyber. Anything
15 else that you guys wanted to talk about in terms
16 of specific recommendations?
17 MR. BLACK: Information sharing on cyber
18 security, I think is important for all of the
19 energy sector. There was reference by Joe to the
20 Electric Sector Coordination Council. I wanted to
21 point out that there's an Oil and Natural Gas
22 Sector Coordinating Council also that works very

1 closely with DHS. The pipeline sector is a part
2 of that. We work with TSA, which has issued
3 pipeline security guidelines and take that very
4 seriously and work with TSA when they come visit
5 the facility and see their recommendations.
6 MR. CAULEY: I just wanted to pick up on
7 a point that Duane made. I absolutely endorse and
8 support the issue of diversity of the mix going
9 forward. And I would actually encourage a study
10 of the value, in terms of security and risk going
11 forward of a diverse mix that includes nuclear,
12 coal, and gas as primary sources of energy. In a
13 diverse mix, we don't know what the price of gas
14 will be in three years or five years from now. We
15 don't know the availability issues or the impact
16 of exporting gas internationally. So, I just
17 absolutely think we need to evaluate and
18 understand the value to customers in terms of
19 reliability and security of diverse fuel mix.
20 MS. WELSH: So, let's talk a little more
21 about the partnerships that industry and
22 government have been undertaking. And, Joe, I

1 heard you say that we need more, but we heard
2 about the National Petroleum Council's efforts.
3 We heard about the ESCC and the NGCC and all of
4 the cyber-related partnerships. I wondered if you
5 all could talk a little bit about what is needed
6 that isn't already happening. And what can this
7 task force do to encourage further private/public
8 partnerships and information sharing? And, Joe,
9 since your testimony talked about needing more,
10 I'll jump to you first.
11 MR. RIGBY: Okay. I wish John Rigby was
12 here right now.
13 (Laughter.)
14 I think the -- where I would maybe go with that is
15 that, you know, on the one hand, you know,
16 obviously, we are stand-alone commercial
17 operations. But one of the tough things that we
18 deal with is that at the end of the day, there is,
19 in fact, a price tag that comes with all of this.
20 And it's a very difficult topic to raise, because
21 if you just look in totality, the aggregated to
22 spend, and you realize that somehow or another,

1 you're either going to have to go out and raise
2 the capital and someone's going to have to pay for
3 this, is, it becomes a very -- it becomes a part
4 of the dialog that's somewhat difficult to
5 deliver, because it does, in fact, have that
6 impact. I think that, to the extent that the --
7 both at the federal and also at the state level,
8 that there's an understanding and I think maybe a
9 clear path with all level of prudence that should
10 be applied to that's spend that there's some level
11 of certainty that we can, in fact, make this
12 investment, because that's really what, in many
13 ways, this starts to come down to, that we're --
14 you know, we do have aging infrastructure. We
15 have opportunities to move into what some might
16 call Utility 2.0, as we leave Utility 1.0. But at
17 the end of the day, this all kind of boils down to
18 resources being applied to make that future come
19 about. And we have to balance that with the
20 economic impacts of that to the end use customer.
21 And I think having an opportunity to dialog with
22 our federal and our state regulators in a way to

1 kind of lay that path out might be -- would be of
2 some real value.
3 I'll just give you a quick anecdote.
4 After the derecho in the summer of 2012 here in
5 the District, I got a phone call from the mayor
6 and he said, "You know, we can't have this
7 anymore. We've got to deal with this." And I
8 didn't think there was much opportunity to really
9 do anything productive under the guise of a
10 public/private partnership. And about 15 months
11 later, we announced a one billion dollar
12 undergrounding project. Now, many would argue
13 that that is not leading edge technology. We're
14 taking a line that's overhead. We're digging a
15 hole and putting it underground. But the impact
16 of that to day-to-day reliability to the retail
17 customers is enormous. But it comes with a cost.
18 It was a billion dollar investment and we were
19 able to work that conversation in such a way that
20 ourselves and the city would split that
21 investment. We would be able -- the city is going
22 to be able to use its Triple A bond rating, and

1 that the commission understood that where we were
2 trying to go at the end of the day was simply to
3 improve reliability and to minimize the
4 extraordinary impact that extended outages have,
5 not only to businesses, but to the lives of
6 people. And as we went through that dialog, we
7 found ourselves standing on a whole lot more
8 common ground than, perhaps, we were in the
9 beginning. And the issue of the cost seemed to
10 kind of come down in terms of its impact. I think
11 that's an example of the kind of dialog we have to
12 have to find this common ground to get to this
13 future that we all want. So, you know, that's
14 just a little more, probably than you wanted to
15 know around how I think -- why I think
16 partnerships are so critical in this environment.
17 MS. WELSH: Anyone else have a comment?
18 MR. BLACK: Well, I'm thinking about
19 your question, Peggy, in the context of concerns
20 about supply locally. And I'm thinking that
21 education of the public and of governments,
22 particularly state and local is important and the

1 communication that we've all been talking about.
2 We found that after Sandy and in concerns this
3 winter about propane supplies, that it was
4 important to help education about how the value
5 chain works, what pipelines -- how pipelines fit
6 in there. No, we don't own the product. Yes, we
7 need power. Yes, you can use pipeline capacity
8 off season to fill downstream propane storage. In
9 those crucial hours of working together after
10 Sandy, there was a lot of time spent to try and
11 make sure people understood how this worked, and
12 that there are not just a few electric utilities
13 in the oil and gas sector. There's many different
14 market participants all working together. So, I'm
15 confident that DOE can help paint that picture to
16 the American people and I encourage it, too. And
17 then, communication, we need to work together on
18 both propane and Sandy. There were regular
19 conversations with DOE and the Energy Reliability
20 Office and EIA. And that's vital. You all need
21 to hear as quickly as you can what operators could
22 tell you individually about supply. Because I've

1 heard great things from those crises about when
2 government learns a situation and finds out that
3 there's an opportunity to help, and helped. Thank
4 you.
5 MR. HIGHLEY: I would just add that
6 following the Metcalf and the Little Rock,
7 deliberate acts of sabotage last year, we had
8 meetings with government officials, legislators,
9 the FBI, Department of Homeland Security, White
10 House, had meetings with Congress and with Senate
11 in which the question was asked, is there a need
12 for new legislation. And after we had the
13 opportunity to brief those officials, many of
14 those briefings in closed-door confidential
15 hearings, I think they agreed there was not a need
16 for additional legislation. We have a process
17 that's in place between FERC and NERC that allows
18 subject matter experts to vet reliability concerns
19 and consider both the costs and the benefits.
20 That avoid exculpating of the grid or -- you know,
21 you could protect the substations with concrete
22 walls around every substation, but you still have

1 transmission lines running across the entire
2 fruited plain. So, we could spend a lot of money
3 and not really improve reliabilities. We have to
4 be careful. And that's why I think the process we
5 have and the partnership that's already in place
6 works without the need for additional legislation.
7 MR. CAULEY: I was going to say that I
8 think almost every recommendation that you've
9 heard this morning should start with
10 private/public partnership, because I think they
11 all engage industry and government in providing a
12 common solution. A couple of examples I would
13 highlight individually. One is the physical and
14 cyber security area. I think we've seen through
15 Metcalf and other incidents the invaluable
16 partnership between law enforcement and industry.
17 We can't look at securing the grid as an industry
18 problem. It's a joint problem. And I think the -
19 - if I could pick only one thing to do of all
20 things for security, I would make sure that the
21 individual company is engaged very actively,
22 productively with the local law enforcement to

1 make sure they have a good understanding of what
2 the critical assets and vulnerabilities are, what
3 responses are needed, and what help is needed, and
4 I think that's an extremely valuable resource.
5 The second specific suggestion would be,
6 I think Joe and Duane hit on it, that in the last
7 two years, the Electricity Sectors Coordinating
8 Council has evolved to be, I think, a model. It
9 has roughly 30 CEOs from industry. Most senior
10 levels of government involved and were focused on
11 coming up with actions and solutions and holding
12 ourselves accountable to get those done. So, I
13 think what I would suggest is that that really
14 needs to be expanded. If you look at any of the
15 severe events we're talking about if you look at
16 Sandy, this is not an electricity only issue. We
17 need to get telecom. We need to get oil and gas
18 involved. We need to have a broader conversation
19 between industry and government at this level
20 where we can identify the key issues and create
21 our little tick list and go through and start
22 working on things.

1 MS. MONTANA: I would add on to Gerry's
2 comments in that regard. I think that, as Andy
3 mentioned, there's an Oil and Gas Sector Council.
4 The NPC study that's currently underway, I think,
5 Peggy, what you hear is there's no need for -- no
6 view that we need additional legislations or
7 additional partnerships, but how do we continue to
8 make those work, the partnerships that we do have
9 work more effectively? And so, one of the things
10 that we're really focused on is making sure we
11 have the most seamless interaction we can between
12 national, state, and local governments during
13 times of emergency and improve our ability to give
14 situational awareness to those government entities
15 and seek faster response for getting things like
16 waivers that would continue to help supply the
17 energy system as quickly as possible following the
18 events. So, there is an opportunity to improve
19 the interactions between governments and our
20 industry. And I think the -- certainly, high of
21 recommendations that we get from the electric
22 sector are worth considering and taking a look at.

1 MR. RIGBY: Could I piggyback on one
2 thing Peggy mentioned? I thought Peggy made a
3 really important point about the people in the
4 industry. Just by way of background, I've probably
5 30-40 percent of my workforce that can retire in
6 the next two to three years. I mean, it's at the
7 craft level, it's all over the property. And I
8 think that when we look at, I'll say, the broader
9 issue of building the grid of the future and
10 dealing with it, we should also look at this as a
11 very unique opportunity for people to work, not
12 just give them jobs, but give them careers. That
13 undergrounding project that I mentioned is going
14 to spur 4,000 jobs. That's one project. And I
15 think, as we deal with the evolution of the
16 industry, we should look at this as a unique
17 opportunity from an economic point of view, that
18 it could really spur tremendous amount of
19 employment and can trigger relationships with
20 universities to create cyber engineers. I mean,
21 there's so many opportunities out there that I
22 think are in front of us that can have an enormous

1 impact to the economy.
2 MS. WELSH: Good point, thank you. So,
3 Joe, you've raised the ugly issue of who pays.
4 And it's one that we all struggle with. But
5 rather than going down that road, specifically, I
6 wanted to ask all of you to provide your
7 suggestions on are there financial incentives or
8 market incentives or other incentives that you'd
9 recommend for investment in resiliency and
10 security? Who wants to tackle that one first?
11 MR. RIGBY: Well, I brought it up, so --
12 if I think about it in the context of our service
13 territory, at the bulk power level, at the FERC
14 level, I think we have actually, have a very good
15 construct in place. We have formula rates that
16 allow us to kind of match the spend with recovery
17 in a fairly consistent manner. And that doesn't
18 mean that we just get to do whatever we want to
19 do, I mean, it has to pass muster. It's
20 evaluated. I think just given the fact that we're
21 in a time where, let's say the incline of organic
22 sales growth is flat, maybe even to negative, but

1 the incline of the infrastructure investment is
2 actually fairly steep. You're not going to get as
3 much, I'll say, near term recovery of that steep
4 incline by just natural organic sales. And that
5 creates a problem. I think we're also dealing
6 with the issue of obviously, these are challenging
7 economic times, but I think the overriding issue
8 is that customers have made it very clear what
9 their expectations are. They're very real and
10 very reasonable expectations of high level
11 reliability and a high level ability to respond to
12 issues. I think that -- and I clearly feel that
13 our state regulators are in a very difficult
14 situation because they're trying to balance all
15 these needs. I think there are states that have
16 put in place recovery mechanisms that, not
17 necessarily incent, but I think provide a
18 certainty of that path of recovery, of being able
19 to work with the state regulators to come to a
20 pre- agreement around what the spend will look
21 like, what it will actually deliver, and, you
22 know, to be held accountable for whether that

1 happens or not. I think if we can move to more of
2 these mechanisms across the country, at least
3 certainly in my part of the world, it's going to
4 provide more certainty for me to go to the capital
5 market and to raise -- we spend a billion three a
6 year in construction. I have to go raise that
7 capital every year to make that happen, then seek
8 recovery, I think to the extent that there's
9 mechanisms in place that don't, in any way,
10 diminish the regulatory oversight. I think that's
11 something that I would really like to see put in
12 place.
13 MS. WELSH: Duane, you mentioned
14 affordability is your organization's driving
15 foundation. You probably have some thoughts on
16 this.
17 MR. HIGHLEY: Well, I was just thinking,
18 I have the privilege of reporting to a
19 democratically elected board of directors. As a
20 non-profit cooperative, we work for the members
21 and they own us. And so, I face the people every
22 month who pay the bill and that's our regulator,

1 that's our primary regulator. They remind me
2 every month that they care about costs and
3 reliability and we have to balance the two of
4 those. So, when it comes to incentives, it's
5 really -- there's nobody else to pay. If we're
6 going to improve the grid, the cost is either
7 going to be paid by our ratepayers or by
8 taxpayers. I'd prefer it be us and our ratepayers
9 because we can make that cost benefit evaluation.
10 So, every month, my board makes that evaluation.
11 They're going to spend $500 million in Arkansas to
12 upgrade the grid to improve reliability. That's
13 their money they're spending. They're making that
14 decision. They don't need any other incentive and
15 they can decide if they need to spend a billion to
16 make it even more reliable or is 500 million
17 enough? I think keeping that in that local level
18 makes a lot of sense.
19 MS. WELSH: Andy?
20 MR. BLACK: Liquid pipeline operators
21 have the incentive today to invest in safety, to
22 invest in resilience. During my spoken remarks, I

1 said $1.6 billion was spent just in 2012 on
2 safety. Operators want to make sure that these
3 can be long-lived assets. The way liquid pipelines
4 are regulated by FERC, cost recovery is not
5 guaranteed. It's just an opportunity and this is
6 a period of pretty significant commercial risk,
7 both in competition with other pipeline operators
8 and with other modes. But right now, the
9 incentives are working.
10 MR. CAULEY: I won't try to repeat what
11 Joe and Duane said, but I think this is another
12 opportunity for the private/public partnership to
13 understand in more rational terms what the risks
14 are that we're trying to deal with. Sometimes we
15 can get caught up in a reactionary mode. We have
16 a bad hurricane, you have a Superstorm Sandy.
17 There's a call for sort of reactionary response.
18 There's a lot of attention politically and
19 publicly on cyber and physical security, and it's
20 causing a lot of investment. My suggestion is
21 that on both the government and industry side, we
22 need to have fact based risk analysis and

1 understand what the options are and what the
2 priorities are. And, I think, if we have a clear
3 set of messages around that, I think the customers
4 will understand where we're investing and why
5 we're investing, and it will help get the support
6 that we need to do these things.
7 MS. WELSH: So, the focus of this panel
8 was on vulnerabilities. I want to ask one final
9 question and then ask you each to kind of give a
10 final set of comments. Is there anything that the
11 federal government can do that it's not already
12 doing with regard to filling the vulnerability
13 gap. Again, thinking about this Quadrennial
14 Energy Review is basically coming back to what the
15 federal government can and cannot do in
16 collaboration with industry and other
17 stakeholders. But, is there anything that you
18 think the federal government should address that
19 it's not already doing?
20 MR. CAULEY: I'll take a first stab.
21 First off, I think that the current trajectory
22 toward a climate-based electricity grid future

1 needs to be done in a way that recognizes physics,
2 electricity, and reliability. So, I would
3 encourage that as we think about targets and
4 shifting resources, that we give, due
5 consideration for the provision of the reliability
6 services that are going to be essential. I mean,
7 the reasons why we're sitting here in this room
8 and the lights aren't blinking and fading up and
9 down as if we were in a tent somewhere in the
10 middle of the Third World area is because we have
11 a very reliable grid that's held together by
12 voltage frequency, ride-though capability, there's
13 a whole list of technical things that have to be
14 done. So, I think we need to make sure that we're
15 going forward with our social and climate policy,
16 making sure that we have compatible reliability
17 policy that's going to make it work so we don't
18 have regrets down the road.
19 Second thing I think we haven't done
20 enough is storage is going to be invaluable with
21 the forms of intermittent and variable resources
22 that we have going forward. We've spent a long

1 time on storage. We've been talking about it --
2 I've been talking about it for 20 years. But we
3 need to make it a reality. It's going to have to
4 be available on the grid to displace some of the
5 valuable larger rotating machines that we have.
6 And then I would finally just say I think we have
7 to think of the value of the spare equipment, the
8 modular transportable equipment, particularly the
9 transformers, whether or not -- the difficulty
10 there is just how much to invest, who invests, and
11 whether we're willing to take the risk or whether
12 we need the insurance policy of having something
13 available. We've done a lot of the research.
14 We've done a lot of the preparation for our
15 prototypes. The question is, do we do something?
16 MS. WELSH: Thank you. Anyone else?
17 MR. HIGHLEY: I just want to add on the
18 topic of the spare transformers and that, I think
19 the government could do things to assist in
20 encouraging domestic transformer production.
21 There's one large manufacturer on U.S. soil today.
22 The rest have all moved offshore and it is a

1 critical aspect of national security to have those
2 spare transformers available and have the
3 capability of manufacturing some of that critical
4 equipment on our soil.
5 MR. RIGBY: I was just going to maybe
6 piggyback a little bit on what Gerry said. I
7 think we have to balance the issues of the grid
8 with the view of all of the above. I think
9 renewables are very important, absolutely part of
10 the portfolio, but I don't think they're the
11 silver bullet. And I really like what Gerry said
12 that you just have to also understand the physics
13 of what's involved and how do you fit them into
14 the macrogrid that exists today, and that's a very
15 complex issue.
16 MS. WELSH: Andy?
17 MR. BLACK: It's hard to get a deal to
18 build a pipeline. Pipelines are expensive.
19 People know it's going to take a while to build
20 them. Pipeline operators want shippers to sign
21 long-term contracts when they finally get together
22 and have the agreements necessary to underpin. We

1 hope government will work with us efficiently so
2 that it can get that built. Similarly, we need to
3 attract capital into this business that's
4 increasingly competitive. Projects are seemingly
5 at risk commercially once the long-term contracts
6 end. We need to be able to attract capital. When
7 it comes to issues, that Oil and Gas Industry
8 Preparedness Handbook talks about the need in
9 times of potential crises for some waivers of
10 government for things like, PHMSA operator
11 qualification rules and fuel specifications, and
12 how storage tanks are regulated temporarily. We
13 need to get into those issues to make sure that we
14 can get the fuel necessary. And then we've talked
15 about drills. It's important for government and
16 pipeline operators to do drills together to talk
17 about how emergency response assets are deployed
18 and how people communicate together, just to be
19 ready, whether it's talking with DOE in terms of a
20 storm or restoration of electric service or in
21 that unlikely event of a pipeline emergency how
22 government and operators can work together.

1 Important.

2 MS. WELSH: Peggy?

3 MS. MONTANA: So, as everyone knows, the

4 energy industry is undergoing tremendous

5 transition with the additional production and

6 capability of our country. That transition is

7 happening very rapidly and I think it demonstrates

8 the industry's ability to respond and build new

9 infrastructure. We put tremendous investments in

10 the assets. It's a very asset-intensive heavy

11 industry, and certainly it's to our best interest

12 to invest in resiliency of those networks, which

13 we continue to do. I think from a federal

14 government standpoint, as Andy talked about, the

15 ability to give us permits for all the new

16 activities that's going on, (indiscernible) the

17 infrastructure built for our country.

18 And I would also say that the thing we

19 need most, and Joe talked a little bit about this,

20 is we need certainty. Continuity and certainty of

21 the regulatory environment for these assets is

22 key. These are long-term assets and they have a

1 long life. And to attract the investment, to be
2 able to build the resiliency, we have to have
3 continued certainty and continuity of the
4 regulatory frameworks.
5 MR. HIGHLEY: Peggy, can I jump on that?
6 MS. WELSH: Sure.
7 MR. HIGLEY: That topic, I really
8 appreciate you raising the certainty, because we
9 have been in a very -- I just want to applaud the
10 DOE for hosting this Quadrennial Energy Review so
11 that we can start to develop a national energy
12 policy. We've been operating in the face of
13 uncertainty for years, and in an environment of
14 uncertainty, we make short-term decisions. Our
15 grid should be planned for the next 50 years. We
16 want to plan a reliable supply for our kids and
17 our grandkids, and these facilities we build and
18 invest in don't just last five or ten years.
19 They're built for 50 or 60 or 75 years. That kind
20 of infrastructure needs long-term planning. And
21 when we're forced into an environment of
22 uncertainty, I can't go to my board and recommend

1 they spend $500 million of their money on
2 something that may or may not be a good idea in
3 five years. If we know what the road map is, then
4 we can make prudent investments for our kids and
5 our grandkids. And our boards, my board will be
6 willing to make those investments. The risk is
7 just too high under the current environment to
8 make long-term plans. So, we're all sitting and
9 waiting, making short-term decisions, building
10 peaking combustion turbines, because that's the
11 cheapest and quickest thing we can do, that's not
12 going to run our grid in the 21st and the 22nd
13 century. It's going to be some kind of baseload
14 and we can't make those decisions today. We're
15 all waiting for a plan. So, I just applaud --
16 again, I applaud this forum and this chance to be
17 part of developing a plan so we can all make good
18 decisions for your kids and our grandkids.
19 MS. WELSH: So, we've got five minutes
20 left, with Melanie sitting in the front row and
21 the senior White House staff here. Is there any
22 parting comments that you'd like for them to hear

1 in the next five minutes?
2 MR. RIGBY: Yeah, I would simply -- I'll
3 state the obvious. We live in a really complex
4 world. I mean, we got some tough issues in front
5 of us. Kind of, I think, we're standing in two
6 places. You know, the Utility 1.0 and the 2.0.
7 But I think that maybe to piggyback on what Duane
8 said, I really applaud the DOE. I think that
9 whenever you're trying to wrestle down a tough
10 problem, the best way to do it is to invite a lot
11 of diverse opinions into the room, encourage that
12 tension managed by facts, and then have a process
13 that kind of winnows things down into something
14 that's actionable where people can then take it
15 and run. And hopefully, that's what this is going
16 to happen here. And I just really appreciate
17 being able to play a small role in that process.
18 MS. WELSH: Thank you. With that,
19 please join me in thanking this esteemed panel.
20 (Applause.)
21 Thank you all and we'll get the stage set for
22 panel two and we'll start right back in, thank

1 you.
2 We are about to get started on our
3 second panel. Let me all ask you to please take
4 your seats, turn off your cell phones, and give us
5 your full attention, because this is a panel you
6 don't want to miss. We are honored and delighted
7 to have on the panel Marty Durbin, who's President
8 and CEO of America's Natural Gas Alliance; Dr.
9 Robert Hartwig, President of the Insurance
10 Information Institute; Robert Misback, who is Vice
11 President of Power Systems Group at Mitsubishi
12 Electric Power Products; and Robert Blue,
13 President of Dominion Virginia Power. I want to
14 thank you all for coming. And, Mr. Durbin, the
15 floor is yours.
16 MR. DURBIN: Thank you, Peggy. And let
17 me first just thank both the White House and DOE
18 for the invitation to be here today. Just to echo
19 the comments of the earlier speakers. I think it
20 is an incredible opportunity to have this group
21 pulled together and to start this process of a
22 Quadrennial Energy Review. So, again, thanks for

1 the opportunity to be here. And just as a quick
2 description, you know, ANGA represents North
3 America's leading independent E&P natural gas
4 producers here in the United States. And our
5 mission is, frankly, to promote the increased
6 demand for and use of natural gas. So, by having
7 said that, we're obviously very tied to -- our
8 success is tied to the rest of the energy
9 infrastructure from the pipelines to the LDCs and
10 the rest there. So, while I am not here speaking
11 on behalf of either ANGA or AGA or our other
12 partners in the natural gas space. Again, they
13 are important partners with us moving forward and
14 I know they will be part of the discussions as
15 this process moves along.
16 As has been noted both in the opening
17 speakers and elsewhere, that, you know, United
18 States is now the world's leading producer of
19 natural gas. And what we've essentially seen in a
20 very short time frame, incredible pace of change
21 here that has just totally changed the landscape
22 of our energy picture and the opportunity that we

1 have, as pointed out in the materials for this
2 meeting today. This new abundance of natural gas
3 in the United States is not only creating jobs,
4 it's powering a manufacturing renaissance, it's
5 cleaning our air, as we use more of it in power
6 generation and other applications and
7 transportation, and, of course, giving us an
8 opportunity to export natural gas to our allies.
9 We certainly anticipate that being part of the
10 conversation as we move forward.
11 So, in essence, you could say that one
12 of the -- if we want to look at what are some of
13 the vulnerabilities we have going forward. I
14 think one of the vulnerabilities is that we've got
15 to make sure we take advantage of this opportunity
16 we have to use this abundant, affordable, clean
17 domestic resource that more and more independent
18 and government resources are being -- coming to
19 the same conclusion. The gas is here. We are not
20 supply constrained. As the previous panel and
21 others have pointed out, there's certainly things
22 that we need to look at from a standpoint of

1 policy, from infrastructure, that can help us to
2 smooth the edges of the distribution transmission
3 system. But we are not at all living in an era of
4 scarcity of resource when it comes to natural gas.
5 And I think that needs to be kind of a clear
6 foundation as we move forward.
7 Again, I think that the abundance of
8 natural gas has helped to eliminate a lot of the
9 long-assumed energy vulnerabilities, and it's
10 been, you know, modern techniques. It's been
11 technological innovation that's allowed us to pair
12 horizontal drilling with hydraulic fracturing that
13 has now resulted in a very highly efficient
14 development of shale gas where we're seeing --
15 we're getting more and more production from fewer
16 and fewer rigs. Just as a quick example, I think,
17 over the last two and a half years, we've gone
18 from having more than 900 natural gas dedicated
19 drilling rigs in the United States, I think today,
20 we're around 320, perhaps even fewer. Yet,
21 production keeps increasing, and at a healthy
22 pace, as well, that's driven by technological

1 innovation in the drilling -- in the production of
2 the wells that were currently drilled, new
3 drilling in. But also, obviously, as we've seen
4 more production move to natural gas liquids and
5 oil, we're getting associated gas there, as well.
6 So, as the infrastructure comes along to be able
7 to capture that gas with the oil production, yet
8 another huge opportunity in supply there for us.
9 Very little -- well, there's no concern about, you
10 know, as demand starts to increase, our ability to
11 be able to meet that demand. And it is important
12 to note that it is that growing demand that is
13 also driving the infrastructure development and
14 the infrastructure investment. The pipeline
15 companies, through the ANGA Foundation recently
16 updated a study that we co-sponsored to show that
17 over the next -- between now and 2035, we'll need
18 about $640 billion, or $30 billion a year of
19 investment, to keep up with the outlook of natural
20 gas and natural gas liquids. Important to note
21 that that's private sector investment, and the
22 industry, natural gas industry and the pipeline

1 industry, have a track record of investing that
2 type of, you know, at that level to be able to
3 meet the demands.
4 So, again, just to -- in conclusion, I
5 think we've got a real opportunity here with the
6 diversity in geography of production, diversity in
7 transmission and transportation of the fuel, new
8 technologies coming along to help with both
9 resilience, such as combined heat and power and
10 other distributed generation opportunities. So,
11 we really look forward to working with all of our
12 partners here and with the administration on this
13 dialog going forward. And I'll leave it there.
14 MS. WELSH: Thank you very much. Dr.
15 Hartwig has PowerPoints. He is the only one does
16 today, so he's going to do these from the podium.
17 DR. HARTWIG: It's not my PowerPoint up
18 there, by the way, totally blank screen, but
19 anyway, while they're getting that up there, I'd
20 like to thank you again, for having this forum
21 here, the DOE. Really it is, and we've heard this
22 several times, it is a critical point in our

1 nation's energy history. And in an industry -- in
2 the insurance business, where I am, it's clearly a
3 critical point, as well. The economy is changing.
4 We have a fundamental industry in this -- in the
5 economy that is changing very rapidly, I think, in
6 a way that we couldn't have anticipated, maybe
7 five years ago.
8 It looks like they're still working on
9 it back there. I can promise you it worked a
10 couple of hours ago as we came in. You saw it,
11 that's right. Well, I'll blabber on as they're
12 doing that.
13 A couple of things, here. When we think
14 about some of the greatest threats that in the
15 insurance industry that we see, when it comes to
16 the issue of the energy business, and for us, the
17 energy business, we think about it on a global
18 scale. It is very much a global business, and the
19 expertise in underwriting and pricing these risks
20 while we're talking here, specifically about the
21 U.S., it kind of takes a village to do it. And it
22 takes a global village. And we're talking about

1 seeing many of the similar sorts of risks here in
2 the United States that was see elsewhere in the
3 world, whether it's in the Middle East, whether
4 it's in Asia, whether it's in the North Sea,
5 whether it's in very, very dangerous parts of the
6 world, such as we think about the gas pipelines
7 that are in areas that are very political hotspots
8 right now, such as the Ukraine and many other
9 places like that. I think we heard on the prior
10 panel that -- is that going to work? Oh, there we
11 go. Okay, great. Thank you very much.
12 And very quickly, there's a number of
13 slides here. You can download them from our
14 website right now and I'm sure they'll be posting
15 them to the DOE/QER website a little bit later.
16 Quickly here, this is -- as I mentioned, energy is
17 a huge business for us in the insurance world on a
18 global scale, but right here in the United States,
19 as well. It's one of the ones that we look at as
20 a real long-term growth play. We heard earlier on
21 about investing for the next 30, 40, 50 years, not
22 the next five or ten. That's how we look at this.

1 And when we summarize the energy markets today, we
2 see it's one of the largest sectors that we deal
3 with. And we have extensive experience in
4 solutions in this particular area. And, as I
5 said, it's very comprehensive. We're talking
6 about everything from extraction, both on shore
7 and off shore, refining and storage,
8 transportation, which is a very big issue right
9 now when we talk about marine, rail, trucking, and
10 the exposures that go on there, generation in the
11 area of electricity, renewables, more recently, of
12 course, but also areas that we didn't talk about
13 at any of the other panels. We have a lot of
14 exposure in the worker's compensation side of the
15 business, as well as management liability, things
16 like directors' and officers' policies, those
17 sorts of things for the kind of decisions that can
18 ultimately result in lawsuits against the
19 management of a company.
20 Typically, for many of the utilities and
21 other energy producers and others that are out
22 there, multi-billion dollar limits are what are

1 needed and we can put those up as a matter of
2 course in this business, both property and
3 liability exposures. And we have risk-sensitive
4 pricing in the business. And that provides proper
5 incentives, I think, to mitigate and to produce
6 the kinds of results we're talking about here
7 today. You're rewarded for your superior
8 experience. Now, the results can be very volatile
9 both because of the exposure to natural
10 catastrophes and because just things happen in
11 this business. And insurers, however, work
12 extremely closely with risk managers. I would say
13 that the energy business has really top-notch risk
14 management departments. And insurers work with
15 underwriters and work with the brokers who are
16 involved as well, to make sure -- to try to keep
17 these risks to a minimum and that can help keep
18 costs down to a minimum, as well, and adverse
19 outcomes, of course, to a minimum.
20 Now, the market, as I mentioned in my --
21 before this came up, truly global. A substantial
22 share of the underwriting capacity for this

1 business actually comes from offshore. And, as I
2 mentioned, we have a history of working very, very
3 closely, working to help stimulate innovative risk
4 management programs in companies and using price,
5 in part, as a tool to get the right outcomes. And
6 it's a win-win-win situation for everybody there.
7 You know, just quickly, to take a look
8 at that, we heard a lot of discussion about these
9 things, but looking forward. Okay, it's an
10 energy-hungry world. And we in the United States
11 are going to be able to take advantage of this in
12 a way we couldn't even envision five years ago
13 through our domestic production of gas and oil,
14 and hopefully, an increased ability to export that
15 in the future. And this -- and instead of
16 importing as much as we do, of course, we're going
17 to be exporting that. That means a huge
18 development in infrastructure is needed in this
19 country as well as upgrading of infrastructure.
20 And you can see whether it's investment in global
21 energy infrastructure, not just the U.S. here, but
22 global, whether it's natural gas, oil, and then in

1 the electrical generation realm, as well. Right
2 here in the U.S., however, you could see that our
3 demand for electricity is going to go nowhere but
4 up. I'm an economist by training, and this is one
5 of the few predictions I can give you with
6 absolute certainty is that we are going to remain
7 an ever increasingly energy-hungry world, and
8 whether that's electricity or what have you. But
9 you do see -- you know, this is by fuel source, so
10 you do see increasing shares, particularly in the
11 area of natural gas. And you heard a lot about
12 that.
13 It's a past -- the past couple of years
14 have been very difficult for utilities and their
15 insurers alike, whether it was, as we heard, a
16 Hurricane Irene or the Snowtober Blizzard, and all
17 of these there. You can see downed power lines, or
18 the derecho, or whether it was Superstorm Sandy.
19 And there are going to be more of these events.
20 We heard, of course, about this year's polar
21 vortex. You know, in terms of causing losses, not
22 necessarily specific to energy, but we do see the

1 preponderance of loss from natural disasters is
2 going to be, in this country, anyway, from
3 hurricanes and tropical storms. Secondarily, in
4 recent years, in terms of dollars, from tornadic
5 events, that's increasing very rapidly, and then
6 winter storms come in number three. That may not
7 be exactly the same breakdown when it comes,
8 although I think hurricanes might be number one
9 and maybe winter storms number two. It depends on
10 where you are in the country.
11 And I skipped over that, but geological
12 events. We haven't had a major earthquake in this
13 country in 20 years. Look at what happened to
14 Japan after a major earthquake and tsunami. So,
15 we have to bear that in mind, as well. Many of
16 these events caused enormous damage to the energy
17 infrastructure. As we mentioned, you know, Sandy
18 earlier on, but many of these hurricanes in prior
19 years. These are the most damaging events from
20 our perspective. But when you look at this, this
21 is going in one direction, and up. You can see
22 natural gas production in this country over the

1 past 110 years. And, in fact, a lot goes along
2 with this. I talked about employment exposures.
3 The number of people employed in oil and gas
4 extraction today is the highest it's been since
5 1986. So, that's important, too. And so, there
6 you see the equivalent on the oil production side.
7 So, a lot of exposures there for the property
8 casualty insurance industry and I can tell you
9 we're there to be able to insure that and to make
10 sure that these facilities -- to help them become
11 safer. But also, when the unthinkable does
12 happen, we are there standing behind them.
13 Quickly, a couple of concerns that I
14 have as I close right here, grid vulnerability.
15 We heard a lot about that. And in particular for
16 us, we're thinking a lot right here in Washington,
17 D.C., about the expiration of the Terrorism Risk
18 Insurance Act that expires at the end of this
19 year. Most of the energy industry benefits from
20 that in that they buy coverages that are backed
21 for terrorism risk and are part of this program,
22 which has been in place since 2012. Pipeline

1 risks, those are out there, and I think they're
2 well contained. There's insurance solutions, also
3 offshore risks, post-Deepwater Horizon remain a
4 concern. New frontiers, Arctic pollution, okay,
5 that being one of the new frontiers out there, as
6 well. Rail transportation, certainly a concern in
7 the wake of several, unfortunately, deadly and
8 costly events that have occurred including Canada
9 and in the United States. And then the issue of
10 cyber, we heard a lot about that. That is a sort
11 of a new type of product that is coming out. I
12 would say it's, in terms of the types of cyber
13 products that protect against physical damage,
14 that is something that is, I think, just over the
15 horizon. Programs are being put together that
16 cobble together coverage for terrorism, sabotage,
17 political risk, violence, all of those sorts of
18 things coming together, hopefully, with programs.
19 But we're going to have to work closely with the
20 federal government and with the energy industry to
21 make sure we can put these things together.
22 So, that quickly does conclude my

1 comments here, but just to conclude, we very much
2 appreciate the DOE holding this forum and look
3 forward to working with you in the future. Thank
4 you.
5 MS. WELSH: Mr. Misback?
6 MR. MISBACK: Good afternoon. I'm Bob
7 Misback, in charge of the Power Systems Group at
8 Mitsubishi Electric Power Products. Thank you for
9 inviting me here today. And I appreciate the
10 opportunity to participate on this first public
11 meeting of the Quadrennial Energy Review and serve
12 on this panel. Mitsubishi Electric is a global
13 company of 120,000 employees worldwide. Our
14 energy infrastructure products include the high
15 voltage transformers and circuit breakers to form
16 the backbone of the U.S. grid. We've been
17 supplying this critical equipment to U.S.
18 utilities for over 50 years. And for the last 25
19 of those years, we've been manufacturing it
20 locally in Pittsburgh. We offer our customers --
21 we also offer our customers advanced energy
22 solutions such as solar panels, smart grid

1 systems, and power electronics technologies to
2 facilitate the deployment of renewable generations
3 such as wind and solar power.
4 Today, I'd like to focus my remarks on
5 the investments that my company is making to help
6 our customers strengthen the physical grid
7 security and cost effectively integrate renewable
8 energy into the U.S. electricity grid. Mitsubishi
9 Electric has invested over $90 million in a smart
10 grid demonstration project at three of our
11 factories in Japan. We've used this to learn how
12 to transform wind and solar energy into high
13 quality stable power that can satisfy demanding
14 industrial and residential applications using
15 advanced controls, power electronics, and energy
16 storage. Our customers are excited by the value
17 this could create in their systems and we're
18 exploring several similar projects here in the
19 United States.
20 Last April, we opened a new factory in
21 Memphis, Tennessee, which represents an investment
22 of over $220 million. This is the largest

1 transformer factory in the United States, and it
2 is the only one that can make the highest voltage
3 transformers used in the electric grid. The
4 transformers manufactured in Memphis support high
5 voltage transmission facilities which enable large
6 quantities of power generated by wind or other low
7 cost sources to be transported long distances to
8 reach large cities where it's needed. We selected
9 Memphis as the site of this factory for several
10 reasons, but none more important than logistical
11 and strategic advantages that it provides. In
12 Memphis, we have access to all five major
13 interstate rail carriers and barge access to the
14 Mississippi River, which facilitates sufficient
15 transportation of these large transformers.
16 Large transformers are a major
17 investment for a utility and they take a long time
18 to build and ship. By manufacturing in Memphis,
19 we have taken a major step in shortening the
20 response time to an event that threatens the
21 integrity of the grid by reducing the time to
22 transport a critical machine to our customers from

1 several months to as little as one week.
2 The attack on the Metcalf Substation in
3 San Jose occurred one week before we opened the
4 Memphis plant and brought increased focus by our
5 utility customers to the exposure of the grid to
6 manmade threats. We're collaborating with all of
7 our utility partners to harden both our products
8 and their substations against potential attacks
9 and natural risks like geomagnetically induced
10 current events. We were among the first to test
11 transformers to understand the risks posed by the
12 geomagnetically inducted currents. We have
13 standardized on a GIC- resistant design so that
14 all units made in Memphis will withstand a GIC
15 event. We've also undertaken new technology
16 initiatives to support grid resiliency, including
17 the development of mobile gas insulated
18 substations, a universal spare recovery
19 transformer, and a smart transformer that improves
20 the survivability and resiliency of this critical
21 equipment.
22 Thank you for the opportunity to appear

1 before you today. I look forward to working with
2 the Department of Energy and to all of the
3 stakeholders in the power sector.
4 MS. WELSH: Thank you. Mr. Blue?
5 MR. BLUE: Good afternoon. I'd like to
6 start by commending the White House and DOE for
7 soliciting a wide range of viewpoints on energy
8 policy if not a wide range of first names among
9 the panelists on this panel today.
10 (Laughter.)
11 My name is Bob Blue and I'm President of Dominion
12 Virginia Power. My company is an operating
13 segment of Dominion Resources and we serve about
14 two and a half million retail electric customers
15 in Virginia and North Carolina. Dominion's
16 business ventures take it into many aspects of
17 today's energy industry, electric transmission and
18 distribution, a fleet of merchant generation
19 stations using fuel sources as diverse as wind,
20 fuel cells, and nuclear power, an extensive system
21 of natural gas pipelines, storage and processing
22 facilities, and local gas distribution companies.

1 We provide electric service to some of our
2 nation's most vital defense and security
3 facilities, including the Pentagon, the world's
4 largest Naval Base in Hampton Roads, and a host of
5 security and military installations in Northern
6 Virginia. Our performance directly affects their
7 mission success.
8 I'd like to share with you some of
9 Dominion's programs to protect against threats,
10 deal with challenges, and ensure the reliable
11 delivery of energy. I'll begin with physical
12 security. Dominion shares FERC's concern for the
13 grid's physical safety. We commend the commission
14 for its March order on protection standards and we
15 are an active participant in the North American
16 Electric Reliability Corporation's process to
17 develop those standards. We're confident that they
18 will be thoughtful, well designed, and give
19 individual transmission operators the latitude
20 they need to implement necessary protective
21 actions. Given the national security importance
22 of the facilities in our service territory,

1 Dominion may need to make some unique changes to
2 safeguard our infrastructure. Well before FERC
3 issued its order, we were taking concrete steps.
4 Last September we announced a plan to spend up to
5 $500 million to better protect critical substation
6 equipment and heighten security. We will also
7 build a new systems operation center at a separate
8 and secure site to house the infrastructure needed
9 to manage our grid and ensure reliability. Back
10 in the last decade, we developed a program to
11 ensure that we have a supply of spare transformers
12 that can be quickly put into service during
13 emergencies such as physical attacks or storms.
14 And by using a manufacturer here in the U.S., I
15 think we were -- Mitsubishi's first customer if
16 not -- one of the first, if not the first, were
17 supporting domestic industry and jobs.
18 In addition to physical security, we
19 continue to focus on potential cyber security
20 threats. Our protective efforts take many
21 different forms, intrusion detection capabilities,
22 network boundary protections, malware protection,

1 cyber security training. We continuously monitor
2 threats giving us the capability to adjust
3 protective measures as new dangers arise. Our
4 ability to respond is helped greatly by our close
5 collaboration with the Department of Energy, other
6 federal agencies, and our peer energy companies.
7 We agree that the best protection for the grid is
8 a government/industry partnership based on trust
9 and real-time information sharing. And I would
10 add that liability protection for those of us in
11 the private sector working with appropriate
12 government agencies must be a key part of that
13 relationship.
14 Dominion's also well aware of the
15 threats that weather, most notably severe storms,
16 pose to our system. Three of the worst storms to
17 affect our electric service territory have
18 happened since 2003. After each, we carefully
19 evaluated their impacts on our system. Based on
20 those assessments, we've hardened our
21 infrastructure and improved restoration. One of
22 the key improvements has been our emergency

1 response communications with local governments and
2 regional authorities.
3 We're also making physical improvements.
4 Undoubtedly, the biggest program is our effort to
5 place up to 4,000 miles of vulnerable overhead
6 distribution lines underground. When completed,
7 this program will reduce by half the time required
8 to restore service to all customers after major
9 storms.
10 We've also worked with the National
11 Oceanic and Atmospheric Administration to assess
12 flooding threats to critical infrastructure.
13 Whenever new substations are built or existing
14 ones rebuilt, they are constructed to withstand
15 500-year flood events.
16 Finally, the changing nature of our
17 country's power supply poses threats in and of
18 itself. One aspect is the rapidly growing
19 dependence on natural gas for power generation.
20 New demands for gas have put unprecedented strain
21 on pipelines. Capacity on the existing pipes is
22 sometimes inadequate to meet residential and

1 commercial needs, along with generation. The case
2 in point was this winter's polar vortex. In just
3 one day, from January 6 to 7, the average price on
4 the Transco Zone 5 hub, serving many of our plants
5 in Virginia, increased by more than 550 percent.
6 Fortunately, we avoided power curtailments or
7 service problems thanks in large measure to a
8 diverse fleet. But January, with its supply
9 constraints and soaring prices sent a clear
10 signal. Federal policies must support private
11 industry's efforts to expand the natural gas
12 pipeline network.
13 I'll conclude by summarizing a few of
14 our recommendations. Information sharing and
15 collaboration between the energy industry and
16 government must be a top priority. It's critical
17 to our ability to assess threats and respond to
18 them. Regulators must develop policies favorable
19 to siting and permitting new infrastructure. As
20 we found with the gas transmission network, in
21 many cases, major elements of the energy system
22 are not equipped to handle today's challenge. And

1 one of the prime ways government can promote new
2 infrastructure is by developing policies that
3 offer fair, reasonable, and certain returns on
4 investment. This is essential to attracting
5 private capital to the development of needed new
6 energy projects. Thanks for including me in
7 today's panel and I look forward to a productive
8 and informative session.
9 MS. WELSH: Thank you all. I'm going to
10 ask you the same question that I asked the first
11 panel starting out, and that is, can you provide
12 the QER Task Force with some specific
13 recommendations as Bob Blue did at the end of his
14 comments on whether or not you think there should
15 be any specific executive or legislative actions
16 needed to fill the vulnerability gaps? And,
17 Marty, why don't you give it a try?
18 MR. DURBIN: Happy to do that. You
19 know, and some of this will be certainly building
20 on what we heard, both on the first panel and from
21 folks here. You know, at this point, this early in
22 the conversation, whether I've got a specific --

1 you know, we ought to have an executive order that
2 does the following, but again, I think they're --
3 these are the important conversations that have to
4 happen now. I do think, as Peggy Montana
5 mentioned on the previous panel and API has
6 pointed out that let's make sure we're looking at
7 work that has been done and is ongoing with the
8 National Petroleum Council. Again, I understand
9 that is a part of the plan just to highlight that.
10 And then, several of the panelists have pointed
11 out the need to insure, both from a certainty
12 standpoint and just to make sure these things get
13 done, I think there is room for better
14 coordination among the agencies and streamlining
15 of the permitting process. We know how quickly
16 things have moved here, just speaking about the
17 natural gas space and how that's going to
18 continue. Being able to keep up with the
19 infrastructure needs, as Mr. Blue just pointed
20 out, as well. I said Mr. Blue, because if I said
21 "Bob" --
22 (Laughter.)

1 So, that's another potential opportunity. I also
2 think just more broadly, too, there's an
3 opportunity here for the administration, and not
4 just this administration, but government officials
5 in general. To help in the -- call it a broader
6 education, if you will, of both the public and
7 policy makers on -- there's a lot of energy
8 education across the board, you know, that's
9 needed in the country. A lot of that falls on us
10 as industry, different parts of industry, and
11 we're doing that. But I also think that it's
12 critical that the policy makers can play a role
13 there to be very clear with the public about the
14 demonstrated safe use, production, and just to be
15 able to explain the needs here, the critical
16 needs, why we're going to have to move forward in
17 these different areas. I'll stop there.
18 MS. WELSH: Dr. Hartwig?
19 DR. HARTWIG: My mike doesn't light up,
20 there we go. All right, thank you. All kinds of
21 technological problems here. There is electricity
22 flowing to this mike, though, I'm glad to be able

1 to say.

2 (Laughter.)

3 Well, thank you very much. I sort of come at this

4 from a little bit of a different angle, as I

5 mentioned, being in the insurance industry. And

6 again, I noted that I was the only one to mention

7 the Terrorism Risk Insurance Act. Just because

8 maybe not everyone in this audience is familiar

9 with it and I'm the only one talking about it,

10 that program, which began in November of 2002 and

11 has had two extensions and this most recent

12 extension expires at the end of this year. This

13 is a program which is a public/private partnership

14 which helped restore stability to the insurance

15 and reinsurance markets in the wake of 911, when

16 effectively, acts of terrorism were almost

17 universally excluded from policies in the wake of

18 that event. That program has allowed the market

19 to stabilize. It has done so at no cost to

20 taxpayers. Let me say that again, no cost to

21 taxpayers. And it continues to provide benefits

22 to the market and to the economy overall. Where

1 we're headed right now is that if you have a
2 policy that perhaps, let's say, it's up for
3 renewal on May 1st.
4 you'll continue the coverage as is
5 through the end of the year and then you're very
6 likely to have an exclusion pop up as of January
7 1st of next year or you possibly might be able to
8 go out in the market, get a very limited amount of
9 what might be relatively narrow coverage out there
10 that wouldn't cover such things as workers'
11 compensation exposures, for example. So, this is
12 a very rare example of a government -- of a
13 program, a public/private partnership that's
14 worked. It's worked flawlessly for the past eleven
15 and a half years now, and done so at no cost to
16 taxpayers and it could continue to operate in that
17 realm. So that would be kind of number one and
18 number two.
19 There are some other issues that I
20 hadn't heard addressed. We're very concerned
21 about this. We stand on the receiving end of a
22 lot of litigation and lawsuits. And to the extent

1 that tort reforms are maintained at the federal
2 level, whether it's class actions or working at
3 the state level to try to get some sanity in a few
4 of these states, there are states where the tort
5 system is just absolutely atrocious. It's an
6 international embarrassment and it hurts us
7 competitively and it hurts every industry
8 including the energy business, and it hurts their
9 insurers. It drives up the cost of coverages
10 needlessly. That being said, I would like states
11 to be aware and the federal government to be aware
12 that when we're talking about pipelines, and we're
13 talking about new kinds of energy infrastructure,
14 there are insurance solutions behind those risk
15 management solutions, and your risk management
16 solutions to bring the likelihood and the severity
17 of events that do occur down to an absolute
18 minimum. But behind all of that, there are
19 insurance solutions. And so one thing I'd like
20 those public policy makers, both the federal and
21 the state level to know is that when it comes to
22 say, environmental issues or property damage

1 issues or even in cases of the loss of life, there
2 are insurance solutions out there. But the tort
3 system absolutely needs to remain in check.
4 MS. WELSH: Thank you. Mr.
5 Misback?
6 MR. MISBACK: Yeah, I just have a couple
7 of observations. The one thing about -- and I
8 would say broadly about legislation and standards
9 is that I think one has to be careful that those -
10 - that standards and legislation does not
11 inadvertently prevent new technology. I think one
12 of the gentlemen, the gentleman from NERC in the
13 last panel alluded to situations where that is
14 happening. For instance, some of the standards
15 which have become somewhat outdated, which govern
16 how solar and wind power is connected to the grid
17 is actually preventing the full capability of
18 those systems to increase stability on the grid.
19 So, I think -- so number one observation, I think
20 is that one has to be careful when writing
21 standards and legislation to make sure you're not
22 preventing new technology flowing into the system.

1 The other thing is that what we see with
2 looking at our customers' behavior is it seems
3 like the kinds of legislation that produces the
4 fastest result and the best result is usually
5 incentives. When FERC put into place -- when FERC
6 decided, for instance, that it would be to the
7 country's benefit to reinforce the high voltage
8 grid to stimulate competition among generation,
9 they put in place incentives and we really did see
10 quite an increase in spending and projects from
11 our customers in building new transmission lines.
12 So, I would say the same, you know, the same
13 general philosophy would apply to reinforcing the
14 resiliency of the grid.
15 MS. WELSH: Terrific, thank you. Mr.
16 Blue?
17 MR. BLUE: I mentioned some of our
18 specific thoughts in my prepared remarks, but I
19 might suggest that it's important to take a step
20 back, and any policies that are pursued at the
21 federal or state level need to recognize the value
22 of the grid. You know, I have 3,800 colleagues at

1 Dominion Virginia Power who get up every morning
2 and often stay up late into the night with the
3 sole objective of making sure that when our
4 customers turn the light switch, the lights come
5 on. And now we're asking the grid to do an awful
6 lot. With environmental regulations transforming
7 generation fleets in many cases, shutting down
8 coal plants for a variety of reasons, moving to
9 more natural gas fire generation, trying to
10 incorporate renewables, trying to harden the grid
11 to withstand cyber attacks or physical attacks or
12 more severe weather, all while on the distribution
13 side of things trying to make sure that we can
14 incorporate new technologies like distributed
15 generation and microgrids. All of these
16 individually would be challenges. Trying to do
17 all of that at one time is a particular challenge.
18 And I think it's important for policy makers to
19 recognize the value of reliability today. I know
20 it seems obvious, but I think sometimes it gets
21 lost in the debate that we need to make sure that
22 companies have the regulatory certainty, any

1 incentives, financial incentives to invest in the
2 grid today, in reliability today. And I also
3 think it's important for policy makers to
4 recognize the value of the grid financially as
5 customers look at different ways of being
6 connected or not connected to the grid that were
7 fair to everyone, and that everyone who benefits
8 from the grid pays for part of it. So,
9 fundamentally, I think regulatory certainty and
10 making sure that all these different policies
11 don't conflict is incredibly important. So, I
12 commend this process, because I think it has the
13 ability to take a look at all of that and make
14 sure we're not asking for conflicting objectives
15 for those of us who are going to end up responding
16 to that policy.
17 MS. WELSH: Thank you. So, I heard a
18 lot of you talk about the emergence of new
19 technologies and the value that they have. As you
20 know, one of the many goals of the QER is to look
21 at where federal research dollars are going to be
22 going. And so, I'd like to ask you each to give

1 us your perspective on where you think R&D should
2 be undertaken with regard to risk mitigation,
3 recovery, and security by the federal government,
4 and by industry in a public/private partnership.
5 So, R&D is the question. Mr. Misback, you talked
6 about emerging technologies. I'll let you take the
7 first stab.
8 MR. MISBACK: Well, I think in the --
9 let me cover it kind of area by area. In the area
10 of renewables integration, most of our R&D is
11 going into power electronic technology, because
12 it's very -- power electronics technology is the
13 key enabler in energy storage. It's a key enabler
14 in wind and solar power. Anytime you're trying to
15 connect an intermittent source or a DC -- a direct
16 current source of energy to the grid, power
17 electronics is going to be very valuable.
18 In the area of grid security, we're
19 really looking at a couple of -- several different
20 areas. One is, of course, protecting the
21 equipment, hardening the equipment. Another area
22 is making the equipment smaller and transportable

1 so you can make it more cost effective for people
2 to have spare components that can be used in many
3 places in their system. You know, that's kind of
4 new, right, because most -- in most utility
5 applications people build things, large things
6 that don't -- that aren't intended to move. So,
7 the idea of having a mobile substation, for
8 instance, is somewhat new.
9 And then, monitoring and diagnostic
10 technology, we think can be very valuable because
11 it can protect equipment from -- it can shut
12 equipment off, essentially, before it fails
13 catastrophically so that you can minimize the
14 effect of a catastrophic event and keep it from --
15 you know, make a small event -- keep a small event
16 from growing into a big catastrophe where one
17 event triggers another.
18 MS. WELSH: Marty, do you want to give
19 it a try?
20 MR. DURBIN: Well, you know, I guess I
21 would just note that there's obviously a lot of
22 private sector R&D going on in this area, but one

1 area I think that is certainly promising in the
2 area of resilience, and again, not that it's brand
3 new, but distributed generation opportunities and
4 different options, like, combined heat and power.
5 We certainly saw, and I think I'd put in my
6 written comments, but, you know, during Superstorm
7 Sandy, you had both universities, hospitals, and
8 others that did have an opportunity to go on what
9 they call island mode and were able to keep power
10 going even as the grid around them was not on.
11 Obviously, it's going to take a lot of
12 coordination with the existing generators and the
13 power grid itself, but again, if we're looking
14 forward at opportunities for resilience and just
15 efficiencies as well, I think that is a promising
16 area.
17 DR. HARTWIG: Maybe I'll make a little
18 comment on this as well. In terms of R&D, I
19 actually know the Administration is doing a lot of
20 good work right now on natural catastrophe
21 mitigation. I think that benefits everybody. And
22 I think that when you look at, for example, not

1 only at the federal level, but the state level,
2 and the city level -- I work in New York City,
3 looking at the vulnerabilities in a city like that
4 and when you protect the power grid, you wind up
5 protecting the transportation system. People like
6 me, every day, we are electric dependent. I go to
7 work every day in an electric vehicle. It's
8 called the subway, okay? And when the
9 electricity's not running, okay, I have a problem,
10 and so does everybody else. And so, when we look
11 holistically, at natural catastrophe protection,
12 the power grid is one part of it, but that is
13 really what is standing behind, particularly in
14 major cities, major systems that, you know, like
15 transportation, air traffic control, many others
16 on which we are all dependent.
17 The other one, and it may or may not be
18 always part of cyber, but the -- I bring up cyber
19 once again, because of the fact that, you can
20 think about a cyber attack bringing down, perhaps,
21 a particular generation facility, but I think I
22 heard Bob to my right, talk about the fact that

1 this could contribute to cascading events. And if
2 you poll CEOs in the world today, you'll find that
3 the number one concern is actually what they call
4 supply chain disruption. And it may be this event
5 didn't happen to them, but in today's
6 interconnected, just-in-time world, if you pull
7 down part of the power grid, you're going to wind
8 up pulling down a much larger part of the economy
9 in many cases. And that's a vulnerability that
10 corporate America is very, very worried about.
11 And I don't think we completely understand the
12 interconnectedness that we have right now and the
13 sort of cascading effects that might occur. So,
14 that kind of research into the kind of mitigation,
15 prevention, and avoidance of those kind of
16 scenarios is helpful.
17 MS. WELSH: Thank you.
18 MR. BLUE: I agree with that. I think
19 DOE currently provides some research funding to
20 universities, to vendors of companies like ours on
21 cyber security products that could be valuable for
22 us to prevent or stop cyber security attacks. I

1 think that's valuable research that could be kept
2 moving forward. And then, one other area, you
3 know, for us, if we have a major disruption, a
4 concern would be disruption of the communications
5 network. Our ability to talk to each other as we
6 try to deal with whatever has happened to the grid
7 is extremely important. And that's not an area of
8 expertise for us, but someone researching ways
9 that we would still be able to communicate in the
10 event of something like that would be very
11 valuable.
12 MS. WELSH: Thank you. So, we've heard
13 a lot today about security, whether it's physical
14 or cyber. What we've not talked about yet and
15 what I'd like the panel's opinion on is there's
16 all levels of government who have responsibility
17 for those issues. How can this Quadrennial Energy
18 Review address the conflicts, the inherent
19 conflicts that are there amongst federal, state,
20 and local governments with regard to security?
21 Are there some recommendations you can provide in
22 that kind of collaboration?

1 MR. DURBIN: Again, Peggy, being early
2 in the conversation, I think it's hard to drill
3 down to, you know, here's exactly what has to
4 happen. But I don't think there's any question
5 that a process like this will help identify where
6 those problems or challenges or potentially the
7 opportunities are for better communication. I do
8 think, going back to some of the earlier comments
9 on the earlier panels that I think the QER process
10 has also got to be very clear about. You know,
11 what is its mission? How expanded should it be?
12 I'm not suggesting they shouldn't play a role in
13 trying to help coordinate across different levels
14 of government, but again, whether or not that's
15 solving all the problems or providing a venue
16 where we can identify them and then kind of go to
17 the next step, but I do think, you know, clearly
18 in some of the challenges and opportunities that
19 have been discussed with regard to natural gas
20 plays a bigger role. That's not just a federal
21 issue. It's at the state public utility
22 commissions. It's with NARUC. It's with the

1 other regional transmission organizations, as well
2 as FERC. So, that's more of a policy side, but
3 still, there's a need for that collaboration
4 across he different levels of government. But,
5 again, for a -- for a specific mission of the QER,
6 I would just be careful not to try to pull too
7 much into its mission.
8 DR. HARTWIG: And a quick point here,
9 I'm familiar with another initiative that's
10 underway and I'm not sure is coordinated with it
11 or not. The Department of Homeland Security, I
12 mean, security is in their name. They take this
13 issue very seriously as well. They look at it in
14 a much broader sense, the vulnerability not only
15 just to the power grid, but to many other
16 dimensions of the economy. And I think they
17 rightly so, and I think that the QER and DOE would
18 fit squarely within this. You have to look at a
19 reliable power grid as being part of this nation's
20 homeland security, and that's why, in part, I view
21 maintaining a viable insurance market in an
22 environment where you're prone to terrorism risk

1 as part of this nation's national economic
2 security. So, I don't know to what degree there's
3 a coordination with DHS. I assume there's some,
4 but I don't know the extent of it.
5 MS. WELSH: Just to give you some
6 clarity, as the Secretary said this morning, there
7 are 14 or 15 federal agencies involved in this
8 effort and the Department of Energy is acting as
9 the executive secretariat, but is working quite
10 closely with DHS. So, thank you for that
11 recommendation. Anyone else?
12 MR. BLUE: I would just say,
13 particularly on the cyber side of things, over the
14 course of the past couple years, I think there's
15 been much better communication between industry
16 and the federal government. And I give a great
17 deal of credit to both sides to share information,
18 because after all, that's the -- that's going to
19 be the real key to successful efforts, is sharing
20 information across the industry and having a
21 successful communication with the federal
22 government is essential to that. I think on

1 physical security, we have found very good
2 coordination among law enforcement at the local,
3 state, and federal level as we have sought to
4 address that. I wouldn't leave out the
5 coordination within the federal government, as I
6 mentioned earlier. There are a lot of different
7 policies that are affecting the electric system
8 and energy infrastructure generally, some on the
9 environmental side, some on the security side.
10 So, I think this is a wonderful opportunity
11 through this process to make sure that there is
12 some unified thinking about what are the goals
13 that we're after? What are the priorities? How
14 fast do we want to try to implement them? And so,
15 I think this provides a great -- the process that
16 you all are undertaking provides a great
17 opportunity to do that.
18 MS. WELSH: So, one last question.
19 Several of you talked about the importance of
20 hardening the grid, and we've got new technologies
21 coming into the grid, whether they're renewables
22 or storage or electric vehicles. Talk to us a

1 little bit about your thoughts on how those new
2 technologies are going to impact the need to
3 harden the grid.
4 DR. HARTWIG: Well, maybe I'll start.
5 Got to harden this microphone here. I think that,
6 as I sort of mentioned earlier on, this issue of
7 cascading effects and the interconnectedness. You
8 talked about -- I mentioned I commute in an
9 electric vehicle everyday called the subway, okay?
10 If you commute, actually, from anywhere in the
11 suburbs, you get to commute mostly on electric
12 lines and that's probably likely going to be
13 increasingly the case as we have more reliance on
14 mass transportation. If you haven't noticed the
15 numbers coming out of Detroit, we've probably hit
16 what many people call peak auto, which is, in
17 terms of the actual number of vehicles that are
18 out there and the number of vehicle miles that are
19 being driven. And increasingly, we see the usage
20 of gas falling. And, in part, that's not only due
21 to increased fuel efficiency that's going to be
22 increased, also due to the increased use of

1 natural gas for some fleet vehicles, and
2 ultimately -- and then electricity, ultimately in
3 cars. So, I think we have to be very cautious
4 here. This interconnectedness is something, I
5 think, that we probably underestimate, so the grid
6 itself, or whatever you want to call it, is going
7 to be more and more important as we go forward in
8 this increasingly digitized society.
9 Just one last anecdote, last year's
10 largest major natural disaster was Moore,
11 Oklahoma, tornado there. Two billion dollars in
12 insured losses. That very same town, in 1999, had
13 been hit by a tornado. Do you know what they did
14 after that with the power lines? They buried
15 them. Okay, do you know what helped that town get
16 back on its feet faster than it could have
17 beforehand? All the utilities were underground.
18 It was extraordinary to see that. I was there on
19 the scene 48 hours afterwards and said, "Where are
20 all the wires?" Well, they were exactly where
21 they should have been. They were underground. The
22 house wasn't there, but the electrical

1 infrastructure was still there. And that was
2 great news to see. That wasn't technology. That
3 was pretty low-hanging fruit, but I think we could
4 do a lot more of that in the country.
5 MS. WELSH: Thank you. Anyone else?
6 MR. BLUE: You know, I think there is
7 some school of thought that more microgrids, more
8 distributed generation will somehow reduce the
9 need for the more centralized grid for the large
10 bulk power system that we have. I don't think
11 that's right. I think that people are going to
12 remain reliant on that system. There will --
13 certainly, new technologies will advance. There
14 will be changes. We will integrate those changes.
15 But I think we're a long ways from the day where
16 people are going to be divorced from the central
17 grid. And so, we need to make sure that we're
18 investing appropriately in that. I know Joe Rigby
19 talked about the FERC formula rates and
20 transmission investments, and I think he's exactly
21 right. I think that system works well. We're
22 investing in our transmission system at Dominion

1 Virginia Power. But, you know, I think centrally,
2 to get back to something that I said earlier.
3 While we think about these new technologies coming
4 on to the system, we shouldn't forget about the
5 reliability of the system as it stands today and
6 in the near future. That's going to require
7 investments, both at the transmission and
8 distribution level and, obviously, recognizing the
9 change in the generation fleet will require
10 investments there. So, I think the new
11 technologies actually emphasize the need for
12 investments in the grid.
13 MR. MISBACK: Yeah, I think that's
14 absolutely right. The grid today is more
15 interconnected than it's ever been. If you go
16 back 50 years, very little power flowed from one
17 utility to the other utility. Today, huge amounts
18 of power cross the country. And if you look at
19 the way it's evolving, the highly efficient gas-
20 fired combined cycle plants that are being built
21 today are very large plants, most of them -- many
22 of them over 2,000 megawatts. So, just as big as

1 large coal or nuclear plants. The very efficient
2 best wind resources in the country, the wind farms
3 that have been built in Texas and the Midwest to
4 take advantage of those things are far away from
5 load centers. So, you have -- more than ever,
6 now, you have large quantities of power moving
7 across the country. Yes, there is a lot of
8 promise for, you know, distributed generation,
9 like solar. But for many, many, many years to
10 come, I think the electric grid is going to be
11 increasing in its importance to the country, not
12 decreasing.
13 MS. WELSH: We've got five minutes left.
14 I'm going to give you all the same opportunity
15 that I gave the last panel. With some important
16 people sitting in the audience, do you have any
17 final specific recommendations for the White House
18 or the Department of Energy as they undertake this
19 extensive review? Short and sweet.
20 MR. DURBIN: I don't have any specific
21 advice that we haven't already captured here, but
22 I did want to, just as a final thought to all of

1 this. Number one, since I raised the idea of
2 distributor generation, obviously, I was thinking
3 about natural gas powered, but I agree with you
4 completely. It's not a matter of replacing, it's
5 integrating with the centrally powered system. It
6 came up several times earlier as well, but the
7 issue of fuel diversity and concerns about putting
8 all of our eggs in one basket, in natural gas.
9 And I would just say, I don't want to call it a
10 red herring, but I think that it's an overstated
11 concern. There's no question, and I completely
12 agree, the way that things have come so quickly,
13 it has been disruptive to the existing market and
14 existing commercial arrangements. There are
15 infrastructure constraints. And again, Mr. Blue
16 identified a specific issue and concern that
17 happened in January where we did have some spot
18 prices. Now, the good news is, that was only
19 about one percent of the sales those days. So,
20 I'm not saying it's not an issue. What I'm saying
21 is, it's not a -- we don't have a supply problem,
22 and right now, if you look at -- I've taken to

1 looking at individual utilities and seeing what
2 the pie chart looks like of their fuel diversity
3 five years ago and what it is today. It was far
4 less diverse, you know, five years ago. Not to
5 pick on any fuel source, but I think natural gas
6 is actually providing diversity to the system, but
7 we've got to do it right and we've got to make
8 sure that we can fix those infrastructure and
9 policy and commercial arrangement issues so that
10 we can smooth those rough services, thanks.
11 DR. HARTWIG: Just very quickly,
12 something I mentioned before, just to the
13 Administration, make the terrorism --
14 reauthorization of that Act a priority, get it
15 passed ASAP. There's already a bill --
16 (indiscernible) of bills that were introduced last
17 year, three bills. There is -- it looks like
18 there's one coming out of the Senate very, very
19 shortly. And do so now while you can avoid
20 greater disruptions in the overall economy, or,
21 God forbid, allowing it to lapse and something
22 happens next year or beyond.

1 MR. MISBACK: So, I liked one of the
2 things that Mr. Highley in the first panel
3 emphasized is that to stay positive. I mean, I
4 think if you sum up what you've heard today, the
5 United States has more low- cost fuel than any
6 other country in the world. I think we have the
7 largest and most reliable electric grid in the
8 world, and we have -- those things have led us to
9 have the lowest cost of electricity of any
10 developed country in the world. And I really
11 think the Quadrennial Report is a great
12 opportunity to make sure that we keep that
13 advantage for years and years to come. And I
14 think we have the new technologies available now,
15 and the grid is -- much of the equipment in the
16 grid was built in the '60s and '70s. So the
17 opportunity is now to -- a lot of refurbishment of
18 the grid would have had to happen anyway. And the
19 opportunity now is to infuse that refurbishment
20 with the new technology that's going to enable the
21 grid to meet all the new challenges that Mr. Blue
22 mentioned, and not only in cyber security, but in

1 integrating renewables, and all the other things
2 that we think the grid will have to do in the next
3 50 years.
4 MR. BLUE: Marty, I agree with you.
5 It's not a supply problem. It's an infrastructure
6 issue. We need more pipeline infrastructure. More
7 broadly, I'd just like to say thanks to the White
8 House, DOE, and the Task Force for undertaking
9 this process. I think it's incredibly important.
10 It's the right time to do it. And I -- my one
11 specific final thought would be, remember the
12 value of public/private partnerships. I think a
13 lot gets done very effectively in this area that
14 way, and I would encourage policy makers to
15 continue with that approach.
16 MS. WELSH: Join me in thanking this
17 panel.
18 (Applause.)
19 We're now going to, as our panel departs, set up
20 for the open mike session. So, give us just a
21 moment and we'll begin that process immediately.
22 We're setting up the lighting system.

1 As you know from the Federal Register Notice, each
2 of the people who have asked to make comments will
3 have three minutes, so we wanted you to be
4 directed to the lighting system here. When it
5 turns yellow, you have 30 seconds, and red means
6 stop. To double check yourself, my colleague will
7 be sitting in the front row and will hold up signs
8 giving you directions. And we ask that you comply
9 with the three-minute rule, or I will interrupt
10 you and ask you -- and thank you for your
11 comments. Remember, this is your opportunity, not
12 only to comment orally, but the Department really
13 wants everyone in this room to file comments. As
14 you heard all morning, this process is going to be
15 successful if the Department and the White House
16 hear from as many different divergent views as
17 possible. So, I'm going to give you that address
18 again. It's QERcomments@hq.doe.gov. Please
19 submit your comments in writing. They have equal
20 weight to whether or not you were an invited
21 speaker or a commenter her at what will be one of
22 many public hearings. We want to hear from all of

1 you.

2 Are we good to go? Terrific. So,

3 again, it is my honor to introduce you to our

4 esteemed Department of Energy colleagues who will

5 be listening to your comments. There are many

6 others who are watching the live streaming of this

7 back at the Forrestal Building, but I want to

8 introduce Dr. Karen Wayland. She is the Deputy

9 Director of the DOE Office of Energy Policy and

10 Systems Analysis for State, Local, and Tribal

11 Cooperation. She is in charge of all these

12 meetings and is the one person who is managing the

13 outreach for this very extensive process. Next to

14 her is John Richards, who is in that same office

15 and serves Karen as senior advisor. And to his

16 right is Matt McGovern, who is also a senior

17 advisor in that office.

18 So, the process will be that you will

19 come to one of the standing mikes, introduce

20 yourself by name, and if you have an organization

21 that you're representing, we'd love to know that

22 as well. And I will be calling off the names as

1 you signed in. So, if you were -- we'll do our
2 best to make sure we're getting you based on the
3 time you signed in. It may not be a perfect
4 system. So, with that, our first commenter is
5 Barbara Tyran.
6 MS. TYRAN: Thank you very much. I am
7 Barbara Tyran, Director of Washington and State
8 Relations at the Electric Power Research
9 Institute, EPRI. EPRI recently completed a
10 concept paper, The Integrated Grid, which examines
11 the rapid rise of distributed energy resources and
12 how these technologies could be integrated into
13 the electric power system so customers could enjoy
14 the benefit of both central power system, and the
15 distributed technologies in the most cost
16 effective manner. The integrated grid enables the
17 optimal combination of local generation, energy
18 storage, energy efficiency, and new uses of
19 electricity integrated with central generation to
20 provide reliable, affordable, and environmentally
21 sustainable electricity. The approach allows
22 resource deployment that will realize all

1 potential benefits and requires a modern grid
2 characterized by connectivity enabling
3 interconnection rules and rate structures that
4 enhance the value of the power system to all
5 consumers. Although the journey towards a fully
6 integrated grid will take decades, EPRI is pleased
7 to submit the first of three phases of The
8 Integrated Grid concept paper and we would like to
9 submit that into the permanent QER comments
10 library as noted earlier today and are available
11 to discuss it at any time.
12 EPRI plans to finalize phase two in the
13 summer of 2014. This next phase will establish a
14 comprehensive framework to address research gaps
15 in key areas and assess the technology needs by
16 examining, one, a benefit cost framework; two,
17 interconnection technical guidelines; and three,
18 grid planning and operations. This scientifically
19 rigorous assessment for systemwide deployment will
20 support prudent investment for grid modernization.
21 Phase two will also be submitted so the QER
22 library upon completion.

1 Phase three will involve demonstrations
2 of the methodology for a particular power system
3 to assess the feasibility of an integrated benefit
4 cost methodology as well as one or more technology
5 demonstrations, and will continue over the next
6 two years. EPRI looks forward to providing future
7 updates and to continuing our collaboration with
8 the Department of Energy and other stakeholders to
9 shape the future of electricity together. Thank
10 you.
11 MS. WELSH: Thank you. Our next speaker
12 is Becky Harrison.
13 MS. HARRISON: Good afternoon. My name
14 is Becky Harrison and I'm the CEO of the GridWise
15 Alliance. And I'm pleased to have this
16 opportunity to address this body as the DOE
17 examines this vital topic of our nation's electric
18 delivery infrastructure. The GridWise Alliance
19 has a unique cross-section of members including
20 electric utility, IT and communication equipment
21 and service providers, national labs, academic
22 institutes, ISO RTOs and more. The GridWise

1 Alliance issued a report last year entitled
2 Improving Electric Grid Reliability and
3 Resiliency, which highlighted many of the lessons
4 learned from Superstorm Sandy and other very
5 large- scale events such as floods, wildfires, and
6 ice storms. In our report we highlighted the
7 increasing interdependency of our critical
8 infrastructures, including our gas delivery
9 infrastructure, our information and communications
10 infrastructure, our fueling supply chain, and our
11 electric infrastructure. As our digital economy
12 becomes increasingly dependent on electricity, the
13 impacts from power outages are increasing and we
14 must understand and manage these interdependencies
15 proactively in order to ensure that we can recover
16 from very large-scale events quickly and
17 effectively.
18 Grid-related technologies, including
19 remote sensing and control capabilities, enable
20 our utility to have greater situational awareness
21 and are essential to preventing or responding to
22 extreme weather events as well as cyber security

1 and physical threats. But today, they are not
2 widely deployed to maximize their capability.
3 Multi-customer microgrids that consist of
4 different entities or properties such as gas
5 stations, ATMs, and grocery stores can improve
6 resiliency through and then following very large-
7 scale events, but the rules regarding who will
8 manage these and how they will interface with the
9 larger grid must be defined before they can be
10 widely deployed. We also believe it is important
11 to ensure that consumers' engagement is
12 incorporated into this process as our nation's
13 electric delivery system undergoes a substantial
14 transformation in the coming years. Our goals
15 must be to maintain and even improve our current
16 reliability levels that our nation has enjoyed
17 while embracing innovation that will take us to
18 the next level. Transitioning to a two-way
19 interconnected electric system where customers are
20 both consumers and producers of electricity is
21 important. Currently, we lack the infrastructure
22 and systems to truly manage a transactive energy

1 world enabling these new pro- sumers. The
2 GridWise Alliance stands ready to assist in this
3 critical QER effort. And I will be submitting our
4 report and our remarks for the record.
5 MS. WELSH: Thank you. Next we have
6 Mollie Simon.
7 MS. SIMON: Hello. Thank you for the
8 opportunity to offer comments on the pending
9 Quadrennial Energy Review. My name is Mollie
10 Simon and I'm here on part of the National
11 Wildlife Federation, one of the nation's oldest
12 and largest conservation organizations dedicated
13 to inspiring Americans to protect wildlife and our
14 children's future. On behalf of our more than
15 four million members and supporters nationwide, we
16 applaud your efforts to craft a comprehensive
17 federal road map to identify and implement
18 consistent, clear energy goals and policies. I'm
19 here today to stress that these policies must
20 enhance our ability to combat climate change. In
21 fact, the National Wildlife Federation believes
22 that this must be the single most important factor

1 in forming all of our major energy infrastructure
2 and investment decisions. We were thrilled to
3 hear President Obama's commitment last June to,
4 "take bold action to reduce carbon pollution," and
5 "lead the world in a coordinated assault on
6 climate change." The National Wildlife Federation
7 has been working hard to support the numerous
8 efforts the Administration has already taken to
9 reduce our economy-wide carbon pollution, and we
10 look forward to continuing this collaboration.
11 These policies have helped protect our most
12 cherished lands and the wildlife that depends on
13 them from the impacts of unabated climate change.
14 However, we must reiterate that an all-of-the-
15 above energy policy is simply incompatible with
16 this Administration's stated goals of cutting
17 carbon pollution and will continue to undermine
18 our ability to address climate change. An all-of-
19 the-above energy policy that allows for the
20 expansion of coal mining and coal leasing, oil
21 development and export, and turns America's
22 heartland into a throughway for Canadian tar sands

1 export pipelines will directly undercut the
2 laudable efforts of the Administration to reduce
3 our domestic carbon pollution, like the pending
4 rule to limit greenhouse gas emissions from
5 existing power plants. We must not undo the
6 potential benefit of the substantial and historic
7 effort by simply increasing emissions in other
8 sectors.
9 The latest report from the
10 Intergovernmental Panel on Climate Change released
11 just a few weeks ago is alarmingly clear. Climate
12 change possesses a growing threat to our health,
13 economic livelihood, and food and water sources
14 for billions of people, including Americans. With
15 the drought in California already in a state of
16 emergency and the rest of the country bracing for
17 a summer filled with increased wildfires,
18 hurricanes and extreme weather events, it is
19 imperative that we do everything in our power to
20 mitigate these impacts and protect communities and
21 wildlife from further devastation. This goal
22 cannot be achieved at the level scientists warn

1 are necessary if we continue an all-of-the-above
2 energy strategy that deepens our reliance on
3 polluting fossil fuels.
4 In June of last year, President Obama
5 declared that he would not find the Keystone XL
6 tar sands pipeline in the nation's interest. It
7 was found to be "significantly exasperating of
8 climate change." We applaud this commitment and
9 look forward to the rejection of the highly
10 pollutant and dangerous project. We also hope
11 that this same climate test will be applied to all
12 major energy infrastructure decisions under the
13 Administration's authority. We are very pleased
14 to see the draft QER include a long- term goal of
15 advancing clean energy and recognize the threat of
16 climate-driven severe weather events to our
17 nation's --
18 MS. WELSH: Thank you very much. Our
19 next speaker is Ron Edelstein.
20 MR. EDELSTEIN: Good afternoon. I am
21 Ron Edelstein from the Gas Technology Institute.
22 I appreciate being able to address the panel and

1 DOE on the QER. I will address the subject of R&D
2 needs, and I'll focus on resiliency and
3 vulnerability, particularly on the natural gas
4 side. I'll start with the end use activities.
5 R&D on combined heat and power and distributed
6 generation in all its senses, that is, natural
7 gas, natural gas-driven engines, fuel cells,
8 renewables-driven, CHP and DG can really help the
9 resiliency of the nation's energy grid. If we go
10 a little bit upstream now to the gas distribution
11 system, which is aging replacement of distribution
12 systems, advanced technologies, to enable risk-
13 based assessments of risks and consequences,
14 running gas to new neighborhoods and new areas and
15 enabling the DG and other systems to be put into
16 place very, very important. And moving further
17 upstream to the pipelines, redundant pipeline
18 systems, additional pipeline capacity places,
19 especially New England, is important, making sure
20 those systems are piggable, that the latest
21 sensors are being worked on, latest technologies.
22 We applaud in this sense Midstream R&D, the new

1 line in the DOE fossil budget, but we think fossil
2 natural gas R&D is woefully underfunded further
3 upstream in the nature gas supply side. Since the
4 closing down of REBSI (phonetic), additional
5 research to fund natural gas supply R&D,
6 particularly with respect to green fracking, which
7 is already in place in many places, and additional
8 technologies to reduce methane emissions. We
9 think this kind of R&D is very, very important to
10 ensure resiliency and reduce vulnerability of our
11 nation's energy system. Thank you.
12 MS. WELSH: Thank you. Our next speaker
13 is Christina Cody.
14 MS. CODY: Good afternoon. I'm
15 Christina Cody. I'm a Senior Program Officer with
16 the National Association of Regulatory Utility
17 Commissioners representing the state public
18 utility commissioners. The QER's early focus on
19 resilience is timely because of the multitude of
20 vulnerabilities our utility infrastructure faces
21 every day. These vulnerabilities can take the
22 shape of sophisticated Metcalf-style attacks or a

1 massive storm like Hurricane Sandy. For well over
2 100 years, our lights, for the most part, have
3 stayed on despite the numerous challenges and
4 vulnerabilities our utility systems face every
5 day. Clearly though, the times and threats we face
6 are changing. The QER can address these
7 challenges in several ways. The utilities own and
8 operate the infrastructure themselves, and
9 although we regulate them, they know their
10 infrastructure better than anyone. Therefore, our
11 regulated utilities are ultimately responsible for
12 shoring up the safety and security of their
13 systems.
14 The QER can inform and support these
15 utility efforts. But as their regulators and as
16 the public officials entrusted with the
17 responsibility of ensuring the safe, reliable, and
18 affordable delivery of utilities services, this is
19 our problem, too. This industry spends billions
20 of ratepayer dollars per year to train, educate,
21 and drill its employees and maintain physical
22 infrastructure so that the lights stay on or come

1 back on quickly after an incident. It is here
2 that role of the states is paramount. State
3 regulators are responsible for setting the rates
4 for and regulations by governing the nation's
5 investor- owned distribution systems. We would
6 all like to have the safest, most reliable system
7 possible. That's everyone's goal. However, we
8 must remember at the end of the day, it's the
9 consumer who will be paying for every decision
10 that is made. Regulators think about their
11 mission in this context.
12 At NARUC, our staff is working around
13 the clock on resilience and security issues.
14 We've written two primers on understanding,
15 measuring, and paying for resilience. Through our
16 Committee on Critical Infrastructure, we are doing
17 a tremendous amount of outreach and education
18 through workshops, seminars, trainings, and much
19 more. On cyber security and resilience, NARUC has
20 launched a multi-state tour running training and
21 educational seminars at our member offices
22 throughout the country. In fact, by this summer,

1 NARUC will have initiated cyber security technical
2 assistance with 35 of our members. The only
3 limitation to our ability to continue this
4 training is resources, and we are grateful for the
5 support of U.S. Department of Energy to allow us
6 to come as far as we have. We are ready and look
7 forward to continuing this important work. We are
8 getting up to speed on all of these developments
9 and quickly because utilities are coming to us
10 with requests to harden their system. Whether
11 these investments address physical or cyber
12 security, they must also use risk- based
13 approaches to prudently meet the prevailing
14 expectations of reliability and affordability of
15 the ratepayer. All of this depends on
16 partnership, dialog, and discussion. As we've
17 seen across the country, states are pursuing
18 innovative approaches to ensuring grid resilience.
19 While NARUC does not endorse any one particular
20 approach, the QER can learn a great deal from the
21 states who are pushing ahead with new and
22 innovative policies. Thank you for your time.

 © 2014

1 MS. WELSH: Thank you. Our next speaker
2 is Barry Lawson.
3 MR. LAWSON: Thank you, we don't have a
4 statement.
5 MS. WELSH: Elizabeth Noll. Jim
6 Hoecker. And the last one, it's not particularly
7 clear whether or not he would like to speak, he
8 put the checkmark in the wrong column, Justin
9 Ackly.
10 All right, we thank you very much. This
11 has been a very informative session. It is only
12 the first of many. Again, I want to encourage all
13 of you to submit comments at
14 QERcomments@hq.doe.gov. Let me turn the floor
15 over now to Dr. Wayland, who will close our
16 session this morning.
17 DR. WAYLAND: Thank you. And I
18 appreciate all the time that people have spent
19 providing us with their views. As the Secretary
20 and Dr. Holdren mentioned, there will be many more
21 opportunities both online and in these public
22 listening sessions. There will likely be about 14

1 more of these sessions around the country. The
2 next one will be on April 21st looking at
3 infrastructure constraints on a regional basis in
4 New England. It will start at nine o'clock on the
5 21st and be held at the Rhode Island Convention
6 Center in Providence. It'll be followed by
7 another session at one o'clock in the Phoenix
8 Building in Hartford, Connecticut. Again, those -
9 - it'll be a whole series of four to five panels
10 looking at infrastructure constraints in New
11 England.
12 Those will be followed by four other
13 meetings that we've already publicly noticed, one
14 in New Orleans on petroleum storage transmission
15 and distribution; one in North Dakota looking at
16 infrastructure constraints in the Baaken; one in
17 Chicago looking at issues around rail, barge,
18 truck, and other modes of transport for
19 electricity -- or energy supplies; and then the
20 final one that we've announced so far is looking
21 at electricity issues with a western focus in
22 Portland, Oregon.

1 The transcript for today -- we've had a
2 court reporter here. The transcript will be up on
3 our website, which is energy.gov/QER within the
4 next couple days. We'll also have a summary notes
5 of the meeting within two weeks, also posted on
6 the web. For those of you who have submitted
7 comments, those comments will not be -- if you
8 submit them to the QERcomments@hq.doe.gov, those
9 will not be publicly available right away, but by
10 the end of the process of writing the QER, they
11 will become part of the public record and will be
12 public. The panelists' statements today will be
13 up on the web within the next 24 hours or 48 hours
14 at this point.
15 I want to thank Energetics and Peggy
16 Welsh who has done so much more than help to
17 facilitate this meeting. Her staff really helped
18 our staff put this together. And I'd like to
19 quickly mention my staff, Matt McGovern, John
20 Richards, Chaani Vines, Larry Mansueti, Levi
21 Tilleman-Dick, Rima Oueid, and Colin Bishopp, and,
22 of course, Michael Goo also helped out. And you'll

1 be seeing them around the country if you join us.
2 Thank you very much.
3 MS. WELSH: Thanks everyone.
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

 © 2014

1 CERTIFICATE OF COURT REPORTER

2 I, NATALIA THOMAS, the reporter before whom the
3 foregoing hearing was taken, do hereby certify
4 that the witness whose testimony appears in the
5 foregoing deposition was duly sworn by me; that
6 the testimony of said witness was recorded by me
7 and thereafter reduced to typewriting under my
8 direction; that said deposition is a true record
9 of the testimony given by said witness; that I am
10 neither counsel for, related to, nor employed by
11 any of the parties to the action in which this
12 deposition was taken; and, further, that I am not
13 a relative or employee of any counsel or attorney
14 employed by the parties hereto, nor financially or
15 otherwise interested in the outcome of this
16 action.
17
18
19
20 _____
NATALIA THOMAS
21
22

1 CERTIFICATE OF TRANSCRIPTION

2 I, WENDY C. CUTTING, hereby certify that I am not
3 the Court Reporter who reported the following
4 proceeding and that I have typed the transcript of
5 this proceeding using the Court Reporter's notes
6 and recordings. The foregoing/attached transcript
7 is a true, correct, and complete transcription of
8 said proceeding.
9
10
11
12
13
14
15
16
17 _____ _____
Date WENDY C. CUTTING
18 Transcriptionist
19
20
21
22

$

$1.6 52:1 87:1
$120 30:20
$220 113:22
$23.9 30:11
$24 30:22
$3.8 30:13
$30 101:18
$37.8 30:6
$4 29:17
$500 86:11 95:1 118:5
$640 101:18
$9.4 50:18
$90 113:9
$95 30:19

1

1,000 69:3,5
1.0 74:16 96:6
1.15 30:21
10,000 50:16
10:00 1:7
100 69:4 164:2
102 2:13
11 1:7
110 110:1
112 2:14
116 2:15
1164 54:4
12 34:11
120,000 112:13
13 2:5
14 5:11 15:4 17:15 140:7 167:22
14.1 50:6
15 15:5 17:15 75:10 140:7
153 2:16
155 2:17
158 2:18
16 34:9
161 2:19
163 2:20
167 2:21
17 21:18
18 2:6
185,000 50:8 65:11
1973 9:14
1986 7:10 110:5
1989 57:18
1990 7:8
1996 7:10
1999 143:12
1st 126:3,7

2

2,000 145:22
2.0 74:16 96:6
2.4 51:18
20 60:2,16 90:2 109:13
20001 1:10
2002 125:10
2003 119:18
2008 29:15 55:7 56:17
2010 8:2 33:5
2011 12:5 55:12,13 56:8,16
2012 25:5 50:5 51:14 52:1 55:7 75:4 87:1 110:22
2013 29:8,15 30:14 34:8 55:9
2014 1:7 29:19 30:7,11 31:1 154:13
2019 29:19
2020 21:19 34:7
2025 30:7,11 31:1
2035 34:10 101:17
21st 10:7 42:8 95:12 168:2,5
22nd 95:12
230,000 29:14
24 169:13
25 112:18
28 2:7

3

3,300 50:20
3,800 129:22
30 29:12 60:2,16 80:9 104:21 151:5
30-40 82:5
320 100:20
33rd 7:4
35 2:8 166:2
37 28:13

4

4 2:3
4,000 82:14 120:5
40 6:13 14:4 104:21
43 2:9
48 143:19 169:13
49 2:10

5

5 121:4
50 94:15,19 104:21 112:18 145:16 150:3
500 86:16
500,000 34:6
500-year 120:15
54 2:11
550 121:5
555,000 34:12
590-plus 28:17

6

6 121:3
60 94:19
60s 149:16

7

7 121:3
70 29:15
70s 149:16
75 94:19

8

8 2:4
8.45 29:12
88 43:16

9

90 29:16
900 100:18
90-day 59:4
911 125:15
97 2:12
99.9998 51:14

A

a.m 1:7
ability 33:9 64:9 67:21 81:13 84:11 93:8,15 101:10 107:14 119:4 121:17 131:13 137:5 158:20 159:18 166:3
able 26:8 49:8 62:20 69:22 75:19,21,22 84:18 92:6 94:2 96:17 101:6,11 102:2 107:11 110:9 123:18 124:15,22 126:7 134:9 137:9 161:22
absence 47:20
absolute 108:6 127:17
absolutely 72:7,17 91:9 127:5 128:3 145:14
abundance 99:2 100:7
abundant 99:16
academia 11:19
academic 155:21
Academy 10:11
accelerate 10:5 19:19
access 42:22 46:7 114:12,13
accomplish 3:18
accomplished 66:13
according 30:17 34:7
accountable 80:12 84:22
achieved 47:18 160:22
achieving 21:21
Ackly 167:9
acknowledge 5:7
acquisition 54:6
across 5:11 11:2 17:16 20:13 50:7 70:6 79:1 85:2 124:8 138:13 139:4 140:20 146:7 166:17
act 4:12 7:8,9 9:18 20:14 110:18 125:7 148:14
acting 140:8
action 12:6 17:9 21:17 24:10 39:5 159:4 171:11,16
actionable 96:14
actions 11:1 22:2 32:16 33:2,7,12 61:19 70:10 80:11 117:21 122:15 127:2
active 46:18 117:15
actively 47:6 79:21
activities 51:8 59:16 66:2 93:16 162:4
activity 15:7
acts 41:2 78:7 125:16
actual 52:13 142:17
actually 25:8,9 72:9 83:14 84:2,21 107:1 128:17 134:19 136:3 142:10 145:11 148:6
adaptation 15:15
add 13:21 23:20 25:19 59:19 60:12 78:5 81:1 90:17 119:10
added 50:17
addition 15:21 47:9 48:4 118:18
additional 30:21 38:9,13 40:11 45:13 56:1 59:19 60:14 78:16 79:6 81:6,7 93:5 162:18 163:4,7
Additionally 27:6
address 11:3 18:9 21:14 22:3 25:16,22 26:1 27:8,13 44:1 47:11 55:17 71:3 88:18 137:18 141:4 151:17 154:14 155:16 159:18 161:22 162:1 164:6 166:11
addressed 48:13 126:20
addressing 1:5 15:13 47:17
adhered 31:6
adjust 119:2
administered 52:4
administration 6:7,16 9:22 10:15 11:15 23:5 102:12 120:11 124:3,4 134:19 148:13 159:8 160:2
Administration's 159:16 161:13
adopted 52:20
advance 144:13
advanced 39:16 44:16 45:17 48:10 112:21 113:15 162:12
advancing 161:15
advantage 99:15 107:11 146:4 149:13
advantages 114:11
adversaries 46:11
adverse 106:18
adversely 32:11
advice 4:4 31:19 32:16 146:21
advisor 12:20 152:15,17
Advisors 5:20 10:1

Advisory 4:11
affect 119:17
affecting 141:7
affects 117:6
affordability 35:22 38:5 85:14 166:14
affordable 42:19,22 99:16 153:20 164:18
affordably 36:14 41:12
afternoon 112:6 116:5 155:13 161:20 163:14
afterwards 143:19
AGA 98:11
against 40:13 54:2 105:18 111:13 115:8 117:9
age 14:5 44:16 70:21
agencies 11:2 15:6 24:2 39:4 41:1 51:7 65:22 119:6,12 123:14 140:7
agenda 3:8
aggregated 73:21
aggregating 32:6
aging 42:4 54:18,19 74:14 162:11
ago 7:15 103:7,10 107:12 148:3,4 160:11
agreed 23:1 78:15
agreement 84:20
agreements 91:22
ahead 17:4 166:21
air 7:8 99:5 135:15
alarmingly 160:11
alike 108:15
Alliance 97:8 155:15,18 156:1 158:2
allies 99:8
allocated 46:8
all-of 159:18
all-of-the 48:10 159:14
all-of-the-above 161:1
allow 45:19 48:15 83:16 166:5
allowed 39:13 100:11 125:18
allowing 34:4 39:11 49:2 148:21
allows 78:17 153:21 159:19
alluded 128:13
already 9:21 13:13 14:1,15 15:1,4 17:14 19:5 20:12 22:10 30:3 36:12 68:21 73:6 79:5 88:11,19 146:21 148:15 159:8 160:15 163:7 168:13
altered 15:9
alternative 51:17
am 14:6 22:8 28:9 31:12 98:10 103:2 153:6 161:20 171:9,12 172:2
amazing 63:18
ambitious 23:13 24:7
Amendments 7:8,9
America 38:4 50:11 136:10
American 28:4,16 49:20 50:3 51:1 52:19 54:11 77:16 117:15
Americans 44:11 49:21 53:17 158:13 160:14
America's 20:4 29:5 50:15 51:4 97:8 98:3 159:21
among 6:5 8:22 46:9 115:10 116:8 123:14 129:8 141:2
amongst 3:22 137:19
amount 60:5,10 63:3 82:18 126:8 165:17
amounts 145:17
analyses 24:14 25:12,21
analysis 4:16,22 8:6 59:13 87:22 152:10
analytical 5:2 14:20
Andy 2:10 28:1 49:16 64:16 70:13 81:2 86:19 91:16 93:14
anecdote 75:3 143:9
ANGA 98:2,11 101:15
angle 125:4
announced 7:16 17:17 18:3 75:11 118:4 168:20
annual 29:17 30:18 55:5
annually 31:1
anticipate 19:21 39:14 99:9
anticipated 103:6
antiquated 37:14,17
anymore 75:7
anyone 38:2 76:17 90:16 140:11 144:5 164:10
anything 71:14 75:9 88:10,17
Anytime 132:14
anyway 102:19 109:2 149:18
anywhere 142:10
API 31:11 65:1 123:5
apologize 43:12
apparently 25:4
appear 115:22
appears 171:4
applaud 43:9 68:11 94:9 95:15,16 96:8

158:16 161:8 162:22
applause 7:20 8:14 13:19 18:12 22:18 26:20,22 35:12 96:20 150:18
applications 99:6 113:14 133:5
applied 74:10,18 161:11
apply 129:13
applying 47:3
appreciate 18:15 42:5 54:14 94:8 96:16 112:2,9 161:22 167:18
appreciation 37:10
approach 26:9 60:2 150:15 153:21 166:20
approaches 166:13,18
appropriate 11:9 119:11
appropriately 51:2 144:18
Approval 34:2
approvals 34:3
approved 40:2
approving 66:1
April 1:7 55:12 113:20 168:2
Arabia 29:10
Arctic 111:4
area 39:20 59:17 60:4 64:7 79:14 89:10 105:4,11 108:11 132:9,18,21 133:22 134:1,2,16 137:2,7 150:13
areas 18:2 39:7 104:7 105:12 124:17 132:20 154:15 162:14
arena 47:5 63:1
aren't 36:15 89:8 133:6
argue 75:12
arise 119:3
Arkansas 27:21 36:1,4,13,22 40:17 69:10 86:11
arrangement 148:9
arrangements 147:14
ASAP 148:15
Asia 104:4
aspect 41:6 91:1 120:18
aspects 28:18 116:16
assault 159:5
assess 120:11 121:17 154:15 155:3
assessing 55:6
assessment 154:19
assessments 119:20 162:13
asset 58:22
asset-intensive 93:10
assets 46:12 58:10,20 80:2 87:3 92:17 93:10,21,22
assist 37:1,5 90:19 158:2
assistance 55:20 166:2
Assistant 5:17
associated 47:22 101:5
association 28:2,17 49:17 163:16
Associations 71:7
assume 140:3
assure 34:20 40:5
assured 65:8
assuring 50:22
Atlantic 53:10
Atmospheric 120:11
ATMs 157:5
Atomic 9:14
atrocious 127:5
attack 46:11,13 57:5 58:22 70:8 115:2 135:20
attacks 47:7 54:3 115:8 118:13 130:11 136:22 163:22
attain 39:10
attention 58:19 87:18 97:5
attest 6:19
attorney 171:13
attract 48:20 92:3,6 94:1
attracting 122:4
audience 13:5 125:8 146:16
Auditorium 1:9
August 31:16 33:5
author 7:7
authorities 120:2
authority 161:13
authorizations 48:2
auto 142:16
availability 20:16 50:22 60:13 72:15
available 12:3,4 69:2 90:4,13 91:2 149:14 154:10 169:9
average 29:17 30:18,22 38:11 121:3
avoid 16:9 26:16 78:20 148:19
avoidable 56:8
avoidance 26:14 136:15
avoided 121:6
aware 23:21 35:1 119:14 127:11
awareness 56:20 81:14 156:20
away 19:14 146:4 169:9

awful 130:5

B

Baaken 17:18 168:16
backbone 112:16
backdrop 16:3
backed 110:20
background 24:3 82:4
backup 46:8 64:12
bad 87:16
balance 42:17 74:19 84:14 86:3 91:7
balanced 26:9
ball 8:10
Barbara 2:16 153:5,7
barge 114:13 168:17
barrels 29:13,14 34:6,12 50:6
Barry 167:2
Base 117:4
baseball 8:8
based 4:3 8:5 47:14 58:14 87:22 119:8,19 153:2 162:13 166:12
baseload 60:5,10 68:18 69:19 95:13
basically 88:14
basis 67:10 168:3
basket 147:8
bear 29:7 66:11 109:15
became 29:8
Becky 2:17 155:12,14
become 48:4 52:13 110:10 128:15 169:11
becomes 74:3 156:12
becoming 6:10 12:4 40:3
beforehand 143:17
begin 61:14 117:11 150:21
beginning 8:8 12:14 41:5 76:9
behalf 28:15 98:11 158:14
behavior 129:2
behind 13:4 110:12 127:14,18 135:13
believe 24:7 39:6 45:21 46:3 68:9 69:16 157:10
believes 158:21
bend 21:19
benefit 42:11,17,22 43:2 49:21 86:9 129:7 153:14 154:16 155:3 160:6
benefited 47:2
benefits 42:14 78:19 110:19 125:21 131:7 134:21 154:1
Berkeley 6:6
besides 38:18
best 34:13 45:22 48:13 93:11 96:10 119:7 129:4 146:2 153:2
better 25:21 31:20 39:13 48:16 118:5 123:13 138:7 140:15 164:10
beyond 148:22
bi-directional 47:22
biennial 9:18
bigger 26:11 138:20
biggest 20:3 70:12 120:4
bill 7:12 85:22 148:15
billion 29:17 30:7,11,14,19,20,22 34:9,11 50:6,18 52:1 75:11,18 85:5 86:15 87:1 101:18 143:11
billions 50:9 160:14 164:19
bills 148:16,17
Bishopp 169:21
bit 5:6 36:9 70:20 73:5 91:6 93:19 104:15 125:4 142:1 162:10
blabber 103:11
black 2:10 28:2 49:5,16 57:8 64:17 71:17 76:18 86:20 91:17
blackout 56:16,17
blank 102:18
blinking 89:8
Blizzard 108:16
Blue 2:15 97:12 116:4,5,11 122:13 123:19,20 129:16,17 136:18 140:12 144:6 147:15 149:21 150:4
blueprint 21:21
board 28:1 40:2 44:7 85:19 86:10 94:22 95:5 124:8
boards 95:5
Bob 112:6 116:11 122:13 123:21 135:22
body 155:16
boils 74:17
bold 159:4
bond 75:22
boost 34:5,10
borders 51:11
bottlenecks 24:16
boundary 118:22
bracing 160:16
branch 9:7
brand 134:2
breakdown 109:7

breakers 112:15
brief 9:9 78:13
briefed 39:11
briefings 78:14
bring 37:2 66:11 127:16 135:18
bringing 135:20
broad 23:7
broad-based 10:9
broader 68:4 80:18 82:8 124:5 139:14
broadly 124:2 128:8 150:7
broke 24:22
brokers 106:15
brought 83:11 115:4
budget 163:1
build 19:16 21:4 25:21 41:12 66:16 67:2 91:18,19 93:8 94:2,17 114:18 118:7 133:5
building 14:19 26:16 31:11 32:15 40:20 45:13 50:12 82:9 95:9 122:19 129:11 152:7 168:8
built 92:2 93:17 94:19 120:13 145:20 146:3 149:16
bulk 83:13 144:10
bullet 91:11
burden 38:14
buried 143:14
burned 40:21
business 36:16 92:3 103:2,16,17,18 104:17 105:15 106:2,4,11,13 107:1 116:16 127:8
businesses 76:5
buy 110:20

C

California 16:15 40:16 59:22 160:15
California's 7:4
Canada 111:8
Canadian 159:22
capabilities 46:11 62:8 118:21 156:19
capability 62:6 89:12 91:3 93:6 119:2 128:17 157:2
capable 23:15
capacities 8:9
capacity 14:20 19:7 29:13,17 41:18,19 50:13 51:1 62:19 65:18 77:7 106:22 120:21 162:18
capital 1:14 48:20 63:10 74:2 85:4,7 92:3,6 122:5
Capitol 1:9,10 49:9
capture 101:7
captured 146:21
carbon 21:8,18,21 22:1 41:10,19 159:4,9,17 160:3
care 7:6 86:2
careers 82:12
careful 79:4 128:9,20 139:6
carefully 119:18
Carolina 116:15
Carolinas 53:9
carriers 114:13
carry 12:1
cars 30:12 143:3
cascading 136:1,13 142:7
case 57:7 121:1 142:13
cases 52:20 121:21 128:1 130:7 136:9
casualty 110:8
catastrophe 22:5 133:16 134:20 135:11
catastrophes 106:10
catastrophic 61:4 133:14
catastrophically 133:13
catch 8:10 16:8
category 67:4
caught 87:15
Cauley 2:11 28:3 54:13 62:1 72:6 79:7 87:10 88:20
cause 41:2 44:21 46:2 57:6
caused 16:16 53:9 109:16
causing 53:13 64:3 87:20 108:21
cautious 143:3
cell 97:4
cells 116:20 162:7
cements 34:16
center 1:9 46:22 59:13 118:7 168:6
centers 146:5
central 144:16 153:14,19
centralized 144:9
centrally 145:1 147:5
century 10:7 42:8 95:13
CEO 28:1,2,3 35:21 38:18 44:4 49:16 97:8 155:14
CEOs 39:11 59:7 80:9 136:2
certain 18:9 51:8 66:1 122:3
certainly 8:17 16:5 23:9 25:10 35:5 81:20 85:3 93:11 99:9,21 111:6 122:19 134:1,5

144:13
certainty 31:8 48:21 74:11 84:18 85:4 93:20 94:3,8 108:6 123:11 130:22 131:9
CERTIFICATE 171:1 172:1
certify 171:3 172:2
cetera 24:3
Chaani 169:20
chain 32:22 77:5 136:4 156:10
chains 32:1
Chairman 27:22 38:19
chairmanship 15:1
challenge 10:8 20:3 23:10,14,18,21 24:5 38:10 63:2 121:22 130:17
challenges 9:8 10:7 12:13,16 15:14,17 16:4,18,20 24:11,16 25:6 32:10 42:8 47:17 117:10 130:16 138:6,18 149:21 164:3,7
challenging 16:16 84:6
chance 95:16
change 10:8 13:3 15:15,19 20:2,6,8,12,14 21:2,14 22:4 98:20 145:9 158:20 159:6,13,18 160:10,12 161:8
changed 98:21
changer 58:18
changes 16:3 19:18 118:1 144:14
changing 50:11 51:4 65:14 103:3,5 120:16 164:6
characteristic 17:4
characteristics 12:2
characterized 154:2
charge 112:7 152:11
charged 9:15 14:16
chart 148:2
Cheap 19:11
cheapest 95:11
check 128:3 151:6
check-in 3:9,14
checkmark 167:8
cherished 159:12
Chicago 17:20 168:17
chief 7:11 35:22
children 22:4
children's 158:14
choice 20:19 43:8
choices 22:2,7
choose 43:8
CHP 162:8
Christina 2:20 163:13,15
circuit 112:15
cities 114:8 135:14
city 75:20,21 135:2,3
clarity 48:16 140:6
class 29:21 127:2
clean 7:8 16:2 19:10,20 21:15 62:14 99:16 161:15
cleaning 99:5
clear 15:6 42:14 74:9 84:8 88:2 100:5 121:9 124:13 138:10 158:18 160:11 167:7
clearances 39:10
clearly 15:18 31:5 84:12 103:2 138:17 164:5
climate 10:8 12:6 13:3 15:14 16:11 20:2,5,8,9,11,14 21:2,5,14,17 22:4,5 89:15 158:20 159:6,13,18 160:10,11 161:8,11
climate-based 88:22
climate-driven 161:16
climatic 48:12
Clinton 6:16
clock 3:7 165:13
close 54:8 61:9 110:14 119:4 167:15
closed-door 78:14
closely 68:12 72:1 106:12 107:3 111:19 140:10
closing 7:21 34:20 59:19 163:4
clothes 50:1
co 15:1
coal 19:14,15,17 41:13,22 68:17 72:12 130:8 146:1 159:20
coal-dependent 68:16
Coast 33:10
cobble 111:16
co-chair 5:20,21
co-chairs 6:1 12:21
Cody 2:20 163:13,14,15
cognizant 31:3
coherent 24:9
coherently 26:4
cold 56:6
coldest 68:22
Colin 169:21
collaborating 115:6
collaboration 17:8 88:16 119:5 121:15 137:22

139:3 155:7 159:10
colleague 151:6
colleagues 129:22 152:4
collecting 12:15
column 167:8
combat 158:20
combination 153:17
combined 102:9 134:4 145:20 162:5
combustion 95:10
comes 41:7 68:15 73:19 75:17 86:4 92:7 100:4 101:6 103:15 107:1 109:7 127:21
coming 21:22 24:1 31:16 45:1 55:8 80:11 88:14 97:14 99:18 102:8 111:11,18 141:21 142:15 145:3 148:18 157:14 166:9
commend 64:21 117:13 131:12
commending 116:6
comment 68:8 71:12 76:17 134:18 151:12
commenter 151:21 153:4
comments 27:8,11,12 35:17 67:3 81:2 88:10 95:22 97:19 112:1 122:14 134:6 138:8 151:2,11,13,19 152:5 154:9 158:8 167:13 169:7
Commerce 7:3
commercial 65:20 73:16 87:6 121:1 147:14 148:9
commercially 92:5
commission 9:14 57:22 76:1 117:13
commissioners 163:17,18
commissions 45:7 138:22
commitment 159:3 161:8
commitments 61:8
committed 21:18 40:8
Committee 4:12 7:3 165:16
common 76:8,12 79:12
communicate 92:18 137:9
communication 53:22 77:1,17 138:7 140:15,21 155:20
communications 32:17 46:22 63:16 120:1 137:4 156:9
communities 36:18 47:16 160:20
community 23:17
commute 142:8,10,11
companies 55:17 101:15 107:4 116:22 119:6 130:22 136:20
company 1:14 68:3 79:21 105:19 112:13 113:5 116:12
comparable 38:15
compatible 89:16
compelling 45:6
compensation 105:14 126:11
competence 71:1
competition 61:6 65:20 87:7 129:8
competitive 92:4
competitively 127:7
compiled 13:7
complete 40:9 172:7
completed 12:4 31:16 120:6 153:9
completely 136:11 147:4,11
completion 154:22
complex 91:15 96:3
comply 151:8
component 35:4
components 33:13 44:17 133:2
comprehensive 105:5 154:14 158:16
compromised 40:6
concept 54:19 153:10 154:8
concern 23:6 41:8 42:5 60:1,9 101:9 111:4,6 117:12 136:3 137:4 147:11,16
concerned 57:7,9 126:20
concerns 53:9 76:19 77:2 78:18 110:13 147:7
conclude 111:22 112:1 121:13
conclusion 99:19 102:4
concrete 78:21 118:3
condition 52:9
conduct 8:3
conducting 33:15
conference 66:10
confidence 67:18
confident 14:6 77:15 117:17
confidential 78:14
confirm 20:11
conflict 131:11
conflicting 131:14
conflicts 137:18,19
congestion

25:3,7,13 26:1,4,10,16
congratulations 13:22 49:6,15
Congress 7:6 9:17 11:9,17 17:12 18:19 78:10
congressional 1:9 7:5 65:22
Congressman 7:1,12 14:6 18:13,14 22:16
connect 132:15
connected 128:16 131:6
Connecticut 168:8
connecting 50:10,12
connectivity 154:2
connects 25:2
consensus 4:8 49:10
consequences 162:13
conservation 158:12
consider 34:1 46:3 58:21 59:20 78:19
consideration 89:5
considered 31:22
considering 81:22
consist 157:3
consistent 83:17 158:18
constant 31:9
constrained 99:20
constraints 16:6,7 17:18,20 121:9 147:15 168:3,10,16
construct 50:10 51:3 66:20 83:15
constructed 120:14
construction 51:8 52:5 66:1 85:6
consumer 36:6 38:11 45:22 50:2 165:9
consumers 32:13 36:5 38:12 42:11 49:20 50:3 54:12 154:5 157:11,20
contained 111:2
context 16:11 76:19 83:12 165:11
continents 20:12
continually 37:19
continue 14:7 18:19 42:9 43:4 48:22 51:21 52:17 54:9,11 63:12 66:15 67:2,14,20 68:5 71:3 81:7,16 93:13 118:19 123:18 126:4,16 150:15 155:5 159:17 161:1 166:3
continued 94:3
continues 44:15 125:21
continuing 155:7 159:10 166:7
continuity 93:20 94:3
continuous 52:6
continuously 119:1
contractor 3:4
contracts 61:8 62:21 91:21 92:5
contribute 30:19 136:1
contributing 44:17
contributions 9:1 14:8 24:1
contributor 14:2
control 33:14 40:20 45:17,18 54:6,7 60:7 62:5 135:15 156:19
controls 113:15
Convention 168:5
conversation 75:19 80:18 99:10 122:22 138:2
conversations 77:19 123:3
Cooperation 152:11
cooperative 27:22 36:1,3,15 38:19 85:20
cooperatives 36:6,13,22 38:9,12
coordinate 48:2 138:13
coordinated 10:16 11:2 139:10 159:5
Coordinating 38:20 47:1 59:7 66:19 68:9 71:22 80:7
coordination 48:17 54:1 71:20 123:14 134:12 140:3 141:2,5
corporate 136:10
Corporation 28:5 36:2
Corporation's 117:16
correct 172:7
correctly 63:4
co-sponsored 101:16
cost 19:10,15 38:8,16 42:10 45:8,9 46:2,7,9 48:6 75:17 76:9 86:6,9 87:4 113:7 114:7 125:19,20 126:15 127:9 133:1 149:5,9 153:15 154:16 155:4
costly 111:8
costs 20:20,21 38:1 42:17 46:2 78:19 86:2 106:18
council 5:20 6:2 10:1 31:10 38:20 39:6 47:1 59:7 66:20 68:9 71:20,22 80:8 81:3 123:8

Council's 73:2
counsel 171:10,13
counselor 4:16
country 5:11 17:16 19:5 20:4 24:18 34:18 38:6 85:2 93:6,17 107:19 109:2,10,13,22 124:9 144:4 145:18 146:2,7,11 149:6,10 160:16 165:22 166:17 168:1 170:1
country's 120:17 129:7
couple 3:10 79:12 103:10,13 108:13 110:13 128:6 132:19 140:14 169:4
coupled 29:20 44:18
course 9:5 10:8 11:12 13:6 15:13 16:5,10,18 17:10 18:6 24:4,15 51:9 54:1 99:7 105:12 106:2,19 107:16 108:20 132:20 140:14 169:22
court 169:2 171:1 172:3,5
cover 126:10 132:9
coverage 111:16 126:4,9
coverages 110:20 127:9
crack 53:3
craft 82:7 158:16
create 68:1 80:20 82:20 113:17
created 44:2
creates 84:5
creating 21:8 99:3
credit 140:17
creep 31:8
crises 53:17 78:1 92:9
crisis 16:15
critical 17:11 33:13 39:7,19 41:5 58:11 68:10 71:2 76:16 80:2 91:1,3 102:22 103:3 112:17 114:22 115:20 118:5 120:12 121:16 124:12,15 156:7 158:3 165:16
critically 36:7
criticized 40:4
crop 20:15
crops 50:1
cross 145:18
crossing 51:11
cross-section 155:19
crucial 77:9
crude 30:6 34:5 49:18 50:6 51:19 65:16
crude-dedicated 30:12
crude-loading 30:13
cubic 34:9,11
Cuilco 36:20
cumulative 30:5
curious 23:5
current 8:9 9:22 88:21 95:7 115:10 132:16 157:15
currently 31:15 71:8 81:4 101:2 136:19 157:21
currents 115:12
curtailments 121:6
customer 64:2 74:20 118:15
customers 44:6 46:10 55:18 64:3,8 69:7 72:18 75:17 84:8 88:3 112:20,21 113:6,16 114:22 115:5 116:14 120:8 129:2,11 130:4 131:5 153:13 157:19
cut 9:10 19:9 40:21
cuts 70:6
cutting 159:16 172:2,17
cyber 26:5 32:4 39:17,21 46:10,19,21 47:3 48:12 54:3 57:5 58:4,9,16 59:12,17 67:8 70:7,8 71:14,17 79:14 82:20 87:19 111:10,12 118:19 119:1 130:11 135:18,20 136:21,22 137:14 140:13 149:22 156:22 165:19 166:1,11
cyber-related 73:4
cyberspace 4:20
cycle 52:7 145:20

D

D.C 1:10 110:17
Dakota 168:15
damage 109:16 111:13 127:22
damaging 109:19
Dan 6:1,3 15:2
dangerous 104:5 161:10
dangers 119:3
Darius 23:4 24:22
data 8:5 25:7 45:17 47:21 54:6 55:7
Date 172:17
day 29:13,15 34:7,9,11,12 49:21 73:18 74:17 76:2 121:3 135:6,7 144:15 163:21 164:5 165:8
days 37:13 68:22 147:19 169:4

day-to-day 75:16
DC 132:15
deadly 111:7
deal 56:1 58:1 62:16 64:12 73:18 75:7 82:15 87:14 91:17 105:2 117:10 137:6 140:17 166:20
dealing 66:21 82:10 84:5
dear 9:2
debate 130:21
debt 7:17
decade 118:10
decades 14:3,5 17:4 19:21 21:8 22:1 30:1 154:6
decentralization 46:1
decide 86:15
decided 129:6
decision 21:4 86:14 165:9
decisions 19:22 21:1 32:20 51:6 94:14 95:9,14,18 105:17 159:2 161:12
declared 161:5
declining 19:11
decrease 20:16
decreasing 146:12
dedicated 100:18 158:12
deepens 161:2
deeply 9:10
default 68:18
defense 40:13 117:2
defined 31:21 157:9
degree 140:2
deliberate 31:17 41:2 46:13 78:7
delighted 43:13 97:6
deliver 38:14 54:11 74:5 84:21
delivered 38:8 50:6 61:4
deliveries 53:11
delivering 41:9 44:5
delivery 10:6 50:13 117:11 155:18 156:8 157:13 164:18
demand 98:6 101:10,11,12 108:3
demanding 113:13
demands 102:3 120:20
democratically 85:19
demonstrate 53:17
demonstrated 55:20 124:14
demonstrates 93:7
demonstration 113:10
demonstrations 155:1,5
denying 24:5
Department 3:4 4:8,15 6:18 9:13,17 11:22 14:16 27:6 39:3 51:9,17 62:17 63:11 78:9 116:2 119:5 139:11 140:8 146:18 151:12,15 152:4 155:8 166:5
departments 106:14
departs 150:19
depend 54:12
dependence 44:19 61:2 120:19
dependent 135:6,16 156:12
depends 109:9 159:12 166:15
deploy 37:18 39:16
deployed 92:17 157:2,10
deploying 45:15
deployment 62:8 113:2 153:22 154:19
deposition 171:5,8,12
deputy 5:8 152:8
derecho 45:4 55:13 75:4 108:18
description 98:2
design 47:15 52:5 115:13
designed 41:4 117:18
desire 71:1
desired 41:3
desk 3:9,14
despite 164:3
destinations 51:16
detect 67:11
detection 47:4 118:21
determine 16:22 22:3
Detroit 142:15
devalue 36:11
devastation 160:21
develop 39:5 47:10 52:17 57:16 67:20 94:11 117:17 121:18
developed 46:20 47:3 48:18 52:18 118:10 149:10
developing 95:17 122:2
development 11:4 30:17 33:19 34:19 40:1,10 71:9 100:14 101:13 107:18 115:17 122:5 159:21
developments 19:19 166:8
device 47:9
DG 162:8,15
DHS 72:1

140:3,10
diagnostic 133:9
dialog 39:12 66:21 74:4,21 76:6,11 102:13 166:16
diesel 53:14
different 14:9 24:15,16,17 26:6,9 47:16 77:13 118:21 124:10,17 125:4 131:5,10 132:19 134:4 138:13 139:4 141:6 151:16 157:4
difficult 73:20 74:4 84:13 108:14
difficulty 90:9
digging 75:14
digital 156:11
digitized 143:8
dimensions 139:16
diminish 20:22 85:10
diminished 60:4
dioxide 41:10
direct 4:21 39:13 40:14 132:15
directed 151:4
direction 17:3 54:5 109:21 171:8
directions 151:8
directly 13:5 40:22 59:8 117:6 160:1
director 4:14 5:8,18 6:11 13:17 152:9 153:7
directors 44:7 85:19 105:16
directs 52:5
dirty 64:5
disable 46:12
disaster 32:11 143:10
disasters 31:14 32:3 53:20 66:21 70:12 109:1
discuss 15:3 28:22 33:18 154:11
discussed 138:19
discussing 4:6
discussion 107:8 166:16
discussions 98:14
disease 20:16
displace 90:4
disruption 35:2 136:4 137:3,4
disruptions 32:1 148:20
disruptive 147:13
distances 114:7
distinct 3:5
distinguished 26:21 27:15 43:21
distributed 102:10 130:14 134:3 144:8 146:8 153:11,15 162:5
distributes 44:10
distribution 17:21 18:1 23:11 27:17 28:13,20,21 45:11 55:16 56:2 61:16 64:2,4,7 70:13,17 100:2 116:18,22 120:6 130:12 145:8 162:10,11 165:5 168:15
distributor 147:2
District 7:5 75:5
disturbance 57:6,15
disturbances 57:18 58:2 61:5
divergent 151:16
diverse 72:11,13,19 96:11 116:19 121:8 148:4
diversify 30:4 69:16
diversity 69:20 72:8 102:6 147:7 148:2,6
divorced 144:16
Dixon 23:4
DOE 6:15 13:12 15:7 31:2 39:2 43:9 49:7 64:11,15 77:15,19 92:19 94:10 96:8 97:17 102:21 112:2 116:6 136:19 139:17 150:8 152:9 155:16 162:1 163:1
DOE/QER 104:15
DOE's 33:5
dollar 75:11,18 105:22
dollars 50:9 109:4 131:21 143:11 164:20
domain 9:1
domestic 6:2 29:1 34:6 90:20 99:17 107:13 118:17 160:3
Dominion 97:13 116:11,13 117:12 118:1 130:1 144:22
Dominion's 116:15 117:9 119:14
done 5:10 11:13 14:11,19 23:19 25:5 59:5 63:3 68:12,14 70:14 80:12 89:1,14,19 90:13,14 123:7,13 125:19 126:15 150:13 169:16
door 49:11
double 151:6
doubled 19:7
downed 108:17
download 104:13
downstream 28:11 77:8
Dr 2:4,13,21 5:5,7,16 6:5,9 8:1,7,13,15 13:17 18:15 23:9 24:6 43:21 97:8 102:14,17 124:18,19

134:17 139:8 142:4 148:11 152:8 167:15,17,20

draft 161:14

dramatically 14:20

draw 31:9

dreamy 42:13

drill 67:15 68:2,4 138:2 164:21

drilled 101:2

drilling 100:12,19 101:1,3

drills 53:21 92:15,16

Drinking 7:9

drive 71:4

driven 100:22 142:19

drives 19:18 127:9

driving 19:13 85:14 101:13

drought 16:16 160:15

Drs 7:21

dry 34:10 49:22 50:1

Duane 2:8 27:21 35:21 54:19 59:6 66:18 68:6 72:7 80:6 85:13 87:11 96:7

due 89:4 142:20,22

duly 171:5

Durbin 2:12 97:7,14,16 122:18 133:20 138:1 146:20

during 3:13 30:8 45:20 56:13 57:12 61:5 68:22 81:12 86:22 118:12 134:6

dynamic 32:20 49:1

dynamics 32:9

E

E&D 23:7

E&P 98:3

earlier 52:21 97:19 104:20 109:18 138:8,9 141:6 142:6 145:2 147:6 154:10

early 122:21 138:1 163:18

earthquake 45:3 109:12,14

earthquakes 32:2

East 1:10 104:3

echo 97:18

economic 20:20 30:16 43:2 48:9 74:20 82:17 84:7 140:1 160:13

economist 108:4

economy 15:12 19:18,20 21:15 83:1 103:3,5 125:22 136:8 139:16 148:20 156:11

economy-wide 159:9

Edelsetein 2:19

Edelstein 161:19,20,21

edge 75:13

edges 100:2

Edison 44:8

educate 32:7 164:20

education 76:21 77:4 124:6,8 165:17

educational 165:21

effect 133:14

effective 19:15 33:8 42:11 45:10 133:1 153:16

effectively 81:9 113:7 125:16 150:13 156:17

effects 136:13 142:7

efficiencies 134:15

efficiency 26:14 38:16 142:21 153:18

efficient 35:6 100:13 145:19 146:1

efficiently 46:4 51:10 92:1

effort 12:22 13:14 14:22 23:7 35:10 120:4 140:8 158:3 160:7

efforts 31:7 52:15 73:2 118:20 121:11 140:19 158:16 159:8 160:2 164:15

eggs 147:8

EIA 77:20

either 22:21 65:15 69:2 74:1 86:6 98:11

elected 85:19

electric 15:22 27:21 28:4 36:1,22 37:11,13 38:9,20 39:18 41:7 44:5,8,9,10 61:3 66:19 68:8 69:7 70:15 71:20 77:12 81:21 92:20 97:12 112:8,12 113:9 114:3 116:14,17 117:1,16 119:17 135:6,7 141:7,22 142:9,11 146:10 149:7 153:8,13 155:17,20 156:2,11 157:13,19

electrical 108:1 143:22

electricity 16:15 17:20 19:8,12,14 23:13 24:11 32:19 37:3 38:3 44:19 47:1 53:6 61:9 80:7,16 88:22 89:2 105:11 108:3,8 113:8 124:21 143:2 149:9 153:19,21 155:9 156:12 157:20 168:19,21

electricity's 135:9
electronic 132:11
electronics 63:15 113:1,15 132:12,17
element 70:20
elements 121:21
elevating 33:12
eleven 126:14
eliminate 68:17 100:8
Elizabeth 167:5
else 71:15 76:17 86:5 90:16 135:10 140:11 144:5
elsewhere 98:17 104:2
embarrassment 127:6
embraced 11:21
embracing 157:17
emergence 131:18
emergencies 31:21 53:21 118:13
emergency 31:14 32:21 45:21 53:4 81:13 92:17,21 119:22 160:16
emerging 48:12 59:21 60:20 61:1,21 132:6
emission 21:20 41:11
emissions 16:9 160:4,7 163:8
emphasize 12:9 14:14,21 18:5 62:11 145:11
emphasized 149:3
employed 110:3 171:10,14
employee 171:13
employees 112:13 164:21
employment 82:19 110:2
enable 32:20 33:20 114:5 149:20 156:19 162:12
enabler 48:9 132:13
enables 153:16
enabling 63:20 154:2 158:1 162:15
encourage 33:19 62:7 63:7,11 71:6 72:9 73:7 77:16 89:3 96:11 150:14 167:12
encouraged 30:15
encouraging 90:20
endeavor 19:4
endorse 72:7 166:19
Energetics 3:3 169:15
energized 37:7
energy 1:5,6 3:4,20 4:8,15,22 5:1,4,22 6:9,10,12,15,19 7:3 8:4,5,20 9:8,12,13,14,16,18,19 10:3,5,16,17,22 11:5,11,18 12:1,8,16 13:3 14:2,8,16 15:9,12 16:2,13 18:17,22 19:1,4,6,10,11,20,22 20:3,4,11 21:1,11,13,15 22:2,6 24:22 27:7,16,19 29:7,22 30:5,16,18 31:3 33:6,22 34:16 35:6 38:7,14 42:9,22 43:9,22 48:11 50:11,15 51:13 62:14,17 70:7,17 71:19 72:12 77:19 81:17 88:14 93:4 94:10,11 97:22 98:8,22 100:9 103:1,16,17 104:16 105:1,21 106:13 107:21 108:22 109:16 110:19 111:20 112:11,14,21 113:8,12,15 116:2,7,17 117:11 119:5,6 121:15,21 122:6 124:7 127:8,13 132:13,16 137:17 140:8 141:8 146:18 152:4,9 153:11,17,18 155:8 157:22 158:9,18 159:1,15,19 161:2,12,15 162:9 163:11 166:5 168:19
energy.gov/QER 169:3
energy-hungry 107:10 108:7
Energy's 4:15
enforceable 39:21
enforced 46:7
enforcement 79:16,22 141:2
engage 15:5 18:21 79:11
engaged 79:21
engagement 11:16 157:11
engaging 35:8 52:14
engineering 10:11 44:12 57:17
engineers 82:20
engines 162:7
England 16:7 17:19 162:19 168:4,11
enhance 32:16 40:12 45:16 154:4 158:20
ENHANCING 1:5
enjoy 37:17 153:13
enjoyed 157:16
enormous 14:2,7 16:18 64:14 75:17 82:22 109:16
ensure 13:5 34:14 37:19 55:18 62:9,18 117:10 118:9,11 156:15

157:11 163:10
ensuring 164:17 166:18
entail 14:18 17:7
entertain 22:11
entertainment 63:17
entire 79:1
entities 81:14 157:4
entitled 156:1
entrepreneurial 29:4
entrusted 164:16
environment 9:2 14:2 32:21 51:19 76:16 93:21 94:13,21 95:7 139:22
environmental 7:7 14:8 15:14 127:22 130:6 141:9
environmentally 153:20
envision 107:12
envisioned 10:18 12:14
envisioning 15:4
EPI 54:3
EPRI 153:9 154:6,12 155:6
EPSA 14:19 24:1
equal 151:19
equate 54:17
equation 60:15
equip 62:4
equipment 56:10,11,12,21 58:2 63:2,5 90:7,8 91:4 112:17 115:21 118:6 132:21,22 133:11,12 149:15 155:20
equipped 121:22
equivalent 62:9 110:6
era 100:3
Ernest 2:5 6:9
Ernie 10:13 13:18
error 56:19
ESC 39:9
ESCC 38:20 73:3
especially 15:14 162:19
essence 99:11
essential 11:20 51:5 60:22 89:6 122:4 140:22 156:21
essentially 98:19 133:12
establish 10:15 48:18 154:13
established 9:17
esteemed 96:19 152:4
Esther 24:21
et 24:3
evaluate 52:8 72:17
evaluated 83:20 119:19
evaluating 52:1
evaluation 86:9,10
event 49:7 56:6,9 57:10,12,19 92:21 114:20 115:15 125:18 133:14,15,17 136:4 137:10
events 16:12 20:17 31:6 32:5,11 33:4 41:1 44:22 48:2 55:9,11,15,16 56:4,5,13,14 57:4,8 59:12 64:1,10 80:15 81:18 108:19 109:5,12,16,19 111:8 115:10 120:15 127:17 136:1 156:5,16,22 157:7 160:18 161:16
everybody 35:16 57:11 107:6 134:21 135:10
everyday 142:9
everyone 3:2 4:19 34:20 93:3 125:8 131:7 151:13 170:3
everyone's 165:7
everything 35:5 105:6 160:19
evolution 82:15
evolve 15:18
evolved 66:7 80:8
evolving 46:15 145:19
exactly 21:11 109:7 138:3 143:20 144:20
examination 18:22
examine 20:4
examined 20:10
examines 153:10 155:17
examining 20:5 154:16
example 30:5 39:9 66:15 76:11 100:16 126:11,12 134:22
examples 24:15 79:12
exasperating 161:7
Excellence 52:22
exchange 3:22
excited 113:16
excluded 125:17
exclusion 126:6
exculpating 78:20
executive 9:7 11:1,11,14 13:12 14:18 28:10,12 46:21 61:18 122:15 123:1 140:9
exercise 41:14,21 67:16
exist 36:16
existing 25:21 32:7 36:10 48:14 50:14 120:13,21 134:12

147:13,14 160:5
exists 91:14
expand 121:11
expanded 48:15,17 80:14 138:11
expanding 14:20 47:6 50:13
expansion 15:21 159:20
expect 23:17 25:5
expectations 84:9,10 166:14
expected 29:11
expeditiously 32:13
expensive 91:18
experience 4:4 28:14 37:9 40:15 42:20 66:9 67:17 105:3 106:8
experienced 45:3
expertise 44:13 46:17 71:1,4 103:19 137:8
experts 9:6 12:17 39:22 53:1 78:18
expiration 110:17
expires 110:18 125:12
explain 124:15
explicit 48:1
exploring 113:18
explosive 47:9
export 34:4 99:8 107:14 159:21 160:1
exporting 72:16 107:17
exports 34:5,10
exposure 105:14 106:9 115:5
exposures 105:10 106:3 110:2,7 126:11
extended 76:4
extension 125:12
extensions 125:11
extensive 52:3,15 105:3 116:20 146:19 152:13
extent 74:6 85:8 126:22 140:4
extinction 20:18
extraction 105:6 110:4
extraordinary 13:13 76:4 143:18
extreme 16:11 20:17 26:5 55:2,11 57:8 156:22 160:18
extremely 68:4 80:4 106:12 137:7

F

face 9:8 20:3 25:5 37:8 38:9 44:14,18 46:14 52:8 85:21 94:12 164:4,5
faced 25:6
faces 163:20
facilitate 113:2 169:17
facilitates 114:14
facilitator 3:6
facilities 30:13 37:19 41:15 51:11 94:17 110:10 114:5 116:22 117:3,22
facility 72:5 135:21
fact 6:20 37:21 73:19 74:5,11 83:20 87:22 110:1 135:19,22 158:21 165:22
fact-based 55:4
factor 70:18 158:22
factories 113:11
factors 26:9
factory 113:20 114:1,9
facts 4:5 29:7 96:12
faculty 6:6,13
fading 89:8
fail 41:22
failed 41:2
fails 133:12
failure 56:21
failures 56:15
fair 122:3 131:7
fairly 46:4 83:17 84:2
fall 41:14 60:1 68:19
falling 142:20
falls 124:9
familiar 125:8 139:9
families 38:6
farms 146:2
fast 141:14
faster 81:15 143:16
fastest 129:4
favorable 121:18
FBI 40:22 78:9
feasibility 155:3
February 56:8,17
federal 4:11 10:16 17:1,6 19:6 33:18 47:20 51:7 52:4 66:7,13 67:7 74:7,22 88:11,15,18 93:13 111:20 119:6 121:10 127:1,11,20 129:21 131:21 132:3 135:1 137:19 138:20 140:7,16,21 141:3,5 151:1 158:17
federally 47:3
Federation 158:11,21 159:6
feel 27:12 67:4 84:12
feet 34:9,11 143:16
FERC 40:2,11 47:9 51:2 59:3,5 62:16 65:21 78:17 83:13 87:4 118:2 129:5

139:2 144:19
FERC's 57:14 117:12
fewer 100:15,16,20
fifth 58:12
figure 64:4
file 151:13
fill 61:20 77:8 122:16
filled 160:17
filling 88:12
final 88:8,10 146:17,22 150:11 168:20
finalize 154:12
finally 7:1 30:11 63:21 90:6 91:21 120:16
financial 83:7 131:1
financially 131:4 171:14
financing 48:18
findings 24:9
finds 78:2
fire 130:9
fired 145:20
firm 62:21
first 1:10 5:14,16 8:18 12:7,12 17:14 25:22 27:1,14 30:8 31:4 37:7,21 40:13 42:7 49:7 53:22 57:20 73:10 83:10 88:20,21 97:17 112:10 115:10 116:8 118:15,16 122:10,20 132:7 149:2 153:4 154:7 167:12
fit 77:5 91:13 139:18
five 17:16 19:8 22:13 26:18 35:17 72:14 94:18 95:3,19 96:1 103:7 104:22 107:12 114:12 146:13 148:3,4 168:9
five-year 55:10 56:15 64:1
fix 148:8
fixing 52:12
flat 83:22
flawlessly 126:14
fleet 116:18 121:8 143:1 145:9
fleets 130:7
flood 56:1 120:15
flooding 53:12 120:12
floods 32:3 156:5
floor 3:12 22:21 97:15 167:14
Florida 56:17
flow 48:16 50:14
flowed 145:16
flowing 124:22 128:22
flows 54:7
fly 68:2
focus 12:13 18:2 23:6,10 24:14 27:18 32:6 58:20 70:9,17 88:7 113:4 115:4 118:19 162:2 163:18 168:21
focused 12:2,8 13:3 18:9 25:17 57:1 80:10 81:10
focusing 38:16 53:2
folks 3:15 23:5 68:11 122:21
food 160:13
forbid 148:21
force 5:22 6:1 31:3 42:15 44:1 61:18 71:8 73:7 122:12 150:8
forced 94:21
forecast 30:9,10
foregoing 171:3,5
foregoing/ attached 172:6
foremost 31:4
forge 10:16
forget 145:4
forgive 51:9
form 48:6 112:15
Formation 17:19
formed 10:9
former 9:14
forming 159:1
forms 18:7 48:2 89:21 118:21
formula 83:15 144:19
for-profit 38:15
Forrestal 152:7
Fortunately 121:6
forum 3:22 44:2 95:16 102:20 112:2
forward 11:1 12:22 18:11 35:8 43:10 54:16 72:9,11 89:15,22 98:13 99:10,13 100:6 102:11,13 107:9 112:3 116:1 122:7 124:16 134:14 137:2 143:7 155:6 159:10 161:9 166:7
fossil 21:4 23:12 161:3 163:1
foundation 32:15 85:15 100:6 101:15
foundational 63:20
fourth 6:22
fracking 163:6
fracturing 100:12
frame 98:20
framework 32:12 46:20 154:14,16
frameworks 94:4
frankly 25:20 98:5
free 14:10 27:12 33:21
frequency 60:7 62:5 89:12
fresh 59:2

Friday 1:7
friend 8:18 14:1 18:13
friends 49:8
front 61:2 66:22 82:22 95:20 96:4 151:7
frontiers 111:4,5
fruit 144:3
fruited 79:2
fuel 21:5 25:18 32:13 34:22 49:22 53:14 61:4,9 64:13 65:9 72:19 92:11,14 102:7 108:9 116:19,20 142:21 147:7 148:2,5 149:5 162:7
fueling 156:10
fuels 16:14 23:12 24:12 53:9 54:11 161:3
full 97:5 128:17
full-fledged 12:7
fully 63:7 154:5
fund 163:5
fundamental 9:4 103:4
fundamentally 131:9
funding 136:19
future 9:17 14:9 16:21 18:3 19:21 20:4 21:3 43:5 69:18 70:1 74:18 76:13 82:9 88:22 107:15 112:3 145:6 155:6,9 158:14

G

gallon 50:2
game 58:18
gap 71:5 88:13
gaps 61:20 122:16 154:14
gas 15:19 16:6 19:12 28:18,20 29:1,5,9,17,19 30:2 31:12,15,19 32:1,14 33:3,19 34:4,10 49:19 61:3,7 62:16,17,21 64:22 65:16 68:20 69:1,5,8,19 71:21 72:12,13,16 77:13 80:17 81:3 92:7 97:8 98:3,6,12,19 99:2,8,19 100:4,8,14,18 101:4,5,7,20,22 104:6 107:13,22 108:11 109:22 110:3 115:17 116:21,22 120:19,20 121:11,20 123:17 130:9 138:19 142:20 143:1 145:19 147:3,8 148:5 156:8 157:4 160:4 161:21 162:3,7,10,14 163:2,3,5
gas-driven 162:7
gaseous 23:12
gasoline 50:3 53:13
gathering 23:16
general 32:8 65:10 124:5 129:13
generally 141:8
generate 19:7,14
generated 114:6
generates 44:10
generation 58:13 60:10 99:6 102:10 105:10 108:1 116:18 120:19 121:1 129:8 130:7,9,15 134:3 135:21 144:8 145:9 146:8 147:2 153:17,19 162:6
generations 113:2
generators 33:17 56:10 70:15 134:12
gentleman 128:12
gentlemen 128:12
geography 47:14 102:6
geological 109:11
geomagnetically 115:9,12
Gerry 2:11 28:3 54:13 61:20 66:17 67:15 91:6,11
Gerry's 81:1
gets 130:20 150:13
getting 25:7 27:3,7 57:21 59:10 60:15 62:12 81:15 100:15 101:5 102:19 153:2 166:8
giant 8:22
GIC 115:13,14
given 35:13 83:20 117:21 171:9
gives 37:10 42:2
giving 7:19 99:7 119:2 151:8
glad 124:22
global 21:20 28:15 30:18 103:17,18,22 104:18 106:21 107:20,22 112:12
GMD 57:13 59:17
goal 52:11 160:21 161:14 165:7
goals 22:1 31:4 131:20 141:12 157:14 158:18 159:16
God 148:21
gone 68:19 100:17
Goo 169:22
goods 50:2
govern 128:15
governed 42:12
governing 165:4
government 8:3 11:16 17:1,7 30:22 31:20 32:18 38:21

39:4,10,16 41:1 42:15 46:16 48:19 50:21 53:15 54:1 59:8 65:2 66:7,14 67:7 68:11 72:22 78:2,8 79:11 80:10,19 81:14 87:21 88:11,15,18 90:19 92:1,10,15,22 93:14 99:18 111:20 119:12 121:16 122:1 124:4 126:12 127:11 132:3 137:16 138:14 139:4 140:16,22 141:5

government/ industry 119:8

governments 76:21 81:12,19 120:1 137:20

grandchildren 22:5

grandkids 94:17 95:5,18

granted 37:12

grants 51:10

grateful 37:6 166:4

gratitude 7:18 13:22

graying 70:21

great 39:9 49:13 65:19 66:8 78:1 104:11 140:16 141:15,16 144:2 149:11 166:20

greater 38:3 51:14 64:8 69:21 148:20 156:20

greatest 103:14

greatly 119:4

green 163:6

greenhouse 160:4

grid 36:10 37:13,17 39:12 40:12 41:4,6,13,18,21 42:1,3,5,7 44:9,13,14,16,20 45:7 46:4,7,12 48:8,11 49:1 54:21 55:6 57:17 58:10 59:1 60:9,20 63:13 78:20 79:17 82:9 86:6,12 88:22 89:11 90:4 91:7 94:15 95:12 110:14 112:16,22 113:6,8,10 114:3,21 115:5,16 118:9 119:7 128:16,18 129:8,14,22 130:5,10 131:2,4,6,8 132:16,18 134:10,13 135:4,12 136:7 137:6 139:15,19 141:20,21 142:3 143:5 144:9,17 145:12,14 146:10 149:7,15,16,18,21 150:2 153:10,16 154:1,6,8,18,20 156:2 157:9 162:9 166:18

GridEx 41:13 67:15

Grid-related 156:18

grid's 117:13

GridWise 155:14,18,22 158:2

grocery 157:5

ground 42:2 76:8,12

group 4:7 10:10 23:22 97:11,20 112:7

grouping 49:13

groups 52:17

grow 48:5

growing 50:11 101:12 120:18 133:16 160:12

growth 48:9 83:22 104:20

guaranteed 87:5

Guatemala 36:21 37:4 42:20

guess 54:18 133:20

guests 23:1 26:21

guidance 57:14

guide 16:21

guidelines 72:3 154:17

guiding 17:1

guise 75:9

Gulf 33:10

gunfire 47:8

Gustav 33:11

guys 71:15

H

half 100:17 116:14 120:7 126:15

Hampton 117:4

hand 7:19 73:15

Handbook 65:1 92:8

handle 42:8 121:22

happen 85:7 96:16 106:10 110:12 123:4 136:5 138:4 149:18

happened 109:13 119:18 137:6 147:17

happens 12:10 85:1 148:22

happy 22:14 49:3 122:18

hard 13:16 56:19 91:17 138:2 159:7

harden 115:7 130:10 142:3,5 166:10

hardened 119:20

hardening 33:1,5 45:10 132:21 141:20

harm 59:1

harming 64:3

harmonize 47:15

harness 33:20

Harrison 2:17 155:12,13,14
Hartford 168:8
Hartwig 2:13 97:9 102:15,17 124:18,19 134:17 139:8 142:4 148:11
Harvard 6:6
harvest 50:1
haven't 57:3 70:19 89:19 109:12 142:14 146:21
having 11:22 14:21 31:6 62:12 66:10 70:15 74:21 90:12 98:6 100:18 102:20 133:7 140:20
hazards 44:14
headed 126:1
health 7:6 43:1 160:12
healthy 100:21
hear 6:8 7:1 9:5,10 13:5 35:19 77:21 81:5 95:22 151:16,22 159:3
heard 11:13 25:6 61:12 70:5 71:12 73:1,3 78:1 79:9 102:21 104:9,20 107:8 108:11,15,20 110:15 111:10 122:20 126:20 131:17 135:22 137:12 149:4 151:14
hearing 48:1 171:3
hearings 78:15 151:22
heart 9:2
heartland 159:22
heat 20:15 45:4 49:22 102:9 134:4 162:5
heavily 24:4 51:21
heavy 93:10
heighten 118:6
heightened 42:5
held 84:22 89:11 168:5
Hello 158:7
help 11:2 22:6 34:17 58:14 59:11 77:4,15 78:3 80:3 81:16 88:5 100:1 102:8 106:17 107:3 110:10 113:5 124:5 138:5,13 162:8 169:16
helped 34:14 78:3 100:8 119:4 125:14 143:15 159:11 169:17,22
helpful 4:1 136:16
helping 5:2 64:8
Henry 2:6 7:2 13:22 14:11
hereby 171:3 172:2
here's 138:3
hereto 171:14
herring 147:10
he's 6:21 43:16 102:16 144:20
high 20:21 37:11 81:20 84:10,11 95:7 112:14 113:12 114:4 129:7
higher 38:10 69:4,5
highest 37:20 110:4 114:2
high-level 63:13
Highley 2:8 27:21 35:19,20,21 68:7 78:5 85:17 90:17 94:5 149:2
highlight 79:13 123:9
highlighted 33:4 156:3,6
highlights 60:1
highly 60:17 100:13 145:19 161:9
HIGLEY 94:7
Hill 7:11 49:9
historic 160:6
history 14:12 103:1 107:2
hit 80:6 142:15 143:13
Hoecker 167:6
hold 35:12 151:7
HOLDEN 23:9
holding 17:15 80:11 112:2
Holdings 44:4
Holdren 2:4 5:5,17 6:5 7:22 8:1,7,13,15 15:2 18:15 24:6 43:21 167:20
hole 75:15
holistically 135:11
homeland 39:3 78:9 139:11,20
homes 49:22
honor 3:5 152:3
Honorable 2:6
honored 23:1 97:6
hope 18:8 26:7 66:15 92:1 161:10
hopefully 67:2 96:15 107:14 111:18
horizon 111:3,15
horizontal 100:12
hospitals 134:7
host 117:4
hosted 41:14
hosting 43:9 94:10
hotspots 104:7
hours 77:9 103:10 143:19 169:13
house 5:5,19,22 6:3 7:3 13:4 39:4 78:10 95:21 97:17 116:6 118:8 143:22 146:17 150:8 151:15
housekeeping 3:10
hub 121:4
Huehuetenango 36:21

huge 69:7 101:8 104:17 107:17 145:17

human 43:1 56:19 70:20

hurdle 63:9

hurricane 33:7,15 45:4 53:7 55:11,12,14 66:9 87:16 108:16 164:1

hurricanes 32:2 33:11 64:18,20 109:3,8,18 160:18

hurts 127:6,7,8

hydraulic 100:12

I

ice 156:6

ICF 34:8

I'd 13:21 27:2 61:16 67:1 86:8 102:19 113:4 116:5 117:8 127:19 131:22 134:5 137:15 150:7 169:18

idea 9:11 95:2 133:7 147:1

identified 10:13 31:5 147:16

identify 11:3 33:17 52:10 80:20 138:5,16 158:17

IH 30:17

II 41:13

Ike 33:11 55:12

I'll 5:15 14:13 23:20 24:6 28:6 49:3 59:16,19 61:9 66:5 73:10 75:3 82:8 84:3 88:20 96:2 102:13 103:11 117:11 121:13 124:17 132:6 134:17 142:4 162:2,4

I'm 3:3 5:13,14 8:20 9:9 12:22 13:14 18:18 21:15 22:9 26:19 28:15,22 35:21 36:5 41:21 43:13 44:3,6 49:16 76:18,20 77:14 104:14 108:4 112:6 116:11 122:9 124:22 125:9 138:12 139:9,10 146:14 147:20 151:17 155:14,15 158:10,18 163:14,15

immediately 41:22 45:9 150:21

immense 9:3

impact 21:2 31:15 41:10 72:15 74:6 75:15 76:4,10 83:1 142:2

impacted 32:11

impactful 45:9

impacting 64:2

impacts 20:14 42:1 45:8 55:14 74:20 119:19 156:13 159:13 160:20

imperative 44:20 46:15 160:19

implement 117:20 141:14 158:17

implementation 11:5

implemented 64:15

implementing 11:22

implications 16:12

implied 25:20

importance 18:5 53:17 117:21 141:19 146:11

important 8:22 9:7 10:14 17:3,4 18:8 26:10 36:7 38:5 44:2 50:21 65:3,6,21 71:18 76:22 77:4 82:3 91:9 92:15 93:1 98:13 101:11,20 110:5 114:10 123:3 129:19 130:18 131:3,11 137:7 143:7 146:15 150:9 157:10,21 158:22 162:16,19 163:9 166:7

importantly 15:13

importing 107:16

imposed 32:10

impressive 49:7

improve 32:21 33:22 36:17 38:22 39:4 52:15 76:3 79:3 81:13,18 86:6,12 157:5,15

improved 56:12 119:21

improvements 119:22 120:3

improves 115:19

improving 33:14 44:16 51:22 156:2

inadequate 120:22

inadvertently 128:11

Inc 27:22

incent 51:2 84:17

incentive 86:14,21

incentives 62:7 83:7,8 86:4 87:9 106:5 129:5,9 131:1

incident 35:7 58:17 59:9 165:1

incidents 33:10 40:17,19 79:15

incline 83:21 84:1,4

include 31:22 33:12 34:1 45:10 47:7 112:14 161:14

included 31:17,18

includes 72:11

including 10:7 12:18 13:15 18:2,5 32:14 111:8 115:16 117:3 122:6 127:8 155:19

156:8,18 160:14
incompatible 159:15
incorporate 44:15 130:10,14
incorporated 157:12
increase 45:14 46:1 101:10 128:18 129:10
increased 29:14 44:19 98:5 107:14 115:4 121:5 142:21,22 160:17
increasing 45:1 61:2 100:21 108:10 109:5 146:11 156:7,13 160:7
increasingly 92:4 108:7 142:13,19 143:8 156:12
incredible 37:9 42:21 97:20 98:20
incredibly 131:11 150:9
indeed 8:20,22 13:14 23:10
independence 45:22
independent 45:20 98:3 99:17
indicate 16:22
indiscernible 36:8 69:11 93:16 148:16
individual 3:19 4:4 47:2 79:21 117:19 148:1
individually 77:22 79:13 130:16
individuals 4:10
induced 115:9
inducted 115:12
industrial 113:14
industries 32:19 71:2,5
industry 11:18 28:14,18 29:5,21 30:2 31:12,15,19 32:8,9,17 33:3,6 35:3 38:22 39:19 40:14 42:9 46:16,18 52:15,21 57:16 58:5,9 59:8,11,15 62:18 63:3 64:22 65:1 66:7,12 67:1 68:12 70:7,21 72:21 79:11,16,17 80:9,19 81:20 82:4,16 87:21 88:16 92:7 93:4,11 101:22 102:1 103:1,4,15 110:8,19 111:20 116:17 118:17 121:15 124:10 125:5 127:7 132:4 140:15,20 164:19
industry's 29:2 33:8 93:8 121:11
industrywide 52:17 54:5
inertia 60:6
inevitable 42:2
influenced 24:4
inform 164:14
information 3:22 4:3,5 32:7 39:5 45:18 48:16 59:10,13,14 67:6,9 68:7,13 71:14,17 73:8 97:10 119:9 121:14 140:17,20 156:9
informations 48:1
informative 122:8 167:11
informed 32:20
infrastructure 1:5 3:21 9:8 12:9,14,16 16:4,9,13,22 17:18 18:22 19:2,22 21:5,7,13 24:11 26:14,17 29:2 30:4,18 32:9 34:3 39:7,20 45:13,14 46:14 50:10,15,19 51:3 54:18 61:15 69:8 74:14 84:1 93:9,17 94:20 98:9 100:1 101:6,13,14 107:18,19,21 109:17 112:14 118:2,8 119:21 120:12 121:19 122:2 123:19 127:13 141:8 144:1 147:15 148:8 150:5,6 155:18 156:9,10,11 157:21 159:1 161:12 163:20 164:8,10,22 165:16 168:3,10,16
infrastructures 26:7 156:8
infuse 149:19
inherent 60:8 137:18
Initially 40:18
initiated 57:14 166:1
initiative 6:12,15 47:13 52:22 139:9
initiatives 46:19 115:16
inning 8:9
innovation 10:3 100:11 101:1 157:17
innovative 107:3 166:18,22
input 3:19,20 11:18 12:15 18:7,11 49:3
insights 23:17
inspecting 52:2
inspection 53:2
inspections 52:10
inspiring 158:13
installations 117:5
installment 12:8
instance 47:20 128:14 129:6 133:8

instead 38:17 107:15
Institute 28:16 44:8 52:19 97:10 153:9 161:21
institutes 155:22
insulated 115:17
insurance 90:12 97:9 103:2,15 104:17 110:8,18 111:2 125:5,7,14 127:14,19 128:2 139:21
insure 110:9 123:11
insured 143:12
insurers 106:11,14 108:15 127:9
intact 53:11
integrate 113:7 144:14
integrated 10:21 16:19 23:15 153:10,12,16,19 154:6,8 155:3
integrating 147:5 150:1
integration 46:22 132:10
integrity 33:14 114:21
intellectual 71:3
intend 59:4
intended 11:15 133:6
intensity 45:1
intentional 40:14
interaction 81:11
interactions 81:19
interagency 5:3
interconnected 136:6 145:15 157:19
interconnectedness 136:12 142:7 143:4
interconnection 154:3,17
interconnectivity 70:16
interdependencies 16:14 26:6 32:10 156:14
interdependency 156:7
interdependent 32:18
interest 4:20 57:9 93:11 161:6
interested 27:7 171:15
interface 157:8
intergovernmental 20:7 160:10
interim 70:15
intermediate 10:21
intermittence 60:13
intermittent 60:3 89:21 132:15
international 34:8 127:6
internationally 72:16
interrupt 151:9
interruption 41:3
interstate 114:13
introduce 4:13 5:13,16 22:21 23:3 152:3,8,19
introduced 148:16
introduction 60:18
intrusion 47:8 118:21
invaluable 62:14 79:15 89:20
invasion 29:3
invest 54:9 63:9 86:21,22 90:10 93:12 94:18 131:1
invested 30:8 113:9
investing 51:21 63:12 88:4,5 102:1 104:21 144:18,22
investment 16:21 30:6,9,12,19 38:10,13 44:20 48:19 63:10 69:8,13,17,20 74:12 75:18,21 83:9 84:1 87:20 94:1 101:14,19,21 107:20 113:21 114:17 122:4 154:20 159:2
investments 17:2,5 21:9 29:18 30:3,14 34:4 42:13 48:5 93:9 95:4,6 113:5 144:20 145:7,10,12 166:11
investor 44:9 165:5
invests 90:10
invigorated 19:9
invitation 97:18
invite 27:2 96:10
invited 27:10 151:20
inviting 18:16 35:9 112:9
involve 155:1
involved 26:2 31:6 66:1 80:10,18 91:13 106:16 140:7
involves 17:12,13
iPad 69:12
Irene 45:4 55:12 108:16
island 134:9 168:5
isn't 73:6
ISO 59:22 155:22
issue 16:8 35:8 52:13 54:20,22 55:1 59:3 64:18 72:8 76:9 80:16 82:9 83:3 84:6,7 91:15 103:16 105:8 111:9 138:21 139:13 142:6 147:7,16,20 150:6
issued 8:2 47:9 72:2 118:3 156:1

issues 7:7 14:3 17:21 18:1,10 25:18 26:2,3,5 34:1,14 43:11 47:19 48:4 53:2 55:17 56:2 70:13 72:15 80:20 84:12 91:7 92:7,13 96:4 126:19 127:22 128:1 137:17 148:9 165:13 168:17,21

it'll 168:6,9

it's 7:18 16:13,15 23:9,13 24:5,6 38:7 40:4 42:17 43:5,13 51:5 56:9 58:18 64:8 65:5,20 66:22 68:5 73:20 79:18 82:6,7 83:4,19 85:3 86:4 87:5,19 88:11,19 90:3 91:17,19 92:15,19 93:10,11 95:13 99:4 100:9,10 102:17 103:2 104:3,4,5,19 105:2,5 107:6,9,20,22 108:13 110:4 111:12 114:8 121:16 124:11 126:2,14 127:2,5 129:19 130:18 131:3 132:12,13 134:2,11 135:7 137:13 138:2,21,22 145:15,19 147:4,10,20,21 150:5,9,10 151:18 165:8 167:6

I've 25:6 36:19 43:5 57:4 77:22 82:4 90:2 122:22 147:22

J

January 121:3,8 126:6 147:17

Japan 109:14 113:11

Jersey 53:14

Jim 167:5

job 5:10 42:17 57:2

jobs 30:21 82:12,14 99:3 118:17

Joe 2:9 43:13 44:3 55:22 59:6 66:4 71:19 72:22 73:8 80:6 83:3 87:11 93:19 144:18

John 2:4 5:16 13:20 14:12 15:2 27:22 43:13,16 73:11 152:14 169:19

join 26:20 27:2 96:19 150:16 170:1

joining 6:7

joint 59:22 79:18

Jose 115:3

jot 27:5

journey 154:5

jump 73:10 94:5

June 159:3 161:4

jurisdictional 48:3

Justin 167:8

just-in-time 61:3 136:6

K

Karen 2:21 5:7 7:13 13:17 25:15 152:8,15

Katrina 53:7

keenly 35:1

Kenderdine 2:3 4:14,18 13:16 22:12,19 25:10 26:12

key 10:20 21:16 35:4 53:2 70:18 80:20 93:22 119:12,22 132:13 140:19 154:15

Keystone 34:2 51:16 161:5

kids 69:18 94:16 95:4,18

kinds 56:3 106:6 124:20 127:13 129:3

knitting 26:8

knocked 53:7

knowledge 39:18

L

labeled 14:3

labs 155:21

lack 157:21

lacking 61:7

land 36:4

lands 159:12

landscape 15:9,11 98:21

lapse 148:21

large 10:5 11:19 12:18 51:13 58:2 60:5,10,11 90:21 114:5,8,15,16 121:7 133:5 144:9 145:21 146:1,6 156:5 157:6

larger 90:5 136:8 157:9

large-scale 56:14 59:20 63:5 156:16

largest 63:22 105:2 113:22 117:4 143:10 149:7 158:12

Larry 169:20

last 6:11,18 12:5 16:5 20:7 40:17 41:14 50:17 58:7 60:1 62:3 78:7 80:6 94:18 100:17 112:18 113:20 118:4,10 128:13 141:18 143:9 146:15 148:16 156:1 159:3 161:4 167:6

lastly 70:19

late 130:2

later 49:4 70:10 75:11 104:15

latest 31:13 37:18

160:9 162:20,21
latitude 117:19
laudable 160:2
Laughter 43:19 73:13 116:10 123:22 125:2
launched 52:22 165:20
law 79:16,22 141:2
laws 52:4
Lawson 167:2,3
lawsuits 105:18 126:22
lay 10:20 75:1
LDCs 98:9
lead 29:6 31:13 159:5
leader 7:6 11:13 34:16
leaders 39:13
leading 20:10 44:21 75:13 98:3,18
leak 53:3
learn 113:11 166:20
learned 33:4 64:11,20 67:17 156:4
learns 78:2
leasing 159:20
least 85:2
leave 22:4 74:16 102:13 141:4
led 5:5 8:1 10:10 15:11 149:8
legendary 14:10
legislation 47:20 67:5 71:13 78:12,16 79:6 128:8,10,21 129:3
legislations 81:6
legislative 11:8 61:19 122:15
legislators 9:1 78:8
lend 25:8
less 148:4
lessons 33:3 64:10,14 156:3
let's 72:20 83:21 123:6 126:2
level 28:15 29:22 53:1 64:2 71:1 74:7,9,10 80:19 82:7 83:13,14 84:10,11 86:17 102:2 127:2,3,21 129:21 135:1,2 141:3 145:8 157:18 160:22
levels 31:20 32:18 33:18 80:10 137:16 138:13 139:4 157:16
leverage 46:16
Levi 169:20
liability 47:22 105:15 106:3 119:10
library 25:14 154:10,22
life 21:10 94:1 128:1
lifetime 17:5
lifting 65:8
light 30:4 33:3 124:19 130:4
lighting 150:22 151:4
lights 89:8 130:4 164:2,22
likelihood 127:16
likely 126:6 142:12 167:22
limit 160:4
limitation 166:3
limited 126:8
limits 105:22
line 28:7 38:13 40:13 49:9 75:14 163:1
linemen 36:21 37:5
lines 28:3 37:2,7 40:21 45:12 50:13,14 79:1 108:17 120:6 129:11 142:12 143:14
liquid 23:12 49:17,21 50:5,16 51:2,20,22 52:21 53:5,19 54:9 64:19 65:11 86:20 87:3
liquids 49:20 51:13,14 53:6 65:16 101:4,20
list 67:21 80:21 89:13
listen 64:6
listening 12:22 152:5 167:22
litigation 126:22
little 3:11 5:6 36:9 40:17 72:20 73:5 76:14 78:6 80:21 91:6 93:19 101:9 104:15 115:1 125:4 134:17 142:1 145:16 162:10
live 36:18 96:3 152:6
lived 38:2
livelihood 160:13
lives 36:17 76:5
living 48:10 100:3
LNG 34:9
load 57:11 146:5
local 37:1,6 47:16 53:12,16 76:22 79:22 81:12 86:17 116:22 120:1 137:20 141:2 152:10 153:17
locally 76:20 112:20
located 63:4,5
location 47:8,14
lock 49:11
locking 21:7
logistical 114:10
long 38:2 52:12 61:7 89:22 94:1 114:7,17 144:15 161:14
long-assumed

100:9
longer 41:12
long-lived 87:3
long-term 10:22 91:21 92:5 93:22 94:20 95:8 104:20
longtime 7:4
loss 109:1 128:1
losses 108:21 143:12
lost 57:11 65:7 130:21
lot 17:9 23:16 42:4,14 57:15 58:3,8 64:6,10 67:17 70:14 76:7 77:10 79:2 86:18 87:18,20 90:13,14 96:10 100:8 105:13 107:8 108:11 110:1,7,15,16 111:10 124:7,9 126:22 130:6 131:18 133:21 134:11,19 137:13 141:6 144:4 146:7 149:17 150:13
love 35:18 152:21
low 20:20 114:6 149:5
lowest 38:8 149:9
low-hanging 144:3

M

machine 114:22
machines 60:5,11 90:5
macrogrid 91:14
magnetic 57:15,18
main 55:14
mainly 17:2
maintain 51:21 54:2 157:15 164:21
maintained 127:1
maintaining 53:18 139:21
maintenance 52:2,11
major 14:13 16:12 24:10 33:10 57:4,5,6 109:12,14 114:12,16,19 120:8 121:21 135:14 137:3 143:10 159:1 161:12
majority 30:7
makers 18:21 32:7 46:3 124:7,12 127:20 130:18 131:3 150:14
malware 118:22
manage 5:3 38:14 55:1 58:15 118:9 156:14 157:8,22
managed 58:5 59:18 96:12
management 45:17 53:3,4 105:15,19 106:14 107:4 127:15
managers 106:12
managing 5:2 57:2 152:12
mandate 42:15
mandatory 39:20 40:3,9 58:12
manipulate 46:12
manmade 115:6
manner 35:6 83:17 153:16
Mansueti 169:20
manufacture 50:1
manufactured 114:4
manufacturer 90:21 118:14
Manufacturers 71:7
manufacturing 19:10 91:3 99:4 112:19 114:18
map 8:5 10:19 95:3 158:17
March 57:18 117:14
marine 105:9
market 19:13,17 32:9 33:21 62:7,20 77:14 83:8 85:5 106:20 125:18,22 126:8 139:21 147:13
markets 105:1 125:15
Marty 2:12 97:7 122:17 133:18 150:4
mass 20:17 36:4 142:14
massive 164:1
match 50:15 83:16
materials 99:1
Matt 152:16 169:19
matter 38:1 39:22 69:15 78:18 106:1 147:4
matters 69:11
maximize 157:2
Maxine 10:11
may 6:10 7:10 40:3,11 45:8,19 46:2 48:3,7 55:9 95:2 109:6 118:1 126:3 135:17 136:4 153:3
maybe 73:14 74:8 83:22 91:5 96:7 103:6 109:9 125:8 134:17 142:4
mayor 75:5
McGovern 152:16 169:19
mean 12:10 25:20 82:6,20 83:18,19 89:6 96:4 139:12 149:3
means 3:6 20:22 58:22 107:17 151:5
measure 42:16 121:7
measures 45:10 119:3
measuring 165:15
mechanisms 34:17 48:18 84:16

85:2,9
meet 10:6 39:1 48:22 51:1 101:11 102:3 120:22 149:21 166:13
meeting 1:6 3:6,19 4:10 8:19,22 12:19 13:7,15 35:15 99:2 112:11 169:5,17
meetings 5:9 13:2 15:3,5 17:15,16 18:2,6,8 27:11 78:8,10 152:12 168:13
megawatts 145:22
Melanie 2:3 4:14 8:15 9:21 13:11,16,21 22:11 26:18 27:4 95:20
member 7:2,22 8:21 18:18 36:17 42:12 44:7 165:21
member-owned 36:2
members 28:17 37:20 43:22 85:20 155:19 158:15 166:2
memorandum 14:17
Memphis 113:21 114:4,9,12,18 115:4,14
men 29:4
mention 67:15 125:6 169:19
mentioned 15:4 27:4 57:4 59:6 62:22 63:22 64:17 66:17,18 81:3 82:2,13 85:13 104:16 106:20 107:2 109:17 123:5 125:5 129:17 141:6 142:6,8 148:12 149:22 167:20
merchant 116:18
messages 88:3
Metcalf 40:16 57:10 58:8,17,19 78:6 79:15 115:2
Metcalf-style 163:22
methane 16:9 163:8
methodology 155:2,4
Michael 169:22
microgrids 45:19,21 130:15 144:7 157:3
microphone 142:5
microphones 22:20
Mid 53:10
Mid-Atlantic 44:6
midday 13:2
middle 89:10 104:3
Midstream 162:22
Midwest 68:15 146:3
mike 3:13
124:19,22 150:20
mikes 152:19
mile 38:12
miles 50:8,16,20 65:11 120:5 142:18
military 117:5
million 29:13 30:21 36:4 44:6 86:11,16 95:1 113:9,22 116:14 118:5 158:15
millions 41:16 44:11
mind 43:7 109:15
minimize 46:9 52:16 76:3 133:13
minimum 106:17,18,19 127:18
mining 159:20
minutes 22:13,22 26:19 35:17 95:19 96:1 146:13 151:3
Misback 2:14 97:10 112:5,6,7 128:5,6 132:5,8 145:13 149:1
miss 97:6
missed 56:20
mission 36:12 37:22 98:5 117:7 138:11 139:5,7 165:11
Mississippi 114:14
MIT 6:12,13,14
10:12
mitigate 48:21 106:5 160:20
mitigated 56:9
mitigation 15:15 132:2 134:21 136:14
Mitsubishi 97:11 112:8,12 113:8
Mitsubishi's 118:15
mix 68:17 72:8,11,13,19
mobile 115:17 133:7
mode 51:12 87:15 134:9
model 39:7 68:10 80:8
modern 49:1 54:20 100:10 154:1
modernization 154:20
modernizing 63:13
modes 51:17 87:8 168:18
modular 63:7 90:8
Mollie 2:18 158:6,9
moment 36:19 67:22 150:21
money 69:14 79:2 86:13 95:1
monitor 119:1
monitoring 133:9
Moniz 2:5 4:17 5:6

6:10,11,17 7:22 8:6,18 10:13 13:10,20 23:20 25:19

Montana 2:7 27:20 28:8,9 70:3 81:1 93:3 123:4

month 85:22 86:2,10

months 16:5 75:10 115:1

Moore 143:10

morning 3:2 8:17 28:9 35:20 43:18 49:5 54:13 79:9 130:1 140:6 151:14 167:16

mostly 142:11

mountains 37:3

move 16:10 68:17 69:9 71:10 74:15 85:1 99:10 100:6 101:4 124:16 133:6

moved 90:22 123:16

moves 98:15

moving 12:11 45:12 46:1 98:13 130:8 137:2 146:6 162:16

multi-agency 14:22

multi-billion 105:22

Multi-customer 157:3

multiple 11:2 26:3

multi-state 165:20

multitude 163:19

multi-year 10:19 20:8

muster 83:19

mutual 55:20

myself 35:22 37:9

N

N.E 1:10

narrow 23:8 126:9

narrowly 12:2

NARUC 138:22 165:12,19 166:1,19

Natalia 1:13 171:2,20

nation 7:17 8:4 29:6 33:20 35:1,2 157:16

national 9:12,19 10:11 28:14 31:10 43:1 46:21 51:11 71:7 73:2 81:12 91:1 94:11 117:21 120:10 123:8 140:1 155:21 158:10,21 159:6 163:16

nation's 9:16 44:9 61:15 103:1 117:2 139:19 140:1 155:17 157:12 158:11 161:6,17 162:9 163:11 165:4

nationwide 158:15

natural 15:19 16:6 19:12 28:18,20 29:1,5,9 30:2 31:12,14,15 32:3,14 33:2 34:4 40:14 49:19 64:22 65:16 68:20 69:19 70:11 71:21 84:4 97:8 98:3,6,12,19 99:2,8 100:4,8,18 101:4,19,20,22 106:9 107:22 108:11 109:1,22 115:9 116:21 120:19 121:11 123:17 130:9 134:20 135:11 138:19 143:1,10 147:3,8 148:5 162:3,6,7 163:2,5

nature 23:14 120:16 163:3

Naval 117:4

nearly 29:14 50:2

necessarily 84:17 108:22

necessary 91:22 92:14 117:20 161:1

needlessly 127:10

negative 43:6 83:22

neighborhoods 162:14

neither 171:10

Nelson 7:13

NERC 40:1,2,9 41:14 47:10 54:14 55:5 58:5 59:12 62:16 68:3 78:17 128:12

NERC's 56:18,22

network 53:18 65:19 66:3 118:22 121:12,20 137:5

networks 39:17 93:12

news 144:2 147:18

NGCC 73:3

NGO 30:9 34:12

NGOs 11:19

night 130:2

nine 51:18 55:9,15 56:5,14 57:4 168:4

Nixon 9:15

nobody 86:5

Noll 167:5

none 114:10

non-profit 36:2,14 85:20

nor 171:10,14

normal 32:12 69:3

North 28:4 98:2 104:4 116:15 117:15 168:15

northeast 55:13

Northern 117:5

notably 119:15

note 101:12,20 133:21

noted 9:21 41:17 98:16 125:6 154:10

notes 3:10 169:4 172:5
nothing 12:10 37:16
Notice 151:1
noticed 142:14 168:13
notion 42:7
not-to-distant 31:7
notwithstanding 23:18
November 8:2 12:5 125:10
nowhere 108:3
NPC 31:11,13 32:15 81:4
nuclear 39:19 58:11 72:11 116:20 146:1
numerous 159:7 164:3

O

Obama 6:7 10:1 21:17 44:3 161:4
Obama's 159:3
object 4:6
objective 130:3
objectives 10:22 11:3 14:13 62:13 131:14
obscure 10:12
observation 128:19
observations 24:9 128:7
obsolete 37:14
obstacles 34:18
obtain 4:7
obvious 96:3 130:20
obviously 67:10 73:16 84:6 98:7 101:3 133:21 134:11 145:8 147:2
occur 32:2 127:17 136:13
occurred 40:15 41:1 55:10 57:19 111:8 115:3
occurring 17:10
Oceanic 120:11
oceans 20:13
o'clock 168:4,7
October 55:13
offer 21:12 62:2 112:20,21 122:3 158:8
offered 69:3
office 4:15,21,22 5:8,19 77:20 152:9,14,17
officer 36:1 163:15
officers 105:16
offices 165:21
officials 59:9 78:8,13 124:4 164:16
offshore 90:22 107:1 111:3
Oh 104:10
oil 15:19 16:10 28:2,18,20 29:1,5,12,14,19 30:2,6 31:11,15,19 32:1 33:2,19 34:5,6 49:17,18 50:7 51:19 64:22 71:21 77:13 80:17 81:3 92:7 101:5,7 107:13,22 110:3,6 159:20
okay 73:11 104:11 107:9 111:4 135:8,9 142:9 143:15
Oklahoma 143:11
old 43:16 49:9
older 9:13
oldest 158:11
ones 104:19 120:14
ongoing 25:4 31:10 123:7
online 167:21
open 3:13 8:18 18:6 42:9 47:19 54:7 150:20
opened 113:20 115:3
opening 55:3 98:16
operate 28:19 54:8 126:16 164:8
operated 46:5
operates 59:12
operating 29:16 94:12 116:12
operation 16:17 45:20 52:6 118:7
operational 44:12 56:15 57:21 62:15
operations 32:12 47:4 53:8 56:21 73:17 154:18
operator 92:10
operators 48:22 50:5,9 51:3,20 52:7,14 53:15,20 54:2 77:21 86:20 87:2,7 91:20 92:16,22 117:19
opinion 137:15
opinions 96:11
opportunities 18:9 20:21,22 24:17 67:19 74:15 82:21 102:10 134:3,14 138:7,18 167:21
opportunity 7:13 9:10 15:11 19:1 21:12 44:1 49:6 54:14 68:3 74:21 75:8 78:3,13 81:18 82:11,17 87:5,12 97:20 98:1,22 99:8,15 101:8 102:5 112:10 115:22 124:1,3 134:8 141:10,17 146:14 149:12,17,19 151:11 155:16 158:8
optimal 153:17
optimistic 43:4,8
options 26:17 69:22 88:1 134:4

orally 151:12
order 5:15 46:21 47:10 59:3,4 65:8,18 70:22 117:14 118:3 123:1 156:15
ordered 40:11
Oregon 168:22
organic 9:18 83:21 84:4
organization 152:20
organizations 58:6 139:1 158:12
organization's 3:20 85:14
origin 15:17
Orleans 18:1 168:14
others 7:14 99:21 105:21 134:8 135:15 152:6
other's 46:16
otherwise 6:5 21:6 54:8 171:15
Oueid 169:21
ought 70:8 123:1
ours 136:20
ourselves 75:20 76:7 80:12
outage 38:2 41:15 57:6
outages 44:21 53:13 64:21 76:4 156:13
outcome 171:15
outcomes 106:19
107:5
outdated 37:14 128:15
outline 11:8
outlook 101:19
output 43:2
outreach 13:17 17:11 152:13 165:17
outset 9:22
outside 9:6
outstanding 5:12 6:21 8:12
overall 28:13 125:22 148:20
overarching 70:6
overhead 75:14 120:5
overriding 84:7
oversight 85:10
overstated 147:10
owes 7:17
owned 36:7 42:12 165:5
owners 36:17

P

pace 29:6 98:20 100:22
PAGE 2:2
paid 86:7
pain 64:3
paint 77:15
pair 100:11
panel 3:11 5:14 10:13 20:7 27:1,14,15 43:9 55:4 88:7 96:19,22 97:3,5,7 99:20 104:10 112:12 116:9 122:7,11,20 123:5 128:13 146:15 149:2 150:17,19 160:10 161:22
panelist 22:14 27:10
panelists 4:1 5:14 27:2 58:3 116:9 123:10 169:12
panels 13:6 105:13 112:22 138:9 168:9
panel's 137:15
paper 153:10 154:8
papers 24:3
paramount 165:2
participant 117:15
participants 77:14
participate 35:9 112:10
particular 24:1 37:10 60:4 105:4 110:15 130:17 135:21 155:2 166:19
particularly 11:6 38:5 63:5 76:22 90:8 108:10 135:13 140:13 162:3 163:6 167:6
parties 171:11,14
partly 25:22
partnered 39:15
partners 65:2 98:12,13 102:12 115:7
partnership 38:21 39:8 75:10 79:5,10,16 87:12 119:8 125:13 126:13 132:4 166:16
partnerships 48:14,15,17 72:21 73:4,8 76:16 81:7,8 150:12
pass 83:19
passed 148:15
past 31:7 34:18 36:20 37:1 42:21 45:2 64:20 108:13 110:1 126:14 140:14
path 45:22 74:9 75:1 84:18
pay 74:2 85:22 86:5
paying 19:6 165:9,15
payoff 24:7
pays 83:3 131:8
PCAST 8:1,2 10:2,4,9 11:10,17,21
peak 142:16
peaking 95:10
peer 119:6
peer-reviewed

20:10

Peggy 2:7 3:3 4:19 27:20 28:6,9 70:2 76:19 81:5 82:2 93:2 94:5 97:16 123:4 138:1 169:15

pending 158:8 160:3

penetration 16:1 60:16

Pentagon 117:3

people 6:20 22:13,19 37:6 42:13,14 49:8,11,14 51:1 64:5 65:8 76:6 77:11,16 82:3,11 85:21 91:19 92:18 96:14 110:3 133:1,5 135:5 142:16 144:11,16 146:16 151:2 160:14 167:18

Pepco 28:1 44:4

per 29:13,14 34:7,9,11,12 38:10,12 164:20

percent 21:19 29:12,16 51:14 60:2,16 69:3,4,5 82:5 121:5 147:19

perfect 153:3

perform 52:11

performance 52:15 55:6 56:13 117:6

performing 52:2

perhaps 24:13 76:8 100:20 126:2 135:20

period 29:19 30:9,10 55:8,10 56:15 59:5 64:1 87:6

permanent 154:9

permit 34:3

permits 51:7,10 93:15

permitting 121:19 123:15

person 152:12

personal 4:4

perspective 14:9 18:16 22:9 36:6 62:15 70:4 109:20 132:1

petroleum 17:22 28:16,21 29:9 31:10 32:8,17 49:19 50:7 52:19 73:2 123:8 168:14

phase 154:12,13,21 155:1

phases 154:7

PHI 44:4

Phil 7:14

philosophy 129:13

PHMSA 52:5,20 92:10

Phoenix 168:7

phone 75:5

phones 97:4

phonetic 163:4

physical 26:5 40:10 47:5,11,17 48:12 57:5 58:4,9,22 59:11,17 63:1 79:13 87:19 111:13 113:6 117:11,13 118:13,18 120:3 130:11 137:13 141:1 157:1 164:21 166:11

physics 89:1 91:12

pick 72:6 79:19 148:5

picked 3:8

picture 26:11 77:15 98:22

pie 148:2

piggable 162:20

piggyback 82:1 91:6 96:7

Pipe 28:3

pipeline 34:2 50:5,8,10,19,22 51:3,8,11,20 52:3,7,14,21,22 53:7,8,15,18,19, 20 54:1,4,5,7,9 62:19 65:4,18 66:3 72:1,3 77:7 86:20 87:7 91:18,20 92:16,21 101:14,22 110:22 121:12 150:6 161:6 162:17,18

pipelines 28:10 30:6,10 49:17,21 50:8,17 51:7,12,15,22 52:6,9 53:5,10 54:9 64:19 65:10,11,15,20 77:5 87:3 91:18 98:9 104:6 116:21 120:21 127:12 160:1 162:17

pipes 120:21

pitch 8:10

Pittsburgh 112:20

places 96:6 104:9 133:3 162:18 163:7

plain 79:2

plan 9:19 12:6 21:17 94:16 95:15,17 118:4 123:9

planned 94:15

planning 33:15 69:13 94:20 154:18

plans 39:5 95:8 154:12

plant 115:4

plants 16:17 19:15 41:13 69:1 121:4 130:8 145:20,21 146:1 160:5

play 50:21 96:17 104:20 124:12 138:12

playing 31:13

plays 138:20

please 3:15 23:3 26:19 27:12 96:19 97:3

151:18
pleased 8:20 13:14 21:16 22:8 55:2 154:6 155:15 161:13
pleasure 6:13 8:11,17
podium 13:9,18 102:16
point 13:9 15:8 50:4 60:18 62:3 71:21 72:7 82:3,17 83:2 102:22 103:3 121:2 122:21 139:8 169:14
pointed 99:1,21 123:6,10,19
points 14:14
polar 45:5 56:13 61:6 108:20 121:2
poles 37:2
policies 19:6 33:18 48:19 50:21 51:2 65:21,22 105:16 121:10,18 122:2 125:17 129:20 131:10 141:7 158:18,19 159:11 166:22
policy 4:15,22 5:19 6:2 8:5 9:12,19 10:17 18:21 21:1 32:7 43:10 46:3 89:15,17 90:12 94:12 100:1 116:8 124:7,12 126:2 127:20 130:18 131:3,16 139:2 148:9 150:14 152:9 159:15,19
political 104:7 111:17
politically 87:18
Politico 23:4
poll 136:2
pollutant 161:10
polluting 161:3
pollution 19:9 21:8,18,22 111:4 159:4,9,17 160:3
poorest 38:6
pop 126:6
portable 33:17
portfolio 91:10
Portland 17:22 168:22
pose 119:16
posed 115:11
poses 21:5 120:17
position 4:7
positive 19:19 43:6 66:6 149:3
possesses 160:12
possible 4:9 11:1 13:15 38:8 43:6 45:19 47:7 81:17 151:17 165:7
possibly 126:7
post 21:19
post-9-11 58:8
post-Deepwater 111:3
posted 169:5
posting 104:14
potential 39:12 52:10,12 54:3 70:9 92:9 115:8 118:19 124:1 154:1 160:6
potentially 61:5 138:6
power 16:17 26:3 33:21 36:3,13,14 38:1,2 39:1,17 41:9,16 42:18 44:5,11,21 45:17 46:8 53:8,11,13 55:6 60:8 61:3 62:5 64:19,20 65:5,6,7,10 69:1,18,19 70:1,13,14 77:7 83:13 97:11,12,13 99:5 102:9 108:17 112:7,8 113:1,3,13,15 114:6 116:3,12,20 120:17,19 121:6 128:16 130:1 132:11,12,14,16 134:4,9,13 135:4,12 136:7 139:15,19 143:14 144:10 145:1,16,18 146:6 153:8,13,14 154:4 155:2 156:13 160:5,19 162:5
powered 53:6 147:3,5
powering 99:4
PowerPoint 102:17
PowerPoints 102:15
practices 44:16 52:18
pre 84:20
predictions 108:5
predicts 50:18
prefer 86:8
preparation 55:19 90:14
prepare 13:2 31:20 53:20 67:11
prepared 59:11 129:18
preparedness 31:12,14 32:21 33:15 64:22 92:8
preparing 9:16 24:2
preponderance 109:1
prepositioning 33:16
presentations 35:14
President 5:17 9:15 10:1,4,10 11:20 12:6,21 14:16 21:17 28:1,2,3,10,12 35:21 44:2,3 49:16 66:11 97:7,9,11,13 116:11 159:3 161:4
presidential 14:17 51:10

President's 5:20 21:16 46:20
press 24:22
pressures 54:7
pretty 87:6 144:3
prevailing 166:13
prevent 67:11 128:11 136:22
preventing 128:17,22 156:21
prevention 136:15
previous 25:11 28:11 33:4 58:3 99:20 123:5
prewiring 33:16
price 38:4 69:4 72:13 73:19 107:4 121:3
priced 69:2
prices 121:9 147:18
pricing 62:9 103:19 106:4
primarily 41:3
primary 7:7 27:18 36:12 41:8 72:12 86:1
prime 122:1
primers 165:14
principal 56:22
prior 6:7,10 58:19 104:9 109:18
priorities 88:2 141:13
prioritization 65:9
priority 121:16 148:14
privacy 47:21
private 17:2 30:3 34:3 65:3 101:21 119:11 121:10 122:5 133:22
private/public 73:7 79:10 87:12
privilege 85:18
pro 158:1
proactively 156:15
probably 17:15 76:14 82:4 85:15 142:12,15 143:5
problem 79:18 84:5 96:10 135:9 147:21 150:5 164:19
problems 52:11,12 121:7 124:21 138:6,15
proceeding 172:4,5,8
process 4:21 5:3,4 10:15,19 12:15 17:12 25:14 40:1,3,7 51:7 78:16 79:4 96:12,17 97:21 98:15 117:16 123:15 131:12 138:5,9 141:11,15 150:9,21 151:14 152:13,18 157:12 169:10
processes 68:1
processing 29:18 116:21
procure 62:20
produce 10:19,20 34:22 106:5
produced 9:20 53:12 57:19 65:1
producer 29:9 98:18
producers 98:4 105:21 157:20
produces 129:3
product 11:15 17:22 77:6 111:11
production 10:6 15:20 29:11,12,20 34:6,11,12 65:14,16 90:20 93:5 100:15,21 101:1,4,7 102:6 107:13 109:22 110:6 124:14
productive 75:9 122:7
productively 79:22
productivity 34:22
products 28:21 32:14 34:22 49:19 50:7 53:14 97:12 111:13 112:8,14 115:7 136:21
professor 6:11,17 10:12 14:4
profit 36:16 38:17
program 22:10 53:3 55:20 110:21 118:10 120:4,7 125:10,13,18 126:13 163:15
programs 107:4 111:15,18 117:9
project 50:20 75:12 82:13,14 113:10 161:10
projected 30:10
projects 28:11 92:4 113:18 122:6 129:10
promise 103:9 146:8
promising 134:1,15
promote 98:5 122:1
prone 139:22
propane 16:7 77:3,8,18
proper 106:4
properties 157:4
property 82:7 106:2 110:7 127:22
proposal 10:14
proposals 11:8
proposed 41:10,17
protect 39:17 54:5 57:17 78:21 111:13 117:9 118:5 133:11 135:4 158:13 159:11 160:20
protecting 58:1 132:20 135:5
protection 54:2 117:14 118:22

119:7,10 135:11
protections 118:22
protective 117:20 118:20 119:3
prototypes 90:15
proven 33:8
provide 3:22 4:2 8:4 11:11 14:17 18:8 21:21 30:21 31:18 32:15 35:6 36:13 42:13,16 48:20 49:3 60:6,11,12,13,21 ,22 61:8,17 70:15 83:6 84:17 85:4 117:1 122:11 125:21 137:21 153:20
provided 68:3
Providence 168:6
providers 155:21
provides 16:3 29:21 54:4 59:14 67:6,10 69:20 106:4 114:11 136:19 141:15,16
providing 45:16 63:4 68:13 79:11 138:15 148:6 155:6 167:19
provision 89:5
prudence 74:9
prudent 95:4 154:20
prudently 166:13
public 1:6 8:12,19 9:6 11:19 12:18 13:6 17:13 18:21 25:8 27:11 32:8 57:10 59:1 76:21 112:10 124:6,13 127:20 138:21 151:22 163:17 164:16 167:21 169:11,12
public/private 48:14 75:10 125:13 126:13 132:4 150:12
publication 9:19
publicly 87:19 168:13 169:9
published 59:22
pull 136:6 139:6
pulled 40:20 97:21
pulling 136:8
pump 53:5 65:6
purpose 3:18 9:4
pursuant 4:10
pursued 129:20
pursuing 46:11 166:17
pursuit 49:12
push 42:6 53:6
pushing 166:21
putting 5:9 25:14 37:2 75:15 147:7

Q

QER 8:7,8 10:18 11:12,14 12:7,21 13:17 16:19 18:22 21:12,20 25:15 27:4 31:5 33:1,17 34:13 35:15 61:18 64:21 71:6 122:12 131:20 138:9 139:5,17 154:9,21 158:3 161:14 162:1 164:6,14 166:20 169:10
QERcomments@hq.doe.gov 27:9 151:18 167:14 169:8
QER's 163:18
quadrennial 1:6 5:1,4,22 8:4,19 10:17 12:1,10 18:17 21:11 22:6 27:19 31:2 43:22 55:3 88:13 94:10 97:22 112:11 137:17 149:11 158:9
qualification 92:11
quality 37:11,21 113:13
quantities 114:6 146:6
Quebec 57:19
question 19:3 20:1 24:20 25:22 54:17 71:11 76:19 78:11 88:9 90:15 122:10 132:5 138:4 141:18 147:11
questions 3:11,12 22:11,13 23:1 25:1 49:4
quick 75:3 98:1 100:16 139:8
quickest 95:11
quickly 33:9 51:4 68:17 69:9 77:21 81:17 104:12,16 107:7 110:13 111:22 118:12 123:15 147:12 148:11 156:16 165:1 166:9 169:19
quite 129:10 140:9

R

R&D 132:1,5,10 133:22 134:18 162:1,5,22 163:2,5,9
rail 30:12 105:9 111:6 114:13 168:17
raise 58:19 73:20 74:1 85:5,6
raised 83:3 147:1
raising 45:12 94:8
range 12:17 60:15 116:7,8
ranking 7:2 8:21
rapid 153:11
rapidly 19:11 93:7 103:5 109:5 120:18
rare 53:16 126:12
rate 154:3
ratepayer 164:20 166:15
ratepayers 86:7,8
rates 38:14 83:15 144:19 165:3
rather 4:8 83:5

rating 75:22
rational 87:13
reach 71:6 114:8
reached 51:15
reactionary 87:15,17
readiness 55:19
ready 42:8 53:11 56:3 92:19 158:2 166:6
real 20:19 46:14 48:22 67:19 75:2 84:9 102:5 104:20 140:19
reality 19:13 30:5 90:3
realize 73:22 153:22
really 18:4 24:8 54:21 61:7 66:8 67:14,21 74:12 75:8 79:3 80:13 81:10 82:3,18 85:11 86:5 91:11 94:7 96:3,8,16 102:11,21 106:13 129:9 132:19 135:13 149:10 151:12 162:8 169:17
realm 46:10 47:6,19 65:5 108:1 126:17
real-time 59:14 119:9
reasonable 84:10 122:3
reasons 89:7 114:10 130:8
reauthorization 148:14
REBSI 163:4
rebuilt 120:14
recap 59:17
receiving 126:21
recent 30:17 31:11 33:7 34:7 50:18 109:4 125:11
recently 7:16 16:8 40:10 101:15 105:11 153:9
recognition 35:4
recognize 33:1 34:21 42:21 43:2 129:21 130:19 131:4 161:15
recognized 11:17
recognizes 47:13 89:1
recognizing 17:5 145:8
recommend 10:4 83:9 94:22
recommendation 10:14 61:17 63:21 67:4,13 71:13 79:8 140:11
recommendations 4:3,9 11:21 24:10 62:2 71:16 72:5 81:21 121:14 122:13 137:21 146:17
recommended 11:10 52:18
recommending 8:3
record 13:7 102:1 158:4 169:11 171:8
recorded 171:6
recordings 172:6
records 29:11
recover 156:15
recovery 48:7 83:16 84:3,16,18 85:8 87:4 115:18 132:3
red 147:10 151:5
reduce 20:15 21:7 60:9 69:9 120:7 144:8 159:4,9 160:2 163:8,10
reduced 53:13 171:7
reducing 21:18 68:21 114:21
reduction 22:1
reductions 21:22
redundancy 40:12 41:4,5 45:14 47:15
redundant 162:17
refer 37:13
reference 71:19
refined 32:14 49:19
refineries 28:21 29:15
refining 29:13,21 105:7
Reflecting 42:20
reforms 127:1
refurbishment 149:17,19
regained 53:12
regard 47:21 67:8 81:2 88:12 132:2 137:20 138:19
regarding 3:20 4:5 59:14 71:14 157:7
region 44:6 60:4
regional 15:3,5 24:14 120:2 139:1 168:3
Register 151:1
regrets 89:18
regrettable 60:17
regular 9:12 53:22 77:18
regularly 39:2
regulate 164:9
regulated 87:4 92:12 164:11
regulation 52:20
regulations 40:11 41:11,12,20 52:4 130:6 165:4
regulator 85:22 86:1
regulators 55:18 74:22 84:13,19 121:18 164:15 165:3,10
regulatory 45:6 48:21 85:10 93:21 94:4 130:22 131:9 163:16
reinforce 14:15 24:6 129:7

reinforcing 129:13
reinsurance 125:15
reiterate 159:14
rejection 161:9
related 55:11 56:6 68:8 171:10
Relations 153:8
relationship 66:6 119:13
relationships 82:19
relative 171:13
relatively 20:20 126:9
relay 56:20
released 20:8 51:19 160:10
reliabilities 79:3
reliability 28:4 38:22 40:5 41:8 42:1,3,18 45:16 46:5,6 60:14,19,22 62:10,15 68:21 69:10,21 72:19 75:16 76:3 77:19 78:18 84:11 86:3,12 89:2,5,16 117:16 118:9 130:19 131:2 145:5 156:2 157:16 166:14
reliable 36:13 37:11,21,22 38:1 41:9 42:18,22 53:18 54:20 86:16 89:11 94:16 117:10 139:19 149:7 153:20 164:17 165:6
reliably 44:13
reliance 68:20 142:13 161:2
reliant 144:12
remain 43:4 47:19 53:10 108:6 111:3 128:3 144:12
remains 44:21
remarks 9:9 14:5,14 55:3 86:22 113:4 129:18 158:4
remember 7:10 25:16 49:9 66:10 150:11 151:11 165:8
remind 35:16 57:11 86:1
remote 37:3 47:8 156:19
removed 41:18,19,20
renaissance 29:20 99:4
renewable 19:6,7,10 60:3 113:2,7
renewables 15:22 60:18 91:9 105:11 130:10 132:10 141:21 150:1
renewables-driven 162:8
renewal 126:3
repeat 87:10
replacement 162:11
replacing 147:4
report 8:3 9:16 20:8 27:20 31:11 33:5 55:5,8 59:22 64:12,15 149:11 156:1,6 158:4 160:9
reported 1:13 172:3
reporter 169:2 171:1,2 172:3
Reporter's 172:5
reporting 1:14 85:18
represent 28:17 36:5 49:18
representative 7:4,5
representatives 39:2
representing 152:21 163:17
represents 44:8 98:2 113:21
requested 59:5
requesting 47:10
requests 51:6 166:10
require 145:6,9
required 11:7 120:7
requirements 4:11 11:4
requires 23:14 154:1
research 63:6 90:13 131:21 136:14,19 137:1 153:8 154:14 163:5
researching 137:8
residential 113:14 120:22
resilience 24:12 29:1 33:2 45:16 53:19 54:10,15,17 55:1 64:9 70:18 86:22 102:9 134:2,14 163:19 165:13,15,19 166:18
resiliency 1:5 3:21 25:18 27:16 32:22 33:6 36:8 39:1 41:6 42:6 44:20 48:19 59:20 83:9 93:12 94:2 115:16,20 129:14 156:3 157:6 162:2,9 163:10
resilient 49:1 64:5
resistant 115:13
resource 11:4 69:18 80:4 99:17 100:4 153:22
resources 39:14 60:3,6,12 62:3 66:12 74:18 89:4,21 99:18 116:13 146:2 153:11 166:4
respect 11:6 163:6
respond 20:2,5,19 31:21 33:9 49:3

51:4 67:12 84:11 93:8 119:4 121:17
responders 53:22
responding 70:11 131:15 156:21
response 10:9 33:6 46:20 48:3 53:4 57:21 59:9 60:7 81:15 87:17 92:17 114:20 120:1
responses 80:3
responsibility 38:7 137:16 164:17
responsible 41:9 46:5 164:11 165:3
responsibly 36:14
rest 90:22 98:8,10 160:16
restoration 65:5 92:20 119:21
restore 32:12 33:9 53:16 65:6 120:8 125:14
restoring 70:14
result 19:11 51:18 105:18 129:4
resulted 100:13
results 10:20 106:6,8
retail 61:7 75:16 116:14
reticence 14:10
reticent 18:18
retire 82:5
retirement 7:16 69:14
return 13:2
returned 36:20
returns 122:3
revenues 30:22
reversing 50:14
review 1:6 5:1,4 6:1 8:4,20 10:2,17,21 12:1 18:17 21:12 22:6 27:19 31:3 43:22 50:18 52:7 88:14 94:10 97:22 112:11 137:18 146:19 158:9
reviewing 51:16
reviews 9:12
revolve 20:1
rewarded 106:7
Rhode 168:5
Richard 9:15
Richards 152:14 169:20
Richardson 7:12
ride 62:6
ride-though 89:12
Rigby 2:9 27:22 43:12,15,16 44:3 66:5 73:11 82:1 83:11 91:5 96:2 144:18
rightly 139:17
rigorous 8:6 154:19
rigs 100:16,19
Rima 169:21
rise 153:11
rising 29:12
risk 21:7 47:11 48:22 58:13 61:1 65:20 72:10 87:6,22 90:11 92:5 95:6 106:12,13 107:3 110:17,21 111:17 125:7 127:14,15 132:2 139:22 162:12 166:12
risk-based 70:4
risks 21:5,6 48:21 52:8 55:2,4 57:2,3 59:20 61:21 87:13 103:19 104:1 106:17 111:1,3 115:9,11 162:13
risk-sensitive 106:3
River 114:14
road 8:5 10:19 66:8 83:5 89:18 95:3 158:17
Roads 117:4
Robert 2:13,14,15 97:9,10,12
robust 10:16 53:18 55:19 61:13 66:3
Rock 40:17 78:6
role 28:11 29:6 31:13 34:21 38:18 48:16 50:22 56:22 96:17 124:12 138:12,20 165:2
roles 67:22
Ron 2:19 161:19,21
room 49:8,11 66:10 89:7 96:11 123:13 151:13
rooms 33:14
rotating 60:5,11 90:5
rough 148:10
roughly 80:9
round 26:20
row 95:20 151:7
RTOs 155:22
rule 151:9 160:4
rules 92:11 154:3 157:7
run 95:12 96:15
runaway 20:14
running 44:13 71:8 79:1 135:9 162:14 165:20
rural 38:4
Russia 29:10

S

sabotage 32:4 40:19 41:2 78:7 111:16
safe 7:9 52:5 124:14 164:17
safeguard 118:2
safely 46:4 51:16
safer 110:11
safest 51:12 165:6
safety 35:4 46:6 51:22 52:4,13,16,17,22 53:1,2 54:10

86:21 87:2 117:13 164:12
sales 83:22 84:4 147:19
San 115:3
sands 159:22 161:6
Sandy 16:13 33:12 45:5 53:12 55:14,21 64:11 66:9 77:2,10,18 80:16 87:16 108:18 109:17 134:7 156:4 164:1
sanity 127:3
satisfy 113:13
Saudi 29:10
Savitz 10:12
saw 3:8 16:14 55:20 56:12 61:5 67:19 68:21 103:10 134:5
SCADA 54:4
scale 10:5 103:18 104:18 156:5 157:7
scarcity 100:4
scenarios 136:16
scene 143:19
schedule 3:7 52:9 69:6
scheduled 31:16
Schiliro 7:14
school 144:7
science 5:18,19,21 10:2 12:20 20:9,11 57:17
scientifically 154:18
scientists 20:10 160:22
scope 23:21 31:8
screen 102:18
scrutinize 21:1
Sea 104:4
seal 24:22
seamless 81:11
season 33:7 77:8
seats 97:4
Sec 2:5 13:20 23:20 25:19
second 15:8 68:7 80:5 89:19 97:3
Secondarily 109:3
seconds 151:5
secretariat 11:12,14 13:8,12 14:18 140:9
secretary 4:16 5:6 6:9,10,14,17,21 7:22 8:6,18 11:11 13:10,11 18:15 25:17 43:21 140:6 167:19
sector 17:2 19:13 39:18 41:7 44:12 47:12 53:19 58:11 65:3 66:19 67:7 70:12 71:19,20,22 72:1 77:13 81:3,22 101:21 116:3 119:11 133:22
sectors 80:7 105:2 160:8
secure 58:9 118:8
securing 58:20 79:17
security 15:12 29:22 30:16 33:22 38:22 39:3,10,21 40:10,12 41:13 43:1 45:22 46:19,21 47:5,11,19 54:3,4,10 58:4,16 59:6,12 63:1 69:21 70:7 71:18 72:3,10,19 78:9 79:14,20 83:10 87:19 91:1 113:7 117:2,5,12,21 118:6,18,19 119:1 132:3,18 136:21,22 137:13,20 139:11,12,20 140:2 141:1,9 149:22 156:22 164:12 165:13,19 166:1,12
security-based 58:14
seeing 16:17 100:14 104:1 148:1 170:1
seek 81:15 85:7
seeking 4:9
seem 44:22
seemed 76:9
seemingly 92:4
seems 37:12 61:11 129:2 130:20
seen 16:4,8,11 30:1 57:3 79:14 98:19 101:3 166:17
segment 116:13
selected 114:8
selective 45:14
seminars 165:18,21
Senate 78:10 148:18
senior 80:9 95:21 152:15,16 163:15
sense 65:10 86:18 139:14 162:22
senses 162:6
sensing 156:19
sensitive 42:12
sensors 162:21
sent 121:9
separate 118:7
September 56:16 118:4
series 168:9
serious 58:17
seriously 34:21 72:4 139:13
servants 8:12
serve 38:6,12,19 67:1 112:11 116:13
served 6:12,15 21:10
serves 39:6 152:15
service 7:18 14:5

33:9 35:2 37:11,21 41:3 45:2 50:17 53:16 65:5 83:12 92:20 117:1,22 118:12 119:17 120:8 121:7 155:21

services 36:15 60:12,14,19,21,22 62:10 89:6 148:10 164:18

serving 36:3 121:4

session 3:14 4:6 9:5 13:1 122:8 150:20 167:11,16 168:7

sessions 167:22 168:1

setting 150:22 165:3

seven 38:12

several 102:22 111:7 113:18 114:9 115:1 123:10 132:19 141:19 147:6 164:7

severe 20:15 32:2 44:20,22 55:9 56:6 80:15 119:15 130:12 161:16

severity 127:16

shale 100:14

shape 155:9 163:22

shaped 48:20

share 14:4 22:10 54:15 106:22 117:8 140:17

shares 108:10 117:12

sharing 39:5 59:10,13 67:6 68:8,13 71:14,17 73:8 119:9 121:14 140:19

Shell 27:21 28:11,13

She's 5:8,9

shift 19:13

shifting 46:9 89:4

shifts 46:2

ship 114:18

shippers 51:5 91:20

shocked 43:17

shore 105:6,7

shoring 164:12

short 10:21 98:20 146:19

shortening 114:19

shortly 148:19

short-term 94:14 95:9

shown 42:10

shut 21:9 133:11

shutting 130:7

shy 23:2

sic 27:22

sides 140:17

sign 3:14 91:20

signal 121:10

signals 62:9

signed 153:1,3

significant 19:4 30:3 31:22 45:8 64:18 87:6

significantly 15:9 48:6 161:7

signs 151:7

silver 91:11

similar 40:9 104:1 113:18

Similarly 34:8 46:12 48:1 92:2

Simon 2:18 158:6,7,10

simply 19:15 76:2 96:2 159:15 160:7

simulated 41:14,16

simulation 41:17

single 6:18 70:12 158:22

site 114:9 118:8

siting 51:6 121:19

sitting 66:10 89:7 95:8,20 146:16 151:7

situation 78:2 84:14 107:6

situational 56:20 81:14 156:20

situations 128:13

six 30:8 55:10

size 23:18

skilled 71:5,8

skipped 109:11

slides 104:13

slow 40:4

small 42:16 96:17 133:15

smaller 132:22

smart 112:22 113:9 115:19

smooth 100:2 148:10

SNL 24:21

Snowmageddon 45:3

snowstorm 55:13

Snowtober 108:16

soar 20:21

soaring 121:9

social 62:13 89:15

society 43:1 143:8

soil 90:21 91:4

solar 19:8 57:5,15,18 58:2 62:4 112:22 113:3,12 128:16 132:14 146:9

sole 130:3

solely 36:16

soliciting 116:7

solution 79:12

solutions 80:11 105:4 111:2 112:22 127:14,15,16,19 128:2

solve 43:11

solving 138:15

somehow 73:22 144:8

someone 41:8 68:14 137:8

someone's 74:2
somewhat 74:4 128:15 133:8
somewhere 89:9
sophisticated 48:5 163:22
sort 70:6 87:17 111:10 125:3 136:13 142:6
sorts 104:1 105:17 111:17
sought 141:3
source 40:18 108:9 132:15,16 148:5
sources 15:20 72:12 114:7 116:19 160:13
southwest 56:7,16,17
space 98:12 123:17
spare 63:2,11 90:7,18 91:2 115:18 118:11 133:2
speak 3:13,16 5:15 18:19 167:7
speaker 2:2 35:12 151:21 155:11 161:19 163:12 167:1
speakers 27:15 35:13 70:5 97:19 98:17
speaker's 55:3
speaking 68:14 98:10 123:16
Special 28:10
species 20:18
specific 22:2 61:17 62:1 71:13,16 80:5 108:22 122:12,15,22 129:18 139:5 146:17,20 147:16 150:11
specifically 17:17 83:5 103:20
specifications 92:11
speed 166:8
spend 73:22 74:10 79:2 83:16 84:20 85:5 86:11,15 95:1 118:4
spending 50:9,19 86:13 129:10
spends 164:19
spent 52:1 77:10 87:1 89:22 167:18
spirit 29:4
split 75:20
spoken 86:22
sponsored 7:9
sporadically 9:20
spot 147:17
spotlight 12:12
spur 82:14,18
squarely 139:18
stab 88:20 132:7
stability 60:8 125:14 128:18
stabilize 125:19
stable 113:13
staff 7:12,14 13:4,12 95:21 165:12 169:17,18,19
staffer 7:11
stage 27:3,20 29:7 96:21
stakeholder 8:19 17:11
stakeholders 18:7 53:16 88:17 116:3 155:8
stand 126:21
stand-alone 73:16
standard 40:9 48:10 54:3 57:14,20,22
standardized 115:13
standards 39:21,22 40:1 46:6 47:10 52:18 58:12,13 117:14,17 128:8,10,14,21
standing 76:7 96:5 110:12 135:13 152:19
standpoint 71:4 93:14 99:22 123:12
stands 145:5 158:2
start 28:6 58:6,7 61:14,22 66:5 79:9 80:21 94:11 96:22 97:21 116:6 142:4 162:4 168:4
started 11:21 97:2
starting 122:11
starts 74:13 101:10
state 19:5 20:9 33:18 41:16 51:10,17 55:18 74:7,22 76:22 81:12 84:13,19 96:3 127:3,21 129:21 135:1 137:19 138:21 141:3 152:10 153:7 160:15 163:17 165:2
stated 14:15 15:2 159:16
statement 167:4
statements 35:14 169:12
states 1:9 6:9 15:10 17:8,13 37:18 39:8 51:6 84:15 98:4,18 99:3 100:19 104:2,18 107:10 111:9 113:19 114:1 127:4,10 149:5 165:2 166:17,21
stations 53:5 64:13 65:6 116:19 157:5
status 34:16
stay 130:2 149:3 164:22
stayed 164:3
staying 13:4
Steel 42:2
steep 84:2,3

stem 71:4
step 12:7 114:19 129:19 138:17
steps 118:3
sticker 69:11
stimulate 107:3 129:8
stock 69:15
stop 124:17 136:22 151:6
storage 27:17 61:15 62:12,14 77:8 89:20 90:1 92:12 105:7 113:16 116:21 132:13 141:22 153:18 168:14
stores 157:5
storm 33:11 92:20 164:1
storms 44:22 55:14,21 64:1 109:3,6,9 118:13 119:15,16 120:9 156:6
strain 120:20
stranded 21:9
strategic 63:10 114:11
strategically 63:4
strategies 32:16 45:8
strategy 48:11 161:2
streaming 37:8 152:6
streamlining 34:2 123:14
Street 1:10
strength 36:10
strengthen 30:15 113:6
strengthening 45:7
stress 158:19
stringing 37:2
strive 35:7
strong 24:14 25:21
strongly 30:15 67:5
structures 62:20 154:3
struggle 83:4
studies 25:3,11 26:1,10 43:5
subject 39:22 61:4,6 78:18 162:1
submit 27:12 151:19 154:7,9 167:13 169:8
submitted 154:21 169:6
submitting 158:3
subscribe 54:19
Subsector 38:20 47:1 68:8
subsectors 68:10
subset 26:2
substantial 11:18 12:15 63:3 106:21 157:13 160:6
substation 40:16,20 45:11 58:21 78:22 115:2 118:5 133:7
substations 33:13 78:21 115:8,18 120:13
suburbs 142:11
subway 135:8 142:9
succeed 14:22
success 11:20 98:8 117:7
successful 62:12 140:19,21 151:15
suffering 19:16,17
sufficient 62:18 65:17 114:14
suggest 80:13 129:19
suggested 55:22
suggesting 138:12
suggestion 80:5 87:20
suggestions 83:7
sum 149:4
sumers 158:1
summarize 105:1
summarizes 18:4
summarizing 121:13
summary 48:8 169:4
summer 12:5 75:4 154:13 160:17 165:22
superior 106:7
Superstorm 45:5 87:16 108:18 134:6 156:4
supervisory 54:6
supplies 50:12 53:8,13 64:12 65:9 77:3 168:19
supply 17:21 28:12,19 32:1,13,22 36:3,15 39:1 62:21 68:19 69:8,18 70:1 76:20 77:22 81:16 94:16 99:20 101:8 118:11 120:17 121:8 136:4 147:21 150:5 156:10 163:3,5
supplying 112:17
support 3:4 30:20 72:8 88:5 114:4 115:16 121:10 154:20 159:7 164:14 166:5
supporters 158:15
supporting 5:1 118:17
supports 47:12
supposed 25:4
sure 22:9 36:10 40:6 43:15 55:22 56:3,10 60:20 66:2,5 77:11 79:20 80:1 81:10 87:2 89:14,16 92:13 94:6 99:15 104:14 106:16 110:10 111:21 123:6,12 128:21

130:3,13,21 131:10,14 139:10 141:11 144:17 148:8 149:12 153:2 162:19

surpassing 29:10

survivability 115:20

sustainable 153:21

swan 57:8

sweet 146:19

switch 130:4

sworn 171:5

syncrophasor 63:12,19

system 10:3 11:6 15:18 16:2 19:17 26:3 28:20 39:1,17 45:17,20 47:15 61:3,14 64:4 68:21 69:9 81:17 100:3 116:20 119:16,19 121:21 127:5 128:3,22 133:3 135:5 141:7 144:10,12,21,22 145:4,5 147:5 148:6 150:22 151:4 153:4,13,14 154:4 155:2 157:13,19 162:11 163:11 165:6 166:10

systemized 48:6

systems 4:16,22 52:3,8 54:6 56:2 61:12 70:17 97:11 112:7 113:1,17 118:7 128:18 135:14 152:10 157:22 162:12,15,18,20 164:4,13 165:5

systemwide 154:19

T

table 69:22

tackle 83:10

tag 73:19

taking 75:14 81:22 118:3

talk 5:6 36:9 42:4 65:2 71:15 72:20 73:5 92:16 105:9,12 131:18 135:22 137:5 141:22

talked 61:21 70:13,19 73:9 92:14 93:14,19 110:2 132:5 137:14 141:19 142:8 144:19

talking 77:1 80:15 90:1,2 92:19 103:20,22 105:5 106:6 125:9 127:12,13

talks 92:8

tank 33:14

tanks 92:12

tar 159:22 161:6

targets 89:3

task 5:22 6:1 31:3 43:22 61:18 71:8 73:7 122:12 150:8

taxpayers 86:8 125:20,21 126:16

team 5:10,12 23:16

tears 37:8

technical 57:16,22 62:8 89:13 154:17 166:1

techniques 100:10

technological 100:11,22 124:21

technologies 11:7 12:3 42:10 44:15 45:15,18 47:4 62:4 63:20 102:8 113:1 130:14 131:19 132:6 141:20 142:2 144:13 145:3,11 149:14 153:12,15 156:18 162:12,21 163:8

technology 5:18,19,21 10:2,3 12:1,20 37:18 39:16 53:3 60:21 63:12,17 75:13 115:15 128:11,22 132:11,12 133:10 144:2 149:20 154:15 155:4 161:21

telecom 80:17

temporarily 92:12

ten 94:18 104:22

Tennessee 113:21

tension 96:12

tent 89:9

term 61:7 84:3 161:14

terminals 28:22 65:7

terms 14:5 15:17 17:1 24:2 58:15 63:1,2 70:11,21 71:15 72:10,18 76:10 87:13 92:19 108:21 109:4 111:12 134:18 142:17

terrific 5:10 129:15 152:2

territory 45:2 83:13 117:22 119:17

terrorism 110:17,21 111:16 125:7,16 139:22 148:13

terrorism-related 32:4

test 66:8 115:10 161:11

testifying 28:15

testimony 73:9 171:4,6,9

Texas 56:7 146:3

thank 4:18,19 8:15 13:11,20 14:11 18:10,14 22:14,16 26:19 28:8 35:9 43:11,20 49:5,14 54:12 61:10,11 64:15,16 71:10

78:3 83:2 90:16 96:18,21,22 97:14,16,17 102:14,20 104:11 112:3,8 115:22 116:4 122:9 124:20 125:3 128:4 129:15 131:17 136:17 137:12 140:10 144:5 151:10 153:6 155:9,11 158:5,7 161:18 163:11,12 166:22 167:1,3,10,17 169:15 170:2

thanking 96:19 150:16

thanks 8:16 13:21 29:3 97:22 121:7 122:6 148:10 150:7 170:3

That'll 15:1

that's 12:18 15:7 17:7 25:8 31:11 42:1 54:21 56:22 64:18 66:14 68:19 69:4 71:9 74:4,10,12 75:14 76:11,13 77:20 78:17 79:4,5 80:4 81:4 82:14 85:10,22 86:1,12 89:11,17 91:14 92:3 93:16 95:10,11 96:14,15 100:11,22 101:21 103:11 104:22 108:8 109:5 110:5 123:17 124:1,8 126:13 133:3 136:9 137:1,7 138:14,20 139:2,9,20 140:18 142:12,20,21 144:11 145:6,13 149:20 165:7

the-above 159:19

themselves 53:10 164:8

thereafter 171:7

Therefore 164:10

there's 12:11 19:3 23:6 35:3 37:16 42:4 57:15 58:8 62:9 63:2 65:11,15,19 69:7 71:21 74:8,10 77:13 78:3 81:3,5 82:21 85:8 86:5 87:17,18 89:12 90:21 99:21 101:9 104:12 111:2 124:2,7 133:21 137:15 138:4 139:3 140:2,3,14 147:11 148:15,18

they'll 58:14 104:14

they're 19:16,17 58:13 59:21 65:13,17 84:9,14 86:11,13 91:10 94:19 102:19 103:8,11 111:1 123:2 141:21

they've 21:10 68:12

Third 37:14,15,16 89:10

thirds 36:3 55:15 63:22

Thomas 1:13 171:2,20

thoughtful 117:18

thoughts 54:15 85:15 129:18 142:1

threat 22:3 31:9 46:13 47:3 160:12 161:15

threatens 114:20

threats 26:5 39:12,14,17 40:13,15 44:18 46:15 47:7,17 48:4,12,13 59:14 67:8 103:14 115:6 117:9 118:20 119:2,15 120:12,17 121:17 157:1 164:5

three-minute 151:9

thrilled 159:2

throughout 165:22

throughway 159:22

tick 80:21

tied 62:2 98:7,8

tight 3:7 16:10

Tilleman-Dick 169:21

timely 19:4 51:6 67:9 163:19

timer 35:17

tipped 60:15

today 3:5,18 4:6,19 5:7 6:4 18:16 19:2,16 21:2 22:3 28:15,22 29:3,16 36:5 44:14 49:13 51:2 54:15 65:13 70:5 86:21 90:21 91:14 95:14 97:18 99:2 100:19 102:16 105:1 106:7 110:4 112:9 113:4 116:1,9 130:19 131:2 136:2 137:13 145:5,14,17,21 148:3 149:4 154:10 157:1 158:19 169:1,12

today's 3:18 9:4 13:1 116:17 121:22 122:7 136:5

token 15:16

tomorrow 17:3 19:3

tool 107:5

tools 59:10

top 29:9 67:20 121:16

topic 27:15 73:20 90:18 94:7 155:17

topics 4:5 36:7

top-notch 106:13

tornadic 109:4

tornado 143:11,13
tornadoes 55:12
tort 127:1,4 128:2
toss 8:8
Total 30:9
totality 73:21
totally 98:21 102:18
tough 73:17 96:4,9
tour 165:20
toward 88:22
towards 46:1 154:5
tower 40:19
town 143:12,15
track 102:1
trade 28:16 71:8
trades 71:6
traditional 60:6
traffic 135:15
train 164:20
training 33:16 53:21 56:20 108:4 119:1 165:20 166:4
trainings 165:18
trajectory 21:20 88:21
transactive 157:22
Transco 121:4
transcript 169:1,2 172:4,6
transcription 172:1,7
Transcriptionist 172:18
transform 113:12
transformation 10:5 11:5 16:2 157:14
transformer 63:7 90:20 114:1 115:19
transformers 58:1 63:6,11 90:9,18 91:2 112:15 114:3,4,15,16 115:11 118:11
transforming 19:12 130:6
transition 19:4,20 21:15 62:13 93:5,6
Transitioning 157:18
translate 22:1
transmission 17:21 23:11 25:3,12,17 27:17 40:19,21 45:11 56:11 61:15 79:1 100:2 102:7 114:5 116:17 117:19 121:20 129:11 139:1 144:20,22 145:7 168:14
transmits 44:10
transport 17:22 23:11 49:18 114:22 168:18
transportable 90:8 132:22
transportation 17:20 32:19 51:18 99:7 102:7 105:8 111:6 114:15 135:5,15 142:14
transported 51:15 114:7
transporting 51:13
travels 50:4
tremendous 15:11 17:8 48:8 66:14 82:18 93:4,9 165:17
trend 45:6
trends 65:14
Tribal 152:10
trigger 82:19
triggers 133:17
Triple 75:22
tropical 33:11 109:3
truck 168:18
trucking 105:9
true 171:8 172:7
truly 106:21 157:22
trust 119:8
trustees 40:2
try 77:10 87:10 106:16 122:17 127:3 133:19 137:6 139:6 141:14
trying 3:17 68:1 76:2 84:14 87:14 96:9 130:9,10,13,16 132:14 138:13
TSA 72:2,4
tsunami 109:14
turbines 95:10
turn 8:12 13:9 18:12 27:1,14 33:20 97:4 130:4 167:14
turns 151:5 159:21
twice 17:14
two-way 157:18
type 102:2 111:11
typed 172:4
types 55:2 111:12
typewriting 171:7
Typically 105:20
Tyran 2:16 153:5,6,7

U

U.S 28:19 29:8,13,15,21 30:6 33:6 34:10,15 37:13 50:8 51:9 65:12 90:21 103:21 107:21 108:2 112:16,17 113:8 118:14 166:5
UC 6:6
ugly 83:3
Ukraine 104:8
ultimate 36:5
ultimately 11:16 34:13 105:18 143:2 164:11
unabated 159:13
uncertainty

94:13,14,22
uncle 43:15
unconventional 15:20
undefined 47:21
undercut 160:1
underestimate 143:5
underfunded 163:2
undergoes 157:13
undergoing 93:4
underground 75:15 120:6 143:17,21
undergrounding 45:15 75:12 82:13
underlying 60:19
undermine 159:17
underpin 91:22
underpins 17:10
undersecretary 6:16,18
understand 15:19 21:6 22:10 60:19 67:21 72:18 87:13 88:1,4 91:12 115:11 123:8 136:11 156:14
understanding 74:8 80:1 165:14
understood 76:1 77:11
undertake 52:10 146:18
undertaken 33:3 115:15 132:2
undertakes 31:2
undertaking 72:22 141:16 150:8
underway 19:5 81:4 139:10
underwriters 106:15
underwriting 103:19 106:22
undo 160:5
Undoubtedly 120:4
unfortunately 111:7
unified 141:12
unintended 46:2
unique 82:11,16 118:1 155:19
United 1:9 6:9 15:10 37:18 39:8 98:4,17 99:3 100:19 104:2,18 107:10 111:9 113:19 114:1 149:5
units 115:14
universal 115:18
universally 125:17
universities 82:20 134:7 136:20
unlikely 92:21
unloading 30:13
unnecessarily 36:11
unprecedented 120:20
unreasonable 46:9
unresolved 48:3
unthinkable 110:11
update 37:19
updated 101:16
updates 155:7
upgrade 86:12
upgrading 107:19
uploaded 35:15
upon 54:12 154:22
upstream 162:10,17 163:3
urge 60:17
usage 142:19
useful 21:10
USGDP 30:20
usually 129:4
Utech 6:2 15:2
utilities 36:7 38:11,16 39:15 40:8,22 44:9,11 45:6 47:2,5,12 67:7 68:15 70:16 77:12 105:20 108:14 112:18 143:17 148:1 164:7,11,18 166:9
utility 39:11,13 44:5 46:14 47:14 70:7 74:16 96:6 114:17 115:5,7 133:4 138:21 145:17 155:20 156:20 163:16,18,20 164:4,15
utilized 34:13

V

valuable 68:4 80:4 90:5 132:17 133:10 136:21 137:1,11
value 38:3 48:9 62:10,11 72:10,18 75:2 77:4 90:7 113:16 129:21 130:19 131:4,19 150:12 154:4
values 60:8
valves 54:8
variable 62:3 89:21
variety 130:8
vegetation 56:2 64:7
vehicle 15:22 135:7 142:9,18
vehicles 49:22 50:4 141:22 142:17 143:1
vendors 136:20
ventures 116:16
venue 138:15
version 57:20
vet 78:18
vetted 39:22
via 47:8
viable 139:21
Vice 10:10 28:10,12 38:19 97:10
view 47:6 81:6

82:17 91:8 139:20
viewpoints 116:7
views 151:16 167:19
village 103:21,22
villagers 37:1,6
villages 37:3
Vines 169:20
violence 111:17
violent 46:13
Virginia 97:13 116:12,15 117:6 121:5 130:1 145:1
vision 21:13
visit 72:4
Visitors 1:9
vital 77:20 117:2 155:17
vogue 37:12
volatile 106:8
voltage 60:7 62:5 89:12 112:15 114:2,5 129:7
volumes 51:13
Voluntary 46:19
volunteered 37:5
vortex 45:5 56:13 61:6 108:21 121:2
vulnerabilities 1:5 3:21 12:17 27:16 36:8 47:12 52:16 59:15 80:2 88:8 99:13,14 100:9 135:3 163:20,21 164:4
vulnerability 44:17,18 61:20 88:12 110:14 122:16 136:9 139:14 162:3 163:10
vulnerable 45:12 48:11 120:5

W

wait 20:21
waiting 95:9,15
waivers 81:16 92:9
wake 111:7 125:15,17
walls 78:22
Walmart 69:15,16
war 19:16
warn 160:22
Washington 1:10 110:16 153:7
wasn't 143:22 144:2
watch 35:18
watching 152:6
water 7:9 20:16 160:13
wave 45:5
waves 20:16
Waxman 2:6 7:2,5,10,15,19 8:21 13:22 14:7 18:13,14 22:16
Wayland 2:21 5:8 13:18 152:8 167:15,17
ways 10:4 26:13,15 74:13 122:1 131:5 137:8 144:15 164:7
weather 16:11 20:17 26:6 44:21 55:11 56:5 119:15 130:12 156:22 160:18 161:16
web 169:6,13
website 25:15 27:4,5 35:15 104:14,15 169:3
we'd 22:14 35:18 66:15 152:21
wedding 6:3
week 20:7 36:20 42:21 115:1,3
weeks 37:1 160:11 169:5
weigh 21:6
weight 151:20
welcome 8:11
we'll 7:1 14:4 18:10 20:13 26:15 35:12 67:8 69:9 96:21,22 101:17 150:21 153:1 169:4
well-documented 64:11
wells 101:2
Welsh 3:2,3 24:19 26:18 35:11 43:12 61:11 64:16 66:4 68:6 70:2 71:10 72:20 76:17 83:2 85:13 86:19 88:7 90:16 91:16 93:2 94:6 95:19 96:18 102:14 112:5 116:4 122:9 124:18 128:4 129:15 131:17 133:18 136:17 137:12 140:5 141:18 144:5 146:13 150:16 155:11 158:5 161:18 163:12 167:1,5 169:16 170:3
WENDY 172:2,17
we're 3:17 4:5 5:1 12:14 23:16,18 24:5,8 26:13 27:1,3 42:7,11,12 44:4 49:8 50:12 56:3,19 57:1,2,21 58:10,12 59:9 62:19 66:21,22 74:13 75:13,14 80:15 81:10 83:20 84:5 86:5 87:14 88:4,5 89:7,14 90:11 94:21 95:8,14 96:5 98:7 100:14,15,20 101:5 103:20,22 105:5 106:6 107:16 110:9,16 111:19 113:17 115:6 117:17 120:3 123:6 124:11,16 126:1,20 127:12 130:5 131:14 132:18 134:13 141:13

144:15,17,21 150:19,22 153:2

western 168:21

we've 16:7,11 17:14 19:7 29:22 43:3 49:13 56:22 57:14,19 59:5 60:4 62:13 64:19 70:14 75:7 77:1 79:14 89:22 90:1,13,14 92:14 94:12 95:19 98:19 99:14 100:17 101:3 102:5,21 112:16,19 113:11 115:15 119:20 120:10 137:12,14 141:20 142:15 146:13 148:7 165:14 166:16 168:13,20 169:1

whatever 83:18 137:6 143:6

wheelhouse 56:18

whenever 96:9 120:13

Where's 63:10

whether 16:6,13,15 20:19 22:3 84:22 90:9,11 92:19 104:3,4,5 107:20,22 108:8,15,18 122:14,22 127:2 137:13 138:14 141:21 151:20 166:10 167:7

Whieldon 24:21

White 5:5,18,22 6:3 13:3 39:3 78:9 95:21 97:17 116:6 146:17 150:7 151:15

whole 18:2 76:7 89:13 168:9

whom 171:2

who's 6:2 38:2 97:7

whose 28:17 171:4

wide 12:17 116:7,8

widely 157:2,10

wider 23:17

wildfires 16:16 156:5 160:17

wildlife 158:11,13,21 159:6,12 160:21

willing 90:11 95:6

wind 19:8 62:4 113:3,12 114:6 116:19 128:16 132:14 135:4 136:7 146:2

winnows 96:13

winter 56:14 68:22 77:3 109:6,9

winterized 56:11

winter's 121:2

win-win-win 107:6

wires 143:20

wish 3:13,16 27:11 73:11

withstand 115:14 120:14 130:11

witness 171:4,6,9

witnessed 33:8

woefully 163:2

women 29:4

wondered 73:4

wonderful 141:10

wondering 25:2

work 5:2 6:20 7:13 13:13,16 31:10 39:6 57:16 58:8 62:17 63:4,6,8 65:4 70:9 72:2,4 75:19 77:17 81:8,9 82:11 84:19 85:20 89:17 92:1,22 104:10 106:11,14,15 111:19 123:7 134:20 135:2,7 166:7

worked 39:9 40:22 53:15 77:11 103:9 120:10 126:14 162:21

workers 49:20 54:11 126:10

worker's 105:14

workforce 70:22 82:5

working 6:14 10:10 23:22 36:22 40:8 43:10 55:17 56:19 59:8,9 61:13 64:21 65:3 66:2 68:11 77:9,14 80:22 87:9 102:11 103:8 107:2,3 112:3 116:1 119:11 127:2 140:9 159:7 165:12

works 25:11 71:22 77:5 79:6 144:21

workshops 165:18

world 29:21 37:15,16 42:7 54:21 63:16,17 85:3 89:10 96:4 104:3,6,17 107:10 108:7 136:2,6 149:6,8,10 158:1 159:5

world's 20:9,18 29:7,8 98:18 117:3

worldwide 112:13

worried 136:10

worse 20:13

worst 119:16

worth 7:18 81:22

wrestle 96:9

writing 27:8,13 128:20 151:19 169:10

written 134:6 165:14

wrong 167:8

www.energy.gov/QER 27:6

X

XL 51:16 161:5

Y

yards 58:21

year's 12:13 27:19 108:20 143:9

yellow 151:5

yesterday 58:7

yet 63:15 100:20 101:7 137:14

yields 20:15

York 135:2

you'll 22:21 35:18 126:4 136:2 169:22

young 7:11

yours 13:18 97:15

yourself 22:22 23:3 151:6 152:20

you've 14:11 79:8 83:3 149:4

Z

Zone 121:4