

OPPORTUNITIES TO IMPROVE AMERICAN ENERGY INFRASTRUCTURE

HEARING BEFORE THE COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE ONE HUNDRED FIFTEENTH CONGRESS FIRST SESSION

MARCH 14, 2017



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CONTENTS

OPENING STATEMENTS

	Page
Murkowski, Hon. Lisa, Chairman and a U.S. Senator from Alaska	1
Cantwell, Hon. Maria, Ranking Member and a U.S. Senator from Washington	3

WITNESSES

Koplin, Hon. Clay, Mayor of Cordova, Alaska, and CEO of Cordova Electric Cooperative, Inc.	21
Leahey, Jeffrey, Deputy Executive Director, National Hydropower Association	27
Bird, Stefan, President and Chief Executive Officer, Pacific Power, a Division of PacifiCorp	48
Leopold, Diane, President and CEO, Dominion Energy, Dominion Resources ..	59
Zindler, Ethan, Head of Americas, Bloomberg New Energy Finance	70
Imhoff, Carl, Manager, Electricity Market Sector, Pacific Northwest National Laboratory	79
O'Sullivan, Terry, General President, Laborers' International Union of North America	91

ALPHABETICAL LISTING AND APPENDIX MATERIAL SUBMITTED

American Gas Association:	
Statement for the Record	168
American Public Power Association:	
Statement for the Record	173
American Rivers:	
Statement for the Record	175
American Whitewater:	
Statement for the Record	184
Bird, Stefan:	
Opening Statement	48
Written Testimony	50
Responses to Questions for the Record	133
(The) Business Council for Sustainable Energy:	
Statement for the Record	190
Cantwell, Hon. Maria:	
Opening Statement	3
Article from the Houston Chronicle entitled "Hacked: Energy industry's controls provide an alluring target for cyberattacks" dated 3/2/2017	6
Citizens for Responsible Energy Solutions:	
Statement for the Record	196
Dahlmeier, Hon. Linda:	
Letter for the Record	202
(The) Hydropower Reform Coalition:	
Statement for the Record	205
Imhoff, Carl:	
Opening Statement	79
Written Testimony	82
Responses to Questions for the Record	157
Koplin, Hon. Clay:	
Opening Statement	21
Written Testimony	24
Responses to Questions for the Record	123

IV

	Page
Leahey, Jeffrey:	
Opening Statement	27
Written Testimony	30
Responses to Questions for the Record	126
Leopold, Diane:	
Opening Statement	59
Written Testimony	61
Responses to Questions for the Record	142
Murkowski, Hon. Lisa:	
Opening Statement	1
Northwest Public Power Association:	
Letter for the Record	213
O'Sullivan, Terry:	
Opening Statement	91
Written Testimony	93
Responses to Questions for the Record	165
Trout Unlimited:	
Letter for the Record	215
Zindler, Ethan:	
Opening Statement	70
Written Testimony	73
Responses to Questions for the Record	150

OPPORTUNITIES TO IMPROVE AMERICAN ENERGY INFRASTRUCTURE

TUESDAY, MARCH 14, 2017

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:05 a.m. in Room SD-366, Dirksen Senate Office Building, Hon. Lisa Murkowski, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

CHAIRMAN. Good morning. The Committee will come to order.

I want to thank, not only our committee members, but our witnesses that are here today. Some people have suggested that perhaps today is not a good day to be at work. I think it is a great day to be at work.

[Laughter.]

And appreciate the inconveniences some may have gone through to make sure that we are beginning this hearing to discuss infrastructure as it relates to the energy sector.

Senator Cantwell and I were just remembering that, I believe, we were the only committee operating when we had a big snow dump last year. The hearing at that point in time was to focus on issues of the Arctic. We will have an opportunity to talk about that a little bit more as it relates to infrastructure as well. This is our first hearing on infrastructure in this new Congress. I am certain it will not be our last.

We are planning today to look at lands, water and resource-related infrastructure, well, that will come next week, and then infrastructure will also be a prominent theme at hearings we have planned on our foreign mineral dependence, cybersecurity and other issues.

What I hope we can all agree on, through all of these hearings, is the types of infrastructure within our committee's jurisdiction are critically important to our country's growth and our prosperity.

The United States has some of the most robust and reliable energy infrastructure in the world. It allows us to harness energy and move it from where it is produced to where it is utilized. Without it, there would be no fuel when we pull up to the station and there would be no light when we flip on a switch. Energy infrastructure is central to our way of life and our standard of living, but it is almost always an afterthought until it breaks down on us.

We have seen that too often in recent years, making this a perfect time to look at our options to either rebuild, or in many cases, build energy infrastructure for the first time.

The reality is that we have our work cut out for us, but that work can be made less difficult, take less time and cost less money if we engage in real solutions.

Much of our nation's infrastructure is privately owned and maintained. Upgrading it and building new infrastructure is an expensive and time-consuming process. Hundreds of projects, representing billions of dollars of investment are currently navigating the federal labyrinth of permitting. Multiple agencies, numerous forms and duplicative requirements make this process cumbersome and could delay projects for years.

Of course, the federal permitting process is also layered on top of state and local permitting processes with little to no apparent coordination at times, which only adds to the difficulty of getting to yes with a project.

I am glad that the President has made infrastructure a national priority. I look forward to working with him and his Administration, as well as members of the Senate, to develop a broad infrastructure package. I certainly hope that package will include provisions that streamline the permitting process for all energy projects.

President Trump has already taken some notable first steps by restoring regulatory fairness for projects like the Keystone XL project.

I had an opportunity last Friday to meet with Prime Minister Trudeau. I think it is fair to say that he is pleased that the United States is taking another look at this important project.

But we all recognize that there is a lot to do. Developing and constructing new energy infrastructure projects can help make energy cleaner, cheaper and more abundant, and it can have a tremendous impact on our rural communities.

I am pleased that Mr. Koplin, Clay Koplin, the Mayor of Cordova and the CEO of Cordova Electric Cooperative, is here with us this morning to discuss how energy development in our home state has transitioned communities away from diesel power, lowered our costs and made energy delivery more affordable. What Mayor Koplin has been able to do over the years with his focus on small hydro has really made a difference, not only for Cordova, but those other communities that look to Cordova as an example.

I also want to point out that when Congress considers an infrastructure package, our committee will, in many ways, be ahead of the curve on a potential contribution to it. During the development of our bipartisan energy bill last year we dedicated a significant amount of time to these challenges. Our members brought forward a number of good ideas to strengthen our energy infrastructure, including streamlining the permitting process for LNG exports, enhancing electricity delivery and improving the regulatory process for hydro relicensing and licensing itself.

I was pleased that we were able to incorporate many of those ideas into the bill that passed the Senate last year with 85 votes. I am well aware that they are still available to us to enact into law in this new Congress.

I would like to say that energy is good. You all have heard that. This morning I would add to it that energy infrastructure is good and that it belongs in any conversation that we have about roads, bridges and airports.

This is an important subject and I am, again, thankful that our witnesses were able to join us this morning.

Senator Cantwell, I would welcome your opening remarks.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Madam Chair. Thank you so much for holding this important hearing and to all our witnesses for being here today. You should be commended for making your way through the snow to help us.

When Americans wake up in the morning, they flip on the light switch, they turn on the hot water in the shower, they grab their fully-charged cell phone before heading out the door and fill up their cars at a gas station. The average person probably does not give much thought to the vast network of energy infrastructure that produces, transports and delivers energy to our homes and businesses.

It is not an exaggeration to suggest that our economy, our national security and our way of life depend on the reliable, secure and efficient operation of energy infrastructure. And it has served our nation well. In fact, the National Academy of Engineers named electrification as the greatest engineering achievement of the 20th century.

As the first two installments of the Department of Energy's Quadrennial Energy Review have pointed out, we are facing severe challenges that threaten to disrupt America's access to that reliable and affordable energy.

First, our hydroelectric dams, power plants, electric transmission lines and pipelines are aging. The pace of investment has not always been sufficient to keep these facilities in good working order. According to the GridWise Alliance, our aging infrastructure is responsible for approximately 25 percent of all power outages in the U.S. The Electric Power Research Institute (EPRI) estimates that the power outages and reductions in power quality cost the U.S. economy as much as \$20 billion annually.

Second, much of our energy infrastructure is also susceptible to increasing severe storms, flooding, drought and wildfires. We have experienced numerous fires in the Northwest where we have had so much burn up, including many transmission lines. It's a real issue, and the Chair and I are going to continue to work on that.

Third, our electric grid is being stressed, due in part to technology innovations, such as smart appliances and solar rooftops, which improve the consumer's experience but rely on operations for which the grid was not originally designed. As we move from one-way to two-way communication, this is a very important issue.

In addition, we do not have enough electric transmission capacity to access the growing demand for electricity from remotely-located wind and solar farms, which are now cost-competitive with conventional electric generation.

Finally, there is the issue of cybersecurity that keeps me up at night thinking about potential hacks from Russians or foreign actors, as we see large-scale attacks happening in other places. If we do not make the necessary investments to prevent and defend against and minimize the impact of these cyberattacks, our enemies may succeed in causing a widespread blackout or devastation to our economy that is so important to millions of Americans.

Chairwoman Murkowski and I put together a bipartisan energy bill last year that made needed investments in our energy infrastructure and our workforce and doubled the amount of funding to protect us against cyberattacks and improved the security of our energy supply chain. We need to know where these products are coming from. We passed that bill 85–12 and then spent several months negotiating a conference report with the House.

Unfortunately, Speaker Ryan and the House of Representatives, in my opinion, dropped the ball in implementing this important energy legislation that would have helped our country move forward. I hope this year the Speaker will finally recognize that protecting our electricity grid and making needed investments requires serious attention.

Today, I am also calling on the Trump Administration to protect the public from growing cyber threats that Russia and other foreign actors pose against our energy assets. That is why today, I am sending a letter to make sure that we clarify the DOE's role as a lead agency in our nation's cybersecurity matters, both on the defense side and on the response side, to hacking of our critical energy infrastructure. This is very important because we have heard rumors the President may issue an Executive Order expanding the Department of Homeland Security's role in this matter. I equate this to seeking medical attention and seeing a doctor, when in reality you need a dentist, because what you have is an oral problem. We need the right experts doing the right things to protect us.

Although digitization of the grid offers tremendous benefits, it also makes the grid more susceptible to cyberattacks. This particularly troubling issue increases the concerns that we have about foreign actors and their capabilities of doing significant damage to the grid.

As Admiral Rogers, Director of the NSA and the Commander of the U.S. Cyber Command during the Obama Administration, recently told Congress, "Russia holds the cyber capability to cripple our infrastructure." And according to a recent NBC News report, the Russians have conducted more than a dozen significant cyberattacks against foreign countries, including the U.S. In addition, the Department of Homeland Security and the FBI recently published a Joint Analysis Report documenting Russian malicious cyber activity in the United States.

We all know that they hacked into three Ukraine distribution utilities knocking power out to more than 225,000 customers. It appears that might have been done again two months ago, when a utility in northern Kiev reported that the grid was brought down as a result of a cyberattack.

Fortunately, the U.S. has not yet been successfully attacked that way. But we do know that there are frequent attempts to hack our utility systems. Just recently the Houston Chronicle published a re-

port about our U.S. oil and gas pipelines and how susceptible they are to hackers using new malware that disrupts the control system. The story goes on to detail that these hackers could increase the flow of oil and gas in the manner that could potentially cause an explosion.

Madam Chair, I would like to enter that article in the record.

CHAIRMAN. Accepted.

[The information referred to follows:]

Hacked:

Energy industry's controls provide an alluring target for
cyberattacks

Story by Collin Eaton (<http://www.houstonchronicle.com/author/collin-eaton/>)

Photos by James Nielsen

Published: March 2, 2017

A ship docked along the Port Arthur Ship Channel Wednesday, Jan. 11, 2017, in Port Arthur.

A Coast Guard cutter glides along the waters of the Sabine-Neches waterway, conducting sweeps for unprotected wireless signals that hackers could use to gain access to oil, gas and petrochemical facilities.



Four massive refineries sit along the 79-mile channel that cuts through this stretch of Gulf Coast. It's one of the largest concentration of refineries, pipelines, chemical plants and natural gas terminals in the United States - and an alluring target for espionage, disruption or worse.

"There are actors that are scanning for these vulnerable systems and taking advantage of those weaknesses when they find them," said Marty Edwards, director of U.S. Homeland Security's Cyber Emergency Response Team for industrial systems.

As national attention focuses on Russian cyberattacks aimed at influencing the last presidential election, oil and gas companies face increasingly sophisticated hackers seeking to steal trade secrets and manipulate industrial sensors and operations.

Nowhere is the threat more consequential than in Houston and Southeast Texas, where the world's most celebrated names in energy produce, refine and transport fossil fuels, including Exxon Mobil, Royal Dutch Shell and Phillips 66.

The operation aboard the Coast Guard cutter, a joint effort with Houston Police last April, was one of the first of its kind in the U.S. to focus on cyberattacks by sea.

The U.S. Department of Homeland Security, responsible for protecting the nation from cybercrime, received reports of more than 350 incidents at energy companies between 2011 and 2015. In most cases, a hacker infiltrated or tried to infiltrate the control systems of energy firms. During that period, the agency identified nearly 900 security vulnerabilities within U.S. energy companies, more than any other industry.

The vastness of oil and gas operations makes it difficult to secure. Thousands of interconnected sensors and automated controls that run oil and gas facilities remain rife with weak spots.

Much of this equipment was designed decades ago without security features. In recent years, companies have linked devices that monitor pressure, control valves and initiate safety procedures to computer networks and - sometimes inadvertently - the internet.

Those connections expose refineries, pipelines and offshore oil platforms to online threats.

"You could mess with a refinery or cause a vessel to explode," said Richard Garcia, a former FBI agent who became a cybersecurity specialist.

The Coast Guard has received several reports that foreign ships attempted to probe the wireless networks of industrial facilities along U.S. waterways, federal authorities say. Homeland Security, which oversees the Coast Guard, declined to confirm details of any operation and intelligence but acknowledged a growing effort to protect oil, gas and chemical systems from hacking.

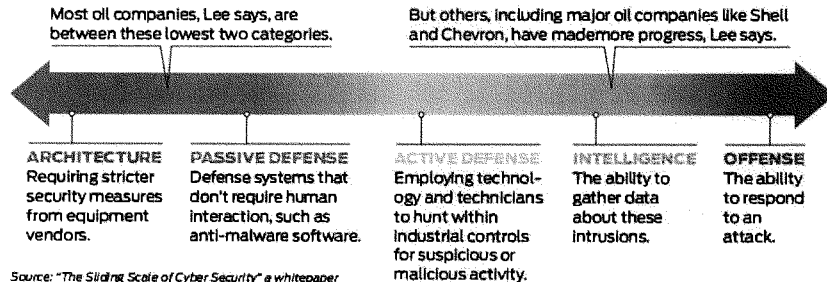
Many energy companies, however, lack the technology and personnel to detect whether hackers have broken into operational systems using sophisticated malware that can take over controls or extract data.

In fact, many oil and gas facilities still use networks run by Windows XP, a 2003 system that Microsoft no longer updates, according to federal authorities and cyber security consultants. Others use even earlier versions of the Windows operating system from the 1990s; in rare cases, a few still use MS-DOS, the precursor to Windows.

"More often than not," Edwards said, "we find that there's been corners cut or they haven't taken a hard look at security when they designed those networks."

The sliding scale of cyber security

Security consultant Robert Lee devised this model to categorize the types of investments companies can make in securing industrial control systems. While some oil companies have installed firewalls and other protective measures between corporate and operational networks, many fall short of actively monitoring internal networks.



'What we don't know'

Strict cybersecurity regulations govern power, chemical and nuclear facilities, but no federal laws impose such standards in the oil and gas industry.

When oil and gas companies have been infiltrated by a hacker, they aren't required to report the incident. And if they turn to federal authorities for help, the specifics are typically kept secret because companies disclose information in exchange for anonymity and discretion.

Homeland Security publishes data on cyberattacks, but with no reporting requirements, the data represent only a small share of the cyberattacks against the energy industry.

"We only know what's reported to us," Edwards said. "We don't know what we don't know."

Most companies are loath to talk publicly about the security of computer systems and industrial controls for fear of providing information that could be used to exploit their operations.

More than 20 of the nation's largest oil companies, including Exxon Mobil Corp. and ConocoPhillips, refiners Phillips 66 and Valero, service companies Halliburton and Baker Hughes, and pipeline operators Kinder Morgan and Enterprise Products Partners, declined to comment or did not respond to multiple requests for comment. The American Petroleum Institute, the national trade association of oil and gas, declined comment as well.

The Department of Energy has developed a model of best practices while trade groups such as the American Petroleum Institute have adopted industry standards, but none is mandatory.

In recent years, forward-looking oil companies have treated potential cyberattacks on critical assets as a major financial risk, but others haven't taken the threat as seriously, said Charles McConnell, executive director of Rice University's Energy and Environment Initiative.

Oil companies tend to rush to deploy new computer technologies that make operations more productive, he said, but only afterward consider ways to mitigate online threats.

"The pace of change of the technology we've adopted is every step of the way more and more vulnerable to cyberattack," said McConnell, who spent 35 years in the energy industry and served for two years as assistant secretary of energy.

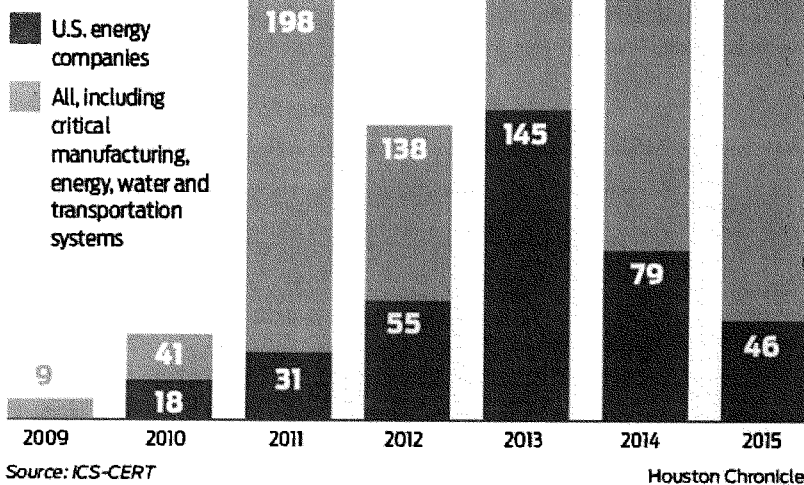
Of nearly 400 U.S. oil employees who specialize in industrial cybersecurity, 61 percent said their companies lack adequate cyber defenses to protect the technologies that run oil and gas facilities, according to a recent survey by the research firm and consultancy Ponemon Institute. Almost seven of 10 respondents said their companies experienced a security breach within the last year, and yet, less than half believe their companies have met industry standards and guidelines for cybersecurity.

Oil and gas companies generally have gotten better at securing their information and data systems, Edwards said, but it would be "dangerous" to characterize the progress as universal.

Some companies have begun to install firewalls, anti-virus and anti-malware programs and require stricter security measures from equipment manufacturers, among other improvements, cyber security consultants said.

Cyber incidents involving industrial control systems

Homeland Security responded to nearly 1,200 cyber incidents across the United States. The data provide a rare glimpse into the threat facing industrial companies, but specialists believe far more cyberattacks go unreported.



In regulatory filings, Exxon Mobil said its cybersecurity programs block 64 million emails, 139 million internet access attempts and 133,000 other potentially malicious actions each month.

"There are definitely some leaders that have done a lot to stand out," said Robert Lee, a former Air Force cyber warfare operations officer and chief executive of security firm Dragos in San Antonio. "But that's not representative of the industry. It's clear a lot of sites haven't done the minimum for security, and there are many more in the middle."

'Boom in the night'

Devices running automated processes within plants - known as operational technology - were designed years or decades ago before the advent of serious online threats. Security experts say even newer models of sensors and automated controls can't automatically block intrusions.

Marc Othersen, former chief information security officer of New York oil producer Hess Corp., says equipment makers must do more to develop adequately secured devices.

"The technology offered to us has not closed the gap," he said. "We will always be behind."

Last year, Exxon Mobil and Lockheed Martin announced plans to advance automated systems for refineries and chemical facilities with built-in cyber defenses. The initiative, which includes collaboration with 40 other companies, was prompted primarily because devices with protections strong enough to thwart the most skilled hackers aren't widely available, said Joe Weiss, managing director of the international cybersecurity standards body ISA99.



Photo: Jordan Pridemore, Staff

With a refinery that could be vulnerable to hackers behind it, a ship navigates through Buffalo Bayou heading to the Houston Ship Channel earlier this year.

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"Ironically, it's the most important (of the systems) but the least secure," he said.
"That's where you go boom in the night."

If hackers, for example, figured out how to exploit devices running along 2.6 million miles of U.S. pipeline, they could tell a monitoring system the flow of oil and gas has stopped along a pipe, prompting automated systems to begin pumping until they cause a pressure blast.

When such systems malfunction, it can lead to disasters on the scale of the 2005 Texas City refinery blast, which killed 15 people and injured 180 more. In that tragedy, there was no malicious intent, but devices were incorrectly calibrated and provided erroneous readings, which, investigators concluded, were major factors leading to the blast.

"There are a lot of people out there who would love to disrupt (a pipeline) for visual effect ... terrorists or other people who want to see black smoke or flames," said Philip Quade, who recently retired as chief of the National Security Agency's cyber task force. "The more strategic threat is what nation-states can do to affect the psyche of the American public."

'In a dark room'

The majority of U.S. oil and gas companies don't have the capability to find or track malware or viruses that have already penetrated control systems, according to Homeland Security, including devices such as sensors and industrial computers.

This means hackers can gain access to the systems and root around for months or years seeking weaknesses, collecting sensitive data and lying in wait with viruses that can disrupt operations.

"We're in a dark room," said Damiano Bolzoni, chief executive of Dutch security firm Security Matters. "Nobody is switching on the light."

Cyber criminals have tried to steal money by sending employees fake invoices. Other hackers lured workers to download malicious software designed to lock people out of computers or other devices until they pay a ransom.

In many cases, oil and gas companies wait to react to problems, said Chris Sistrunk, a consultant with Mandiant, which specializes in cybersecurity. For example, he recalled how an oil company's cybersecurity team was alerted to a security breach, in which a 7-year-old computer worm had been discovered in a Windows operating system. Its presence suggested that the company hadn't updated protection software in at least seven years.

"Security people are putting out fires instead of hunting for evil on the network," Sistrunk said.

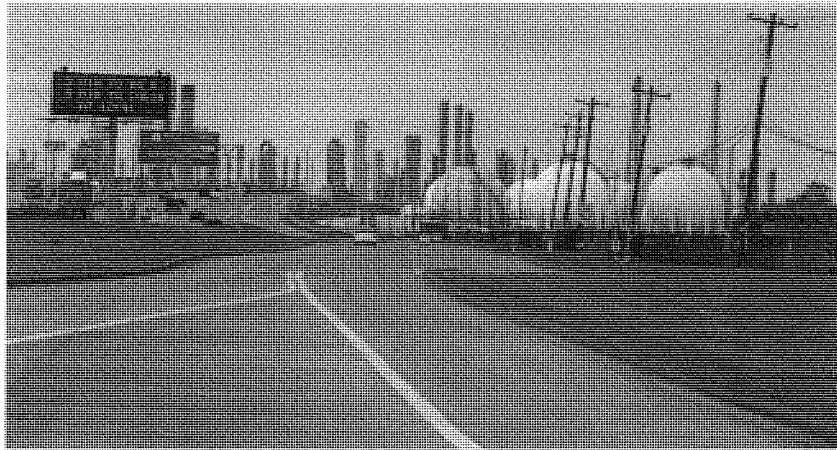
The most sophisticated threats come from hackers backed by foreign governments. Cybersecurity researchers say both Russia and China have sponsored hacking groups, often recruited from the cyber-underworld, to probe industrial control systems in the United States and Europe.

More recently, hackers allegedly from Russia and China have used phishing emails, infected USB drives and other techniques to penetrate computer networks in broad espionage campaigns against U.S. energy companies aimed at siphoning information about industrial control systems, according to the National Security Agency and cybersecurity firms.

"These attackers are adaptive and intelligent," said Michael Assante, former chief security officer of the North American Electric Reliability Corp., which regulates the security of electric grids. "That's a scary thing to be up against."

For the most part, federal officials said, cyberattacks against energy companies appear aimed at stealing trade secrets to boost foreign industries and economies. But some officials anticipate that hacker groups may try to gain footholds in pipelines, refineries and power plants, should the day come when a rival nation or extranational group has reason to hold assets hostage or launch a disruptive attack.

"When the day comes and they need leverage in negotiations or a full-blown act of war, it's not hard to imagine how they might use such a capability," said Barak Perelman, chief executive of the Israeli cyber security firm Indegy.



FRANCIS JAMES NIELSEN / HOUSTON CHRONICLE

A refinery along highway 225 Wednesday, Jan. 25, 2017, in Dear Park. (James Nielsen / Houston Chronicle)

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Quade, the former chief of the NSA's cyber task force, said the threat is more than theoretical, pointing to two viruses launched at energy operations: Stuxnet, which damaged thousands of centrifuges at an Iranian nuclear facility in 2010, and Shamoon, which wiped out computer files in Saudi Arabian oil and gas facilities two years later.

"In the last five years, we've had repeated demonstrations in the willingness of certain nation-states or other actors to actually use this stuff," Quade said.

It's unlikely that Russia or China would sabotage the nation's energy infrastructure because of the probability of retaliation, but these two world powers have honed their abilities to hold key U.S. assets hostage and use cyber capabilities to thwart U.S. military responses to online assaults on domestic soil, the U.S. Department of Defense said in a report last month.

"This emerging situation threatens to place the United States in an untenable strategic

position," the Defense Department said.

But security professionals say a major cyberattack against the United States remains a distant possibility, at least for now.

"They're waiting for a rainy day," said Margrete Raaum, who leads the Norwegian computer emergency response team for the energy sector.

Security vs. costs

Despite improvements, some oil and gas companies still don't make it particularly hard for hackers to get into many systems. Consultants have found lapses in security as egregious as writing passwords of critical computer systems on sticky notes pasted to consoles.

Other networks had generally weak passwords or the default passwords set by manufacturers.

"There's a lot of those," Edwards said.

Part of the problem reflects the culture of the oil and gas industry, said Steve Mustard, an industrial cybersecurity expert at the trade group Automation Federation.

Upgrading a multitude of devices could cost millions of dollars, and oil companies often find it too expensive and time-consuming to patch software running multibillion-dollar refineries that produce gasoline almost all the time.

Even a four-hour security upgrade can stop production for days, said Philip Hurlston, who works with oil companies and the FBI as oil and gas sector chief at security group InfraGard in Houston. Hurlston says an industry mantra still plagues the mindset of some executives: "Run the equipment until it dies."

Security experts said the steps that energy companies can take to defend against hackers aren't necessarily difficult. It's often a matter of limiting unauthorized access, adopting careful procedures for protecting networks and making sure the latest cybersecurity measures are in place.

The question remains, however, how quickly companies are moving to take such actions, and perhaps more fundamentally, how seriously do they take the threat.

"For an oil executive, worrying about a cyberattack sounds like science fiction," said Brett Young, a consultant and founder of the cyber security collaborative, OpenICS Project. "It's like worrying about a meteor strike."

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There are no comments yet.

Collin Eaton is an energy reporter for the Houston Chronicle.



Collin Eaton
([author/collin-eaton/](/author/collin-eaton/))

Business Reporter, Houston Chronicle

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Senator CANTWELL. Thank you.

Our grid and our economy and way of life have increasingly become more dependent on our electricity grid and smart equipment. We need to make sure that we are deploying energy in new ways safely and efficiently.

The electrification of our economy requires a more robust, smarter, modern electricity grid to accommodate the 21st century. By reducing overall energy consumption and facilitating consumer access to cleaner grid modernization, we also can make improvements in the competitiveness of our U.S. economy.

The World Economic Forum estimates that the digital transformation of the electricity technology will create \$1.3 trillion in economic value over the next ten years. So to me, it is imperative that the U.S. lead in this effort.

As the Quadrennial Energy Review pointed out, we need to invest in the workforce that's needed, approximately 200,000 workers with STEM skills will be needed for the electricity grid of the future. Our energy bill last year would have created a Department of Energy Workforce Advisory Committee to make sure we have the curriculum established to get those workers for the future.

Madam Chair, I look forward to hearing our witnesses on these important issues and continuing to make investments in the energy infrastructure that we need for our nation. Thank you very much.

CHAIRMAN. Thank you, Senator Cantwell.

You remind us about the important issue of cybersecurity, not only as it relates to our energy sector, but really, all aspects of our economy. But on a morning like today when people are thinking about the physical aspects of our energy grid, because I would venture to say that with the snow and ice you have got some power lines that are down somewhere, not at my house, but you have got some power lines that are down somewhere. When people are inconvenienced or are without what they have come to expect or they realize that capacity is limited, it is less, their energy sources, are less reliable, they look to us to say what have you done to fix it? We are going to have an opportunity to discuss that here this morning.

As I mentioned earlier, Mr. Clay Koplin is the Mayor of Cordova, Alaska. He is the CEO of Cordova Electric Cooperative. He has come a long way to be here with us this morning and I look to him as one of Alaska's energy experts. I appreciate that you're with us here this morning, Mayor.

He will be followed by Mr. Jeffrey Leahey, who is the Deputy Executive Director for the National Hydropower Association. We appreciate your leadership in the hydrospace which is very, very important to us.

Mr. Stefan Bird is with us. He is the Chief Executive Officer for Pacific Power. Thank you for joining us.

He will be followed by Diane Leopold, who is the CEO and President of Dominion Energy. Good morning to you.

Mr. Ethan Zindler will follow Ms. Leopold, and Mr. Zindler is the Head of Policy Analysis for Bloomberg New Energy Finance. Good morning.

Mr. Carl Imhoff is next, the Manager of the Electricity Market Sector for Pacific Northwest National Laboratories. We thank you for your good work.

The panel will be rounded out this morning by Mr. Terry O'Sullivan, who is the General President of Laborers' International Union of North America. We look forward to your comments as we talk about energy and those workers that provide these opportunities for us.

With that Mayor Koplin, if you want to lead off the panel and we will just go through. I would ask each of you to keep your remarks to no more than five minutes. We do have a larger panel than usual this morning, but your full comments will be incorporated as part of the record. Thank you.

STATEMENT OF HON. CLAY KOPLIN, MAYOR OF CORDOVA, ALASKA, AND CEO OF CORDOVA ELECTRIC COOPERATIVE, INC.

Mr. KOPLIN. Thank you.

Good morning, Chairman Murkowski, Ranking Member Cantwell and members of the Committee. I'm Clay Koplin, Mayor of Cordova and a CEO of Cordova Electric Cooperative and have expertise in developing energy infrastructure and the values that it can deliver.

Cordova is located in Prince William Sound near Anchorage, and the community has rebounded from a series of economic disasters that defines its resilience. Our current status includes a ranking as the 13th largest seafood delivery port in the country and the largest commercial fishing fleet in the State of Alaska.

Socially it ranks as the number one high school in the state and the safest community in the State of Alaska.

So, energy infrastructure in the community includes a smart grid boasting 100 percent LED lighting, 100 percent underground power lines with a high renewables contribution. This ascension has resulted from strategic infrastructure investments in a collaborative of local partnerships. These successes have attracted the interest of the national laboratories and around resilience, smart grid, microgrid and demonstration of best practices.

In 2006 we had 48 inches of rain in three days and fortunately FEMA showed up with a federal disaster declaration that allowed the project to rebuild and make you whole. And then FERC showed up to assist and regulate.

The problem is those two lead agencies and their inherent conflict were followed by a regulatory dog pile that kind of left Cordova Electric at the bottom of the stack holding the football. Fortunately, Senator Murkowski's office and her staff got everybody back onto the field, playing as a team, and after five long years and \$22 million, had us to the finish line and our project back in operation.

But on a positive note, during that flooding our 100 percent underground power lines allowed not a single outage in the community.

So, what are the ways that we could improve the way that we develop infrastructure? Execute local game plans to add resilience and value; invest in projects, not in processes; and promote federal facilitation to deliver higher value from these projects.

I give you an example of a local game plan of converting to 100 percent underground power lines. And that's just an example in the tens of millions of dollars of social value that that added to our community of a local initiative.

But we also need a federal role of investing in projects by participating in both funding the infrastructure, but also sending experts in the field to derive value, not only from the projects themselves but for their own agencies. The whole team has to take the field. Now we can't just have blockers out on the field while we have the quarterbacks and the salary cap stars strategizing and criticizing from the sidelines.

Cordova Electric's two initial hydroelectric projects had construction timelines and costs doubled during construction due to regulatory posture and a lack of accountability. These projects should have been developed by a team effort working in the field together right through the final whistle on the project. The dated traditional approach is to craft a perfect game plan for success. Now the problem is that injuries and fouls and other teams' changes in strategy undermine that plan.

So what we need is an agile approach that expects those kinds of fouls and injuries and tricks by the other team and relies on the agility, the talent and the close communication between the team, including the federal agencies that can coach us to quickly adapting to changing conditions.

There's a football team a little north of here in Foxboro, Massachusetts that's perfected that adaptation game, and I think there's some lessons that we might be able to learn in our infrastructure investments.

Cordova is poised to proceed with a Crater Lake Water and Power Project right now that's been designed to build an agile team and an agile project management structure. It will probably succeed with or without federal assistance to deliver water to a growing industry, renewable energy, emergency and commercial water supply, recreational, educational, self-sufficiency and commercial business opportunity value streams all from one project. That's the kind of shared cost/shared benefit projects that we should be looking at with our infrastructure investments and it exemplifies Cordova Electric's aspiration to be a leader in environmental stewardship in a new age of energy.

The project probably would be under construction now if hydro had been classified as renewable and we had access to the crab spawning to build it, but we'll use RUS and other mechanisms to get the project built. We want to finance this long-life asset for a sustained, balanced score card return on investment of all those value streams.

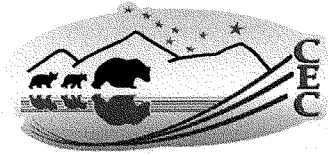
Unfortunately, the concept of a public/private partnership may not work so well for energy infrastructure investments, like we'd hope. Private equity tends to price to risk, and unfortunately, regulatory is one of the biggest risks of building a project.

In summary, I encourage local, strategic game plans that make sense investing in both financial and agency staff resources out in the field so that we can have successful outcomes for all players and which will consistently deliver the better social, economic and environmental values that we all want from these projects.

Thank you for this opportunity to testify. I'd encourage any questions you might ask and I'd strongly encourage a field hearing in Cordova so that you can actually see these solutions and successes on the ground and not just hear about them.

Thank you.

[The prepared statement of Mr. Koplin follows:]



CORDOVA
ELECTRIC
COOPERATIVE, INC

**Written Testimony of Clay Koplin
CEO of Cordova Electric Cooperative, Inc. and Mayor of Cordova, Alaska
On behalf of Cordova Electric Cooperative and The City of Cordova
Before the Senate Energy and Natural Resources Committee
Hearing to Receive Testimony on Opportunities to Improve American Energy Infrastructure
10:00AM, Tuesday March 14, 2017**

Good morning Chairman Murkowski and ranking member Cantwell. I am Clay Koplin, Mayor of Cordova Alaska and CEO of Cordova Electric Cooperative (CEC) with expertise in power lines, power plants, and the value that energy infrastructure investments deliver locally and nationally.

Cordova is located in Prince William Sound in southcentral Alaska about 150 air miles from Anchorage with a population of 2,300. The community's time-tested resilience in reinventing its excellence in the wake of disasters can be likened to a phoenix that keeps rising from the ashes. From the closure of the world's largest Kennecott Copper Mine and longest private railroad Copper River and Northwest in 1938, to the resurrection as the world's largest razor clam industry destroyed by the 1964 great Alaska earthquake uplift, to the more recent globally ranked Prince William Sound fisheries' devastation by the 1989 Exxon Valdez oil spill, Cordova bounds to its feet when knocked flat. Current status includes a ranking as the 13th largest seafood delivery port in the US, the largest commercial fishing fleet in Alaska, and a world-class intelligent energy grid boasting 100% LED street lighting, 100% underground power lines, 77% renewable energy supply, and leading and innovating micro grid technology. Socially, Cordova is ranked as the best high school, safest community, and third best city for young families in Alaska. It ranks in the top ten communities in Alaska in nearly every positive metric and continues to grow its population despite a statewide recession. This ascension has resulted from state and federal grants and loans for energy infrastructure and private sector fishing and processing infrastructure investments. It has been aided by the resilience and agility of CEC and other community organizations partnering to navigate the financial, regulatory, and business challenges of developing and operating energy infrastructure with lean resources and a formidable logistical environment. These successes have attracted the interest of the national laboratories.

Every Alaskan community has a story about a tsunami, an avalanche, an earthquake, a volcano, a changing climate, a charging grizzly bear, or some other random inconvenience requiring extreme and often unconventional solutions to restore order to their world. For Cordova, the damage caused to the Humpback Creek Hydroelectric Project by 48" of rainfall over a span of three days in October of 2006 contributed to a federal disaster declaration by "lead agency" FEMA to "make you whole" if rebuilt to exactly pre-flood design and function. Enter "lead agency" and licensor FERC stipulating redesign and reconstruction to current safety standards; not the design that failed. The ensuing regulatory dogpile of permitting agencies left Cordova Electric at the bottom clutching the football and wondering why we had been tackled by our own team. Thanks to the assistance of Senator Murkowski and her staff, we were able to peel the players off the pile, line them up on the same side of the ball, and get the project reconstruction moving down the field and finally to the goal line in summer of 2012. The federal funding from FEMA essentially covered the excessive component of the regulatory costs while the

balance of State of Alaska Renewable Energy Fund grants and CEC financing were able to overwhelm the remaining financial and logistical barriers. Of particular note is what didn't present a challenge during the flooding: power outages. Thanks to 100% underground and submarine power cables, a local policy initiative since 1978, even equipment submerged under seven feet of water continued to deliver service - except to flooded homes and businesses disconnected for safety.

What are ways we can improve the Federal Government's role in energy infrastructure projects? Build underground power lines or other local initiatives to add resiliency and value, invest in projects, and facilitate delivery of the highest possible value from those investments.

Building underground rather than overhead power lines is an example of a locally vetted and implemented policy that adds resiliency and is welcomed by consumers. This is a way in which federal technical assistance sent to the playing field learns and disseminates best practices yielding low-hanging fruit for others investing in infrastructure. Keeping all quarterbacks and salary cap stars on the sidelines strategizing with coaches while assigning only linemen to the field diminishes the game but not the cost.

The language of the federal roles in developing infrastructure; "regulating" and "permitting", tells the story of a process rather than product directed influence. In the case of the Humpback Creek disaster in Cordova, the \$5.3 million received as emergency aid barely offset the financial resources consumed by the total regulatory process, while the \$16.7 million balance invested by CEC and the State of Alaska was the actual infrastructure investment. Policy changes that bring both the funding and the representatives of the Federal agencies right onto the game field to observe, participate, and facilitate the projects as value-adding partners will result in true team efforts and higher game scores. Consequently, I believe this will actually improve agency performance in achieving their missions of contributing to environmental, financial, social, and cultural excellence. These are now shared goals between regulators and industry. The current paradigm of lobbing regulatory grenades at infrastructure developments every time there is an appearance of non-compliance or the insurgence of innovations that do not fit the boxes on a dusty checklist is no longer successful in a complex, uncertain global environment. More agility and resilience is necessary to overcome modern barriers to infrastructure investment.

CEC has had similar development experiences with the initial development of the Humpback Creek Hydroelectric Project in 1992, the Power Creek Hydroelectric Project in 2002, and our current Crater Lake Water and Power Project in 2017 – project development timelines and costs doubled primarily as a result of an ineffective regulatory framework. Each of these projects could have been developed as a team effort that required each stakeholder; CEC, community, agencies, NGOs, and ratepayers to take the field and work together as a team from the kickoff through the final whistle. The traditional approach to this type of teamwork is to evaluate the opponent and craft a perfect play-by-play game plan for success. The problem with this approach is that injuries, fouls, and adjustments by the other team undermine that plan. An agile approach to the game expects fouls and injuries and tricks by the other team, and relies on the agility, talent, and close communication between team members and coaches to quickly adapt to changing conditions. There is a football team a little north of here in Foxboro that has perfected this game, and applying this Agile Project Management approach to energy infrastructure development can reduce the costs and timelines of projects while improving and expanding the value streams they deliver.

As an example, Cordova is currently poised to proceed with the rebuild of an end-of-life harbor to sustain our fishing industry and with the development of the Crater Lake Water and Power Project to provide the water necessary to accommodate the growth and full utilization of half a billion dollars of seafood fishing and processing infrastructure.

The Crater Lake project would likely already be under construction if the Energy Bill you crafted last year had passed, declaring hydro a renewable resource in the IRS tax code and other federal definitions. CEC could have accessed nearly a billion dollars of leftover 1.5% Clean Renewable Energy Bonds for construction. Regardless, a non-jurisdictional determination by FERC allowed CEC to proceed with implementation of an Agile project management plan, which we hope to demonstrate with or without federal assistance. We prefer federal financial assistance and close engagement (in the field) to collaboratively execute, evaluate, and capture the process and the limitations of its application.

The Federal Grant and loan programs are critical for developing infrastructure if only to offset the current regulatory costs. Unfortunately, the public-private partnership concept probably isn't going to work for energy infrastructure investments like we would hope. Private equity prices to risk, and frankly, the greatest risk to developing energy infrastructure is often regulatory uncertainty.

Once a partnering and collaborative environment of teamwork has been established, the value streams from an investment can be maximized. In addition to economic benefits, social, educational, and adjacent value streams can be derived. For example, the Crater Lake Water and Power Project is primarily a clean water supply adequate to meet the needs of the growing seafood industry in Cordova, which has exceeded the current water supply. The resulting employment, state and federal tax revenue growth, and tsunami and earthquake tolerant emergency capabilities of this project are just a few of the downstream values of just the water component. By harvesting the energy from the high pressure water source before it is delivered to the City, CEC can directly elevate the renewable share of Cordova energy to 90%. The energy storage capacity of the project charts a path to 100% renewable contribution by making intermittent renewables like solar, wind, and tidal feasible. In this particular case, the dam provides direct protection against historical ice dam flooding of a downstream adventure lodge, and the same general protection that all reservoirs provide against drought and flooding. In addition, the power plant/water plant can be designed and located to complement, rather than detract, from the adjacent adventure lodge. A third story could be added to serve as a small restaurant or other small business opportunity at low incremental cost. A large picture window on an exterior wall and a glass portal on the electric generator can allow schoolkids and tourists to physically see the inner workings of a hydroelectric plant. A small tribal hatchery could enhance commercial, subsistence, and recreational salmon fishing opportunities downstream of the project. A tidewater pipeline could allow the project to deliver hundreds of millions of gallons of excess or emergency water for disaster relief and/or commercial markets. Construction roads could be repurposed as community hiking or skiing trails after project completion. The carbon, nitrous oxide, and sulfur dioxide emissions offset by the reduced use of diesel power generation creates a value stream for organizations seeking to contribute to a cleaner globe.

In summary, federal participation in energy infrastructure development is, perhaps, more essential than ever. It can be improved by directly encouraging such initiatives as broader implementation of underground power lines and continuing to work toward formal adoption of hydropower as a renewable resource. By changing the federal agency posture from regulator/permitter to facilitator and assigning agents to project development teams, the grants and loans are more likely to contribute financially to building the projects and delivering better social, economic, and environmental value streams.

Thank you for this opportunity to testify. I would encourage any questions you might ask, and strongly encourage a field hearing to Cordova where you can see rather than hear of these opportunities.

Respectfully,

Clay Koplin

CHAIRMAN. Thank you, Mayor. We will look at the opportunity for my colleagues here. The Mayor has indicated this is great little community with safe, good schools. It is also without access to the road system. Population about—

Mr. KOPLIN. 2,300.

CHAIRMAN. 2,300 people.

But when you think about what it means to take a community of 2,300 people off of diesel and put it on renewable available hydro, it makes all the difference.

Sorry, I do not mean to be editorializing, I just get excited about Cordova because it is a great community.

Senator FRANKEN. Sounds like a great place for a field hearing.

CHAIRMAN. I think that is a wonderful suggestion, Senator Franken. We might have to take the Mayor up on that.

Let's go to Mr. Leahey.

**STATEMENT OF JEFFREY LEAHEY, DEPUTY EXECUTIVE
DIRECTOR, NATIONAL HYDROPOWER ASSOCIATION**

Mr. LEAHEY. Good morning, Chairman Murkowski, Ranking Member Cantwell and members of the Committee. I am Jeffrey Leahey, Deputy Executive Director of the National Hydropower Association (NHA). I'm pleased to be here to discuss the importance of hydropower to the U.S. electric system, its untapped growth potential and the policy issues that need addressing to realize that growth.

Today our existing U.S. hydro fleet is made up of almost 2,200 plants and provides six to seven percent of all U.S. electricity and close to half of all renewable generation, making hydropower the single largest provider of renewable electricity. In addition, another 42 pump storage plants make up almost 97 percent of U.S. energy storage. The system also contributes to cleaner air and provides other benefits including river management for fish and habitat protection, flood and drought management, water supply, irrigation and others. Hydro also provides many grid benefits, peaking generation, load following, reliability and more. With the growing need for these services, U.S. hydropower has expanded in recent years with a net capacity increase of close to 2,000 megawatts since 2005.

Hydro projects also bring economic benefits where they are located. The industry employs a sizable workforce of 150,000 and access to low cost, clean, reliable power attracts many high-tech firms and manufacturers to regions with hydropower.

And hydro can do even more. The myth is that hydro is all tapped out. However, I urge the Committee to review the new hydropower vision report by the Department of Energy released last year. It highlights the significant potential to expand U.S. hydropower with the right policies in place. Fifty gigawatts of growth is possible by 2050.

For example, only three percent of our 80,000 dams generate electricity. A 2012 assessment found over 12 gigawatts of potential with eight gigawatts available at the top 100 sites. Eighty-one of the top 100 sites were located on Corps of Engineers' dams.

Some projects though, are not pursued over concerns about the uncertain, duplicative and lengthy licensing process. For example, one NHA member reports that their new project at a Corps dam

in Iowa will come online in 2018 having started development in 2005, 13 years earlier.

Turning to existing hydro projects, owners can get more power out of their plants through upgrades in efficiency improvements. This allows for increased generation and can have added benefit of improved environmental performance.

Looking at pump storage, these projects can rapidly shift, store and reuse energy when there is corresponding system demand and facilitate the integration of intermittent, renewable resources. As more intermittent generation is added to the grid, the need for pump storage is increasing. Right now, about 15,000 megawatts of proposal are before FERC.

However, Congress needs to address the challenges existing asset owners and developers face. Water is a public resource and the industry recognizes the need for thorough project reviews. But the process can be a cause of delay.

Again, using non-powered dams as an example, FERC issues the license but construction cannot begin until other approvals from the federal dam owners are in place. Processes like these and others are not always coordinated, are sequential rather than in parallel.

Also holding back hydro is its limited recognition or lack thereof as a renewable. State renewable portfolio standards and other environmental markets often contain restrictions on the amount of eligible hydropower.

Federally, programs for renewable energy procurement or development on public lands either exclude hydro completely or restrain its participation. When hydro is not valued as a renewable it creates economic disadvantage. The renewable energy tax credits are a clear example.

The 2015 PATH Act creates a competitive imbalance between wind and solar and other renewables. The hydropower credits were extended through 2016, now expired, while the wind and solar credits were extended for years longer. Competing for investment dollars, this tipped the scales against hydropower.

NHA also highlights R&D investment for technology innovation. The DOE Water Power Office is one of the smallest in the Department, and the hydropower R&D program routinely receives the least funding followed closely by the marine energy program.

One last policy area to consider is that of regional electricity markets. Often the grid benefits of hydro and pump storage are not valued and compensated under existing power markets, and project proponents do not receive the full benefit of the services they provide.

While my testimony today focused on hydro's benefits and growth opportunities, I want to take a moment on dam safety.

As with other infrastructure, U.S. dams and its associated infrastructure are aging and in some cases, are in need of reinvestment. However, it is important to note that hydropower dams are highly monitored and regulated by FERC or the federal dam owners themselves. The hydropower industry believes protecting lives and property are the top priority and we work cooperatively with FERC's division of dam safety and inspections.

NHA also has a committee of ONM and Dam Safety professionals who discuss technical information and best practices and we run our operational excellence program. This web-based tool shares information across the industry so asset owners can learn from one another to meet the highest standards of performance. Certainly, NHA supports continued investment in both the civil works and power sides of the industry as part of any discussion into hydropower infrastructure needs.

With that, let me conclude and thank the Committee for this opportunity to testify and I look forward to your questions.

[The prepared statement of Mr. Leahey follows:]



Written Testimony of

**Jeffrey Leahey
Deputy Executive Director**

On behalf of

The National Hydropower Association

Before the

**Senate Energy and Natural Resources Committee
Hearing to Receive Testimony on Opportunities to Improve American Energy
Infrastructure**

Regarding

An Overview of Hydropower, its Benefits, and Policy Issues

March 14, 2017

Written Testimony of Jeffrey Leahey, Deputy Executive Director, National Hydropower Association

Executive Summary

1. In the last several years, hydropower has provided approximately 6 percent of all U.S. electricity generation and nearly half of renewable generation. By 2030, approximately 400 projects representing 18,000 MW of capacity of the existing system will be up for relicensing.
2. Hydropower has significant untapped growth potential, particularly at existing infrastructure and with low impact projects, such as capacity additions at current hydropower facilities, adding generation to non-powered dams, and closed-loop pumped storage, among others. The Department of Energy's recent Hydropower Vision Report estimates that close to 50 GW of new capacity is available by 2050, with the right conditions and policy support in place.
3. New hydropower project development, as well as the relicensing of existing projects, faces a variety of obstacles. These include: a regulatory process that can be modernized to increase coordination and reduce unnecessary duplication, delays and costs; a lack of valuation of grid security and reliability services; and inequitable treatment and recognition under renewable energy tax incentives and other renewable/clean energy programs, including federal R&D funding to support new technologies. Combined, these issues are impacting hydropower competitiveness and creating unnecessary challenges that hold back growth.
4. NHA supports policies to address regulatory inefficiencies and to improve coordination in the overall hydropower project approval process and calls on Congress and the Administration to address this and other energy and market policy issues that limit investment in hydropower infrastructure. And, we believe this can all be done in ways that promote the hydropower resource while protecting environmental values.
5. Hydropower has a critical role to play in meeting our nation's energy, environment, and economic objectives. The benefits from this resource are many – low-cost, reliable, base load renewable electricity, along with additional ancillary grid services (load following, frequency response, energy storage, etc.) – services that will allow our country to add significantly to our national portfolio of renewable, clean energy resources.
6. Finally, as the Congress works to address our energy and infrastructure needs, whether that be on a new national infrastructure program or further work on an energy bill, policies that support the preservation of the existing hydropower system and promote the deployment of new projects (for all categories of water power technologies) must be included. A greater recognition that our hydropower infrastructure is incredibly valuable is needed, and continued investment and re-investment in the system is critical to our energy future and national security.

Introduction

Good morning Chairman Murkowski, Ranking Member Cantwell, and members of the Committee. I am Jeffrey Leahey, Deputy Executive Director of the National Hydropower Association (NHA). I am pleased to be here to discuss the importance of hydropower to the U.S. electric system, the untapped growth potential across the various sectors of the industry, and the policy issues that need to be addressed to fully realize that growth.

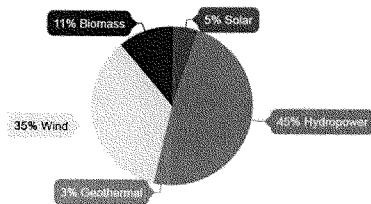
As background, NHA is a nonprofit national association dedicated to promoting clean, affordable, renewable U.S. hydropower – from conventional hydropower to pumped storage to marine energy to conduit power projects. NHA represents more than 220 companies, from Fortune 500 corporations to family-owned small businesses. Our members include both public and investor-owned utilities, independent power producers, developers, equipment manufacturers and other service providers, and academic professionals.

U.S. Hydropower Statistics

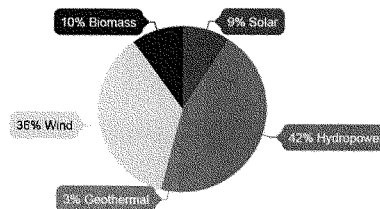
Currently, the U.S. conventional hydropower fleet is made up of almost **2200 individual plants** with a total capacity around **80 GW**. In the last two years, these plants provided approximately **6 percent** of all U.S. electricity generation and **almost half** of all renewable electricity generation – making hydropower the single largest provider of renewable electric power in our country. Looking over the long term, hydropower has supplied a cumulative 10 percent of U.S. electricity generation over the past 65 years (1950-2015), and 85 percent of cumulative renewable power generation over the same time period.

In addition to the conventional hydropower system there are an additional **42 hydropower pumped storage plants** with approximately **22 GW** of capacity – projects that make-up almost all, **97 percent**, of energy storage in the U.S. today.¹

2015 Sources of Renewable Electricity Generation



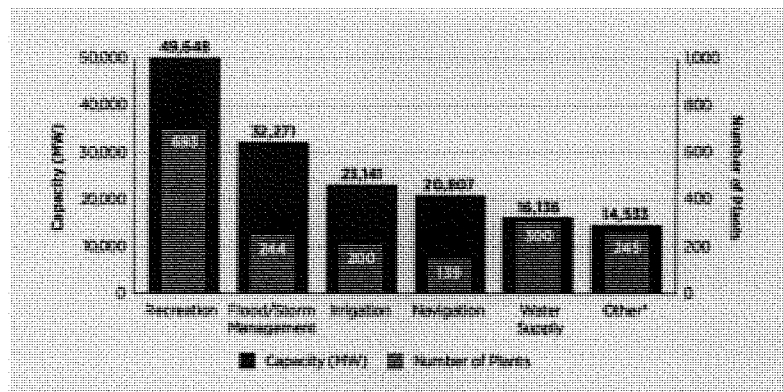
2016 Sources of Renewable Electricity Generation



¹ 2016 Hydropower Vision Report, Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office, Executive Summary P. 9.
<https://energy.gov/sites/prod/files/2016/10/f33/Hydropower-Vision-Executive-Summary-10212016.pdf>

Hydropower generation is a clean air resource and avoids millions of metric tons of carbon emissions each year. In fact, regions that rely on hydropower as a primary energy source (like the Northwest) reap the benefits of significantly cleaner air with some of the lowest carbon intensity rates in the country.

In addition to this clean and renewable energy, hydropower infrastructure provides other important benefits, including managing river flow for aquatic species and habitat protection, flood control and drought management, water supply, irrigation and more, as the chart below illustrates.²

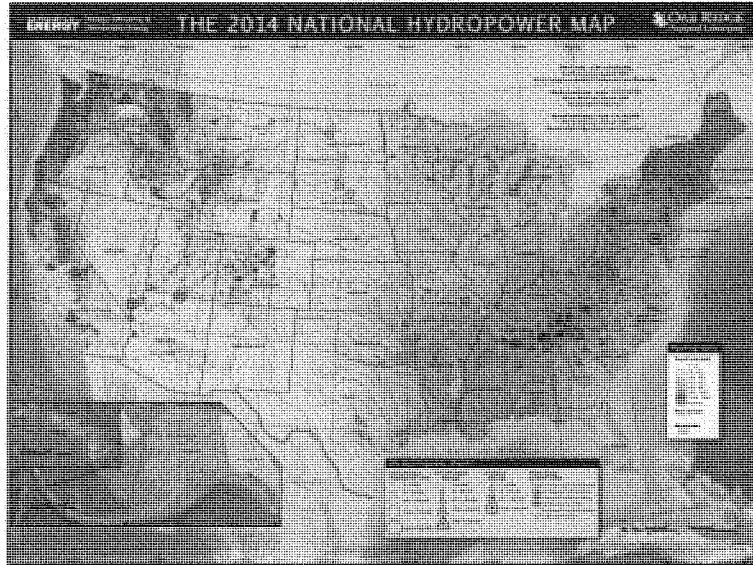


*Note: The use categories are not mutually exclusive; a given dam can be included in more than one category. The data include only powered dams.
Source: Uribe-Martinez et al. 2015 [1]

Figure 2-11. Total capacity and number of plants for six separate uses (illustrated by the blue bars) of existing hydropower dams and reservoirs

The next map below was developed by the Department of Energy (DOE) through Oak Ridge National Laboratory (ORNL) and provides a visual representation of the size and location of projects for both the federal and non-federal hydropower systems. Existing hydropower assets are located in all but two states (Delaware and Mississippi), though every state receives the benefit of the clean renewable generation that these projects provide.

² Hydropower Vision Report, Chapter 2, Page 83.



The contributions of the existing hydropower fleet to the electric grid are many (base load power, peaking generation, load-following, energy storage, reliability and more). With the need for more of these benefits and services, as the nation strives to become more energy independent, NHA has seen the hydropower industry grow and expand in recent years.

In fact, the United States experienced a net capacity increase of **1.4 GW**³ from 2005 to 2013, enough to power over half a million homes⁴. FERC has reported an additional 260 MW of capacity being placed in service since then, with even more projects in licensing or in the construction phase today. And this number could significantly increase with a modernized regulatory approval process that currently takes years longer than that of other renewable resources – in some cases licensing can take 10 years or longer.

In addition, hydropower projects bring multiple economic benefits to the communities in which they are located and those that they serve. To start, the industry itself currently employs a sizable workforce. 143,000 jobs are created just from the continued operation and maintenance, as well

³ 2014 Hydropower Market Report, Executive Summary P. VI.

⁴ An Assessment of Energy Potential at Non-Powered Dams in the United States, Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office and Oak Ridge National Laboratory, April 2012, Executive Summary P.VII, Footnote 1.
http://nhaap.ornl.gov/sites/default/files/NHAAP_NPD_FY11_Final_Report.pdf

as upgrades, of the existing system, with additional employment opportunities gained in the pursuit of new project development and deployment.⁵

One recent example that demonstrates the jobs benefit is AMP Public Power Partners of Ohio. AMP is building 4 new hydropower projects on existing Corps of Engineers' dams on the Ohio River (3 are completed and 1 is still under construction). The company reports that approximately 1800 construction jobs were created over a 4 year construction window, with the operation of the projects providing an additional 50 permanent jobs. Another example is Missouri River Energy Service's Red Rock project on the Des Moines River near Pella, Iowa, currently under construction at a Corps of Engineers dam. The company estimates that 250 workers will be needed on site through 2017-2018.

On top of this, the access to low-cost, reliable clean power is attracting many companies to regions with hydropower. For example, major high-tech companies like Google, Facebook, and Yahoo require large, energy-intensive data centers to drive their businesses. Specifically, in September 2010, Yahoo opened a new facility in Lockport, New York to utilize hydropower provided by the New York Power Authority. And again, in 2013, New York officials cited the importance of low-cost hydropower in Yahoo's decision to expand the Lockport facility.⁶

Another example of hydropower supporting economic development and new job creation partnerships is BMW. Access to low-cost and reliable hydropower along with other renewables lured the company to Moses Lake, Washington. Breaking ground on its \$200 million manufacturing facility in July 2010, the plant, a joint venture with SGL Automotive Carbon Fibers, was built to supply parts for BMW's line of high performance cars. In fact, the company in 2014 announced it would fund a \$100 million expansion of the facility – again citing access to affordable hydropower along with other renewables.⁷

Growth Potential

One of the largest misconceptions of the hydropower industry is that any growth potential is "tapped out". In its new report issued in 2016 titled, Hydropower Vision: A New Chapter for America's 1st Renewable Electricity Resource, the Department of Energy smashes that myth. The Vision analysis finds that U.S. hydropower could grow to nearly **150 GW by 2050**. This would represent close to a **50 percent** increase in capacity.

The report identifies opportunities for **13 GW** of new hydropower capacity by adding generating facilities to existing non-powered dams and canals, upgrades to existing hydropower facilities, and limited development of new stream reaches. It also finds the potential to add up to **36 GW** of new pumped storage capacity.

⁵ Vision Chapter 2, Page 203-204. <https://energy.gov/sites/prod/files/2016/10/f33/Hydropower-Vision-Chapter-2-10212016.pdf>

⁶ <http://www.nypa.gov/Press/2013/130322.pdf>

⁷ <http://www.seattletimes.com/business/bmw-plans-big-expansion-of-moses-lake-carbon-fiber-plant/>

Looking to the benefits of this potential, the report finds \$148 billion in cumulative economic investment. \$58 billion in savings in avoided mortality, morbidity and economic damages from air pollution. Cumulative 30 trillion gallons of water withdrawals avoided for the electric power sector. 5,600,000,000 metric tons of CO₂ emissions reductions with \$209 billion in avoided global damages. And over 195,000 hydropower-related gross jobs spread across the nation in 2050.⁸ Those are quite substantial benefits for our country.

Adding Generation to Non-powered Dams

One of the prime areas of growth in the hydropower industry is on existing infrastructure, such as non-powered dams and conduits. Of the approximately 80,000 dams in the U.S. today only **3 percent** have electric generating facilities. Put another way, **97 percent** of our dams do not produce power and were built for other purposes such as water supply, irrigation, navigation and recreation.

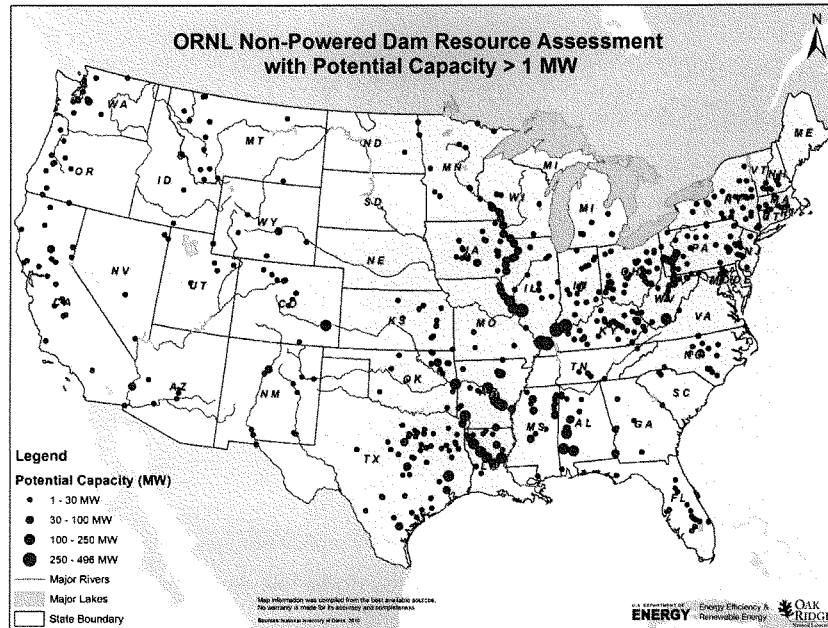
NHA recognizes that not every existing dam may be a suitable candidate to add power generating equipment, as many factors come into play in development decisions: project development costs and revenue opportunities; energy generation potential; natural resource considerations; transmission needs; dam safety; etc. However, what this statistic shows is the large untapped universe of potential opportunities that exist – and that are not being developed in significant part because of the concerns about the uncertain, duplicative and lengthy regulatory process.

Those dams that are candidates for hydropower development are infrastructure that will continue to exist, operate and release flows to meet water supply, irrigation, flood control, and other purposes for which they were originally constructed – regardless of whether hydropower facilities are installed. It is good public policy to take advantage of these existing releases to capture the energy currently untapped at these sites to add to our portfolio of renewable, carbon-free resources.

The U.S. Department of Energy recognized this opportunity and in 2012, through the Oak Ridge National Laboratory, released an assessment of potential capacity at non-powered dams for projects greater than 1MW. The map below on the following page depicts the size and location of the top projects of that survey with capacity greater than 1 MW.⁹

⁸ Hydropower Vision, Executive Summary P. 7 and 23.

⁹ <http://www.energy.gov/eere/water/hydropower-resource-assessment-and-characterization>



The results of the study show that over **12 GW** of potential exist across the existing system with **8 GW** of potential available at the top 100 sites.¹⁰ Also of interest, **81 of the top 100** sites were located on federal facilities, in particular, Army Corps of Engineers dams.¹¹

These types of projects are some of the lowest impact new developments in the energy sector. No new dams need to be built and the projects aim to utilize existing flows through the projects. This water is already moving through the system, what better way to maximize the benefits of this infrastructure by also generating clean, renewable power with them.

Capacity Additions/Efficiency Improvements at Existing Hydropower Infrastructure

The potential for new conventional hydropower generation is not only about adding new capacity at non-powered dams. Existing hydropower facilities are also expanding through upgrades and efficiency improvements.

¹⁰ 2012 Non-Powered Dams Report, Executive Summary P.VII and VIII.

¹¹ 2012 Non-Powered Dams Report, Executive Summary P.VIII.

In fact, since EPCRA of 2005 and the inclusion of hydropower as an eligible technology in the production tax credit (PTC), over **150 projects** have received certification. These projects have seen, on average, about a **9 percent** gain in generation.¹² These 150 projects represent a small fraction of the hydropower fleet, so there are even further gains to be had if more projects undertake these kinds of upgrades.

And in many instances with these upgrades, the project realizes not only an increase in capacity or generation, but also an increase in environmental performance. The Wanapum Dam Turbine Replacement Project by Grant County Public Utility District in the state of Washington illustrates this. The project includes replacing the original turbines and replacing or refurbishing generating equipment at the dam. The advanced equipment is designed to be 3 percent more efficient. It will also reduce wear on the equipment and improve passage of juvenile salmon.¹³

NHA also notes from an infrastructure perspective that there is tremendous opportunity for re-investment in the federal hydropower system. Almost half of the U.S. hydropower generation comes from the federal system, with the bulk owned and operated by the U.S. Army Corps of Engineers, the Bureau of Reclamation and the Tennessee Valley Authority. The median age for federal hydropower projects is 50 years.¹⁴ Turbine and other equipment refurbishments (including repairs, replacements and upgrades) are available and can improve the performance of these projects both from an energy and environmental perspective.

Hydropower Pumped Storage

Pumped storage is a modified use of conventional hydropower technology to store and manage electricity. As shown below, pumped storage projects store potential electricity by circulating water between an upper and lower reservoir.¹⁵

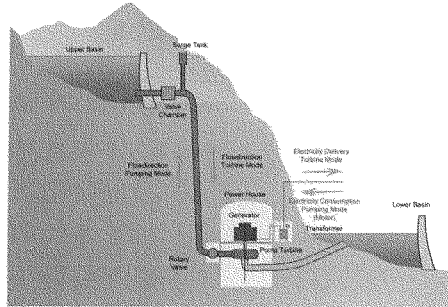
Electric energy is converted to potential energy and stored in the form of water at an upper elevation. Pumping the water uphill for temporary storage “recharges the water battery” and, during periods of high electricity demand, the stored water is released back through the turbines and converted back to electricity like a conventional hydropower station. See illustration below.

¹² Federal Energy Regulatory Commission data.

¹³ <http://www.grantpud.org/your-pud/projects/wanapum-dam-turbine-and-generator-replacement-project>

¹⁴ Hydropower Vision, Chapter 2, Page 147.

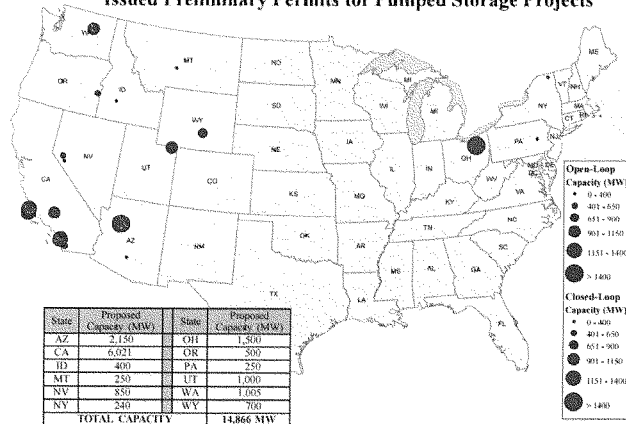
¹⁵ Illustration provided by GE Renewable Energy.



Pumped storage projects able to rapidly shift, store, and reuse energy generated until there is the corresponding system demand and for variable energy integration. This energy shifting can alleviate transmission congestion, which helps more efficiently manage the electric grid, and can reduce the need for costly new transmission projects, as well as to avoid potential interruptions to energy supply.

As more intermittent generation is added to the grid, particularly in the West, the need for the services that pumped storage provides is increasing. As a result, we are seeing a significant renewed interest in these projects, including closed-loop project proposals.¹⁶ As the map below shows, there are currently close to **15,000 MW** of proposed new pumped storage projects before FERC with preliminary permits right now.

Issued Preliminary Permits for Pumped Storage Projects



Source: FERC Staff, January 12, 2017

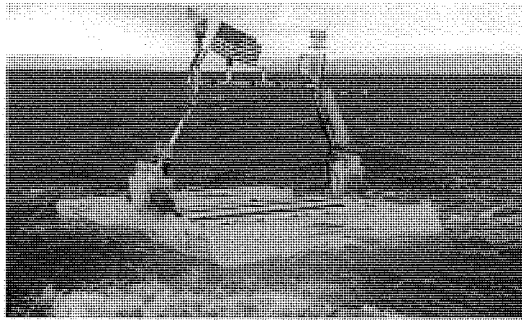
Note: Preliminary determination of open- vs. closed-loop classification based on preliminary permit application.

¹⁶ Closed loop pumped storage projects are physically separated from existing river systems. They present minimal to no impact to existing river systems because after the initial filling of the reservoirs, the only additional water requirement is minimal operational make-up water required to offset evaporation or seepage losses.

Again, NHA recognizes that not all of these projects may be developed, however, they clearly rebut the proposition that hydropower is a “tapped out” resource.

Marine Energy and Hydrokinetics

With more than 50 percent of the U.S. population living within 50 miles of coastlines, there is vast potential to provide clean, renewable electricity to communities and cities across the United States using marine and hydrokinetic (MHK) technologies. MHK technologies extract energy from waves, tides, ocean currents, rivers, streams, and ocean thermal gradients. Though still in its early stages of development as a whole, the MHK industry continues to move forward with new technological innovations, test site developments, and demonstration projects.¹⁷ DOE assessments have estimated that the total marine resource potential represents up to 25 percent of projected U.S. electricity generation requirements by 2050.¹⁸



Conduits

Conduit projects utilize existing tunnels, canals, pipelines, aqueducts and other manmade structures that move water. These are fitted with electric generating equipment and are often small projects that are able to extract power from the water without the need for additional infrastructure or a reservoir.

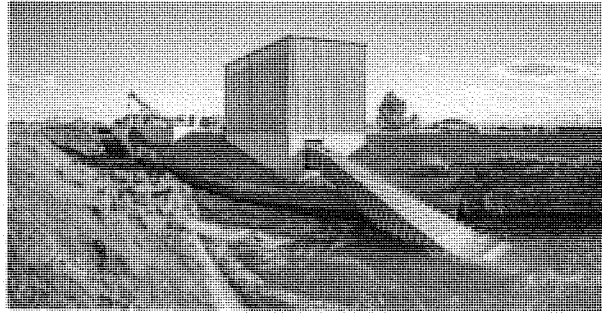
One of the prime opportunities in this sector is at Bureau of Reclamation infrastructure. In a recent study, Reclamation identified 373 potential sites with a capacity of 103 MW, enough to power 33,000 homes.¹⁹

¹⁷ Photo below of technology demonstration of Columbia Power Technologies of Charlottesville, Virginia

¹⁸ <https://energy.gov/eere/water/marine-and-hydrokinetic-resource-assessment-and-characterization>

¹⁹ Site Inventory and Hydropower Energy Assessment of Reclamation Owned Conduits (Final Report - March 2012). <https://www.usbr.gov/power/CanalReport/>

In addition, as a result of the expedited review of non-federal conduit projects under the Hydropower Regulatory Efficiency Act of 2013, the Federal Energy Regulatory Commission (FERC) has approved dozens of small conduit projects across the country.^{20,21}



Also, in 2013, legislation was passed focused on similar small conduit development at Bureau of Reclamation infrastructure and Reclamation has made changes to its lease of power privilege (LOPP) program. Reclamation continues to see increased interest in these project opportunities as well.²²

New Stream-Reach Development

Lastly, the DOE has also recently conducted a study of potential new greenfield projects. The assessment concluded that the technical resource potential is 85 GW of capacity. When federally protected lands—national parks, national wild and scenic rivers, and wilderness areas—are excluded, the potential is about 65 GW of capacity.²³ Not all of these new hydropower opportunities are likely to move forward once site-specific considerations are taken into account. Site selection will be an important factor. Additionally, the industry and the DOE are investigating innovative new technologies and operational regimes to see where some of this potential can be realized, while also minimizing potential impact.

Challenges for Hydropower and Policy Needs

To begin, hydropower has the longest, most complex development timeline (for project relicensing or new project approvals) of any of the renewable energy technologies, with some

²⁰ <https://www.ferc.gov/industries/hydropower/indus-act/efficiency-act/qua-conduit.asp>

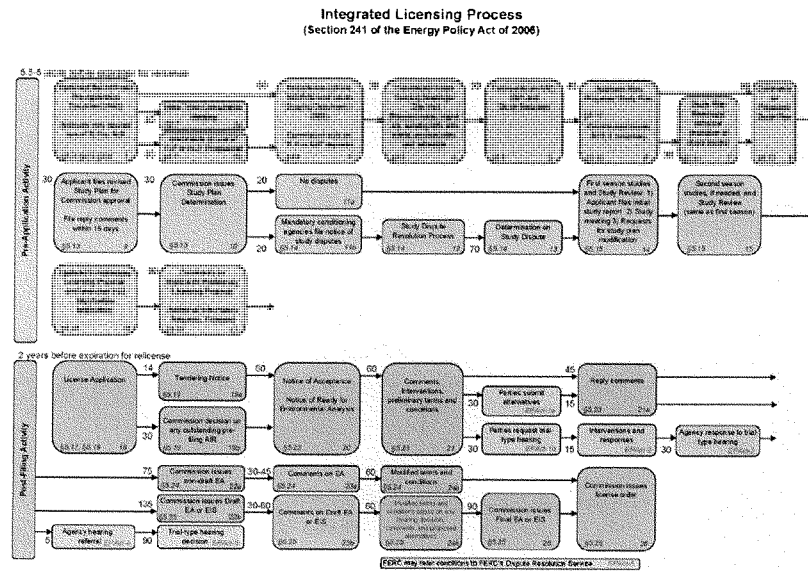
²¹ Picture of Natel Energy, Monroe Hydro Project, a 250 kw hydroelectric plant located in an irrigation canal, in partnership with Apple.

²² <https://www.usbr.gov/power/LOPP/index.html>

²³ <http://www.energy.gov/eere/water/downloads/new-stream-reach-hydropower-development-fact-sheet>

projects taking **10 years or longer** from the start of the licensing process through construction to being placed-in-service.

This process requires a considerable up-front financial commitment from the developer or asset owner to undertake the engineering and environmental studies required for various federal and state approvals. The chart below outlines the integrated licensing process or ILP, the default process, of several, for authorizing hydropower projects.



*Section 241 of the Energy Policy Act of 2006 n.p.k

A multitude of federal and state agencies, as well as the public and other stakeholders, play a major and important role in the process. And in the chart above, additional authorizations such as those required by federal dam owners if building on their infrastructure, are not included. These decisions and authorizations have tended to come at the end of the timeline after the FERC issuance of the license.

Water is a public resource and NHA and the industry recognize the necessity for and value of thorough review of project applications. However, redundancies and sequential reviews contained in the overall process are key reasons for delays. For example, for projects adding generating facilities to non-powered federal dams, FERC may issue a license, yet that project cannot commence construction until it has received additional approvals from the federal owner

of the dam (Corps of Engineers or Bureau of Reclamation). If there are unanticipated delays for those additional needed approvals, no work can commence. It is a similar case for state issuances of Clean Water Act Section 401 water quality certifications. A license cannot be issued, nor work commenced, until the certificate is approved.

NHA believes the time, cost and risks associated with licensing hydropower projects are not commensurate with the impacts, particularly when compared with other forms of generation – conventional or renewable. As former NHA President John Suloway testified before Congress in 2015²⁴, because of this, when faced with the choice of what type of generation to install, there is less risk in choosing a simple cycle turbine or a combined cycle plant that burns natural gas or low-sulfur oil, than building a hydropower plant.

While there is some variability with regard to size and location, the regulatory approval processes for simple cycle turbine or combined cycle plants are generally 1-2 years – even in urban areas like New York City. The FERC licensing process for hydro plants is generally 8 years or more, including both licensing and pre-filing activities. With regard to licensing costs, a combined cycle plant is approximately \$1 to \$2 million; whereas, some studies alone can cost multiples of that figure for a hydropower project. It is not uncommon for a hydropower license applicant to spend \$10 million or more on just the licensing process.

And this is not just an issue for new project deployment, but also for existing projects that are undergoing relicensing. In fact, by 2030, approximately 400 projects, representing 18,000 MW of capacity, will be in or have gone through relicensing. NHA has already begun to hear from owners of smaller projects, particularly in the Northeast, but across the country, that the process costs for licensing may render projects uneconomic and result in the surrender of licenses. As states continue to press for more clean and renewable energy resources, it would be unfortunate to lose the many benefits these existing hydropower projects provide.

NHA believes that Congress and the Administration should seek to reduce uncertainties in the hydropower licensing and relicensing processes, eliminate unnecessary and/or duplicative studies or other requirements, create discipline in the schedule, and reduce the time for obtaining federal and state approvals. In doing so, policymakers would be recognizing the value of hydropower as a critical component in the nation's energy supply portfolio. In addition, NHA believes process improvements can maintain the substantive ability of federal and state regulators to appropriately protect, mitigate and enhance natural resources.

Another issue that holds back hydropower is its limited recognition, or the complete lack thereof, as a renewable and/or clean energy resource under federal or state programs/environmental markets. State renewable portfolio standards provide one good example, and often contain restrictions on the amount of hydropower that is eligible. These include: project capacity limitations (30 MWs or less); placed-in-service restrictions (no eligibility for existing generation); resource and technology limitations (i.e. existing infrastructure; no new dams; capacity uprates or efficiency improvements only); explicit operational or impact criteria (run-of-river; low-impact certified), among others.

²⁴ <https://energycommerce.house.gov/hearings-and-votes/hearings/discussion-drafts-addressing-hydropower-regulatory-modernization-and>

On the federal side, there are many recent examples of initiatives related to renewable energy development on public lands, federal renewable energy procurement policies, and government-wide sustainability goals that either excluded hydropower as an eligible renewable technology, or qualified hydropower in a way that significantly reduces (or effectively eliminates) its ability to participate.

For example, in 2015, Executive Order No. 13,693 utilized a definition of “renewable electric energy” that includes only new hydroelectric generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project and yet excludes generation added to non-powered dams and others.²⁵ Another example is the 2012 U.S. Army Corps of Engineers proposal for “Large Scale Renewable Energy Production for Federal Installations”, which completely excluded hydropower as an eligible resource. And also, the EPA’s Green Power Partnership Program significantly limits the definition of qualifying hydropower. When hydropower is not included and recognized as a renewable resource on par with other resources like wind and solar, it creates a distinct economic and market disadvantage for the industry participants (existing asset owners and developers alike).

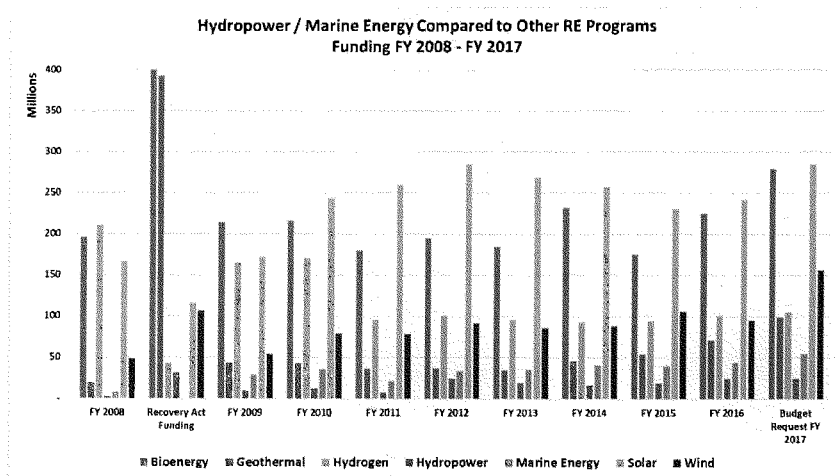
This disadvantage is no more clearly illustrated than in the context of the extension of the renewable energy tax incentives (Section 45 production tax credit (PTC) and Section 48 investment tax credit (ITC)). The PATH Act of 2015 created a competitive imbalance between incentives for wind and solar and other renewables, including hydropower. While the PTC and ITC for hydropower, MHK, and other technologies was extended through the end of 2016 (now lapsed), the credits for electricity produced from wind and solar facilities was extended for years longer. This on top of the fact that the hydropower industry, only receives, and has only ever received, half-credit under the PTC since becoming eligible years after the program was created for the wind industry.

As hydropower projects continue to compete for investment dollars, the policies adopted at the end of 2015 tipped the scales against investment in hydropower, putting the industry at a distinct disadvantage – a disadvantage that is magnified when you include the RPS policy treatment other renewable resources have as described above. NHA is working to fix this inequity to allow hydropower resources to better compete in the marketplace without the thumb on the scale tipped in favor of other renewable resources in the tax arena.

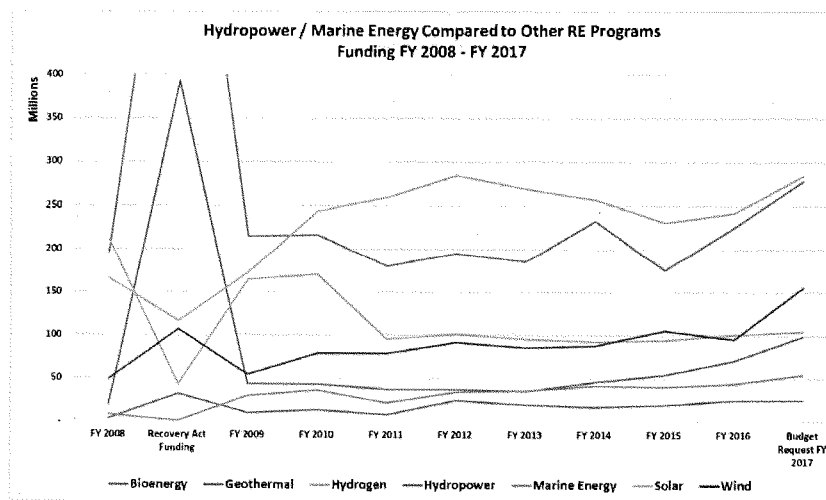
Lastly, on the federal policy front, NHA highlights investment in R&D for technology innovation. The DOE Water Power program, which represents the single largest source of renewable electricity in the United States today, still remains one of the smallest of the Office of Energy Efficiency and Renewable Energy (EERE), particularly when compared to the funding levels for other EERE programs.

The graph that follows charts the funding levels for the EERE programs from FY 2008 through the Administration’s FY 2017 funding request, including American Recovery and Reinvestment Act of 2009 (ARRA).

²⁵ Fixing America’s Surface Transportation Act (Pub. L. No. 114-94) Executive Order No. 13,693, Planning for Federal Sustainability in the Next Decade (2015)



The next graph below presents the same information, but more clearly shows the trend lines through time for each individual renewable energy technology program.



NHA appreciates and is encouraged by the growing investments by Congress in the DOE's Water Power program activities in recent years. However, as these charts clearly indicate, the

level is still substantially below that afforded other EERE programs, with the hydropower program receiving the least funding, followed by the MHK program receiving the next lowest level of funding. One of the factors for the tremendous growth in other renewables over the last several years is the sustained investment shown by the federal government in technology R&D and market acceleration initiatives in these sectors.

One final policy area that NHA would like to raise is that of regional electricity/power markets. Similar to what was discussed above on the state and federal energy policy front, oftentimes the various grid benefits both hydropower and pumped storage projects provide are not valued or compensated in our existing electricity markets. NHA, in 2015, filed comments with FERC on this issue that we believe are useful in this discussion and highlight the need to re-examine policies in order to promote hydropower deployment.²⁶

In its filing, NHA notes:

“While energy storage projects are eligible to participate in some markets, there are several attributes of energy storage and specifically pumped storage units that are not currently addressed by these tariffs. Pumped-storage plants can offer significantly more benefits to the electric system than those commonly recognized by ISOs and included in the comments previously received by the ISO commenters. Specifically pumped storage plants can offer real time system inertia [see FERC 755 reference to flywheel effect], generator droop setting that can respond to system conditions instantaneously, and Automatic Voltage Regulation Control (AVR) that can adjust rotor field strength in real time. All three of these services can be provided by traditional hydropower generators as well and pumped storage plants. These three services are critical services that allow instantaneous response to grid conditions that keep the voltage and frequency stable as other services like AGC respond in the ultrafast 1-4 second time frame. Markets are not currently available to compensate for these services.

Additionally, energy storage devices are able to provide grid services that offset the need for new transmission and or distribution infrastructure. Under the current regulatory environment, energy storage plants are classified as a generation resource and are not currently eligible for to get a transmission rate of return for these services.”

Conclusion

Both the existing system and new hydropower projects have a critical role to play in meeting our nation’s energy, environment, and economic development objectives and much is at stake for hydropower and the families, businesses and communities that rely on its low-cost, reliable, renewable generation.

²⁶ See: Electric Storage Participation in Regions with Organized Wholesale Electric Markets, FERC Docket No. AD16-20-000

NHA and the hydropower industry stand ready to help meet our common clean energy goals and we look forward to working further with Congress and the Administration to find pathways to address the important policy issues – federal, regional and state – to fully maximize and unlock the potential of the hydropower resource.

As the Congress works to address our energy and infrastructure needs, whether that be on a new national infrastructure program or further work on an energy bill, policies that support the preservation of the existing hydropower system and promote the deployment of new projects (for all categories of water power technologies) must be included. A greater recognition that our hydropower infrastructure is incredibly valuable is needed, and continued investment and re-investment in the system is critical to our energy future and national security.

I thank the Committee for providing me this opportunity to testify and I look forward to answering your questions.

CHAIRMAN. Thank you, Mr. Leahey.
Let's go to Mr. Bird. Welcome.

STATEMENT OF STEFAN BIRD, PRESIDENT AND CHIEF EXECUTIVE OFFICER, PACIFIC POWER, A DIVISION OF PACIFICORP

Mr. BIRD. Chairman Murkowski, Ranking Member Cantwell and members of the Committee, I greatly appreciate the opportunity to appear before you today as you consider the need for investment and modernization of U.S. energy infrastructure.

My name is Stefan Bird, and I'm the President and CEO of Pacific Power. Pacific Power, together with Rocky Mountain Power, comprise PacifiCorp which together serve 1.8 million customers across six Northwestern states. PacifiCorp owns and operates a diverse portfolio of resources totaling approximately 11,000 megawatts and includes hydroelectric power, coal power, natural gas, geothermal, wind and solar and biomass resources. We integrate those resources and serve our customers across the largest, privately-owned grid in the Western U.S. that totals 16,500 miles of high voltage transmission across ten Western states.

Your opening comments, Chairman Murkowski and Ranking Member Cantwell, were right on point, certainly in regard to the need for transmission infrastructure investment. And so, I'm going to abbreviate my opening comments and really move to the focus of my comments this morning in regard to streamlining and modernizing our permitting structure to keep pace with our need for advancements in energy infrastructure.

As the largest transmission owner in the Western U.S., PacifiCorp has long supported measures to better coordinate the existing federal permitting and citing processes from major electric transmission projects on public lands to reduce the uncertainty for project applicants and to streamline the approval process.

For the past ten years, we've been actively permitting several stages of a \$6 billion, 2,000-mile transmission infrastructure expansion, we call Energy Gateway. And some of those stages are already constructed and operating.

The purpose of Energy Gateway is to improve reliability and access to some of the lowest cost renewable resources in the Western United States. An important benefit is the hundreds of living wage construction jobs and the millions of dollars in property and sales tax revenue these projects contribute to the communities they are cited.

To give you an idea of the delays we experience, consider the record of decision we received on the last day of the previous Administration for our Gateway West transmission segment. It described the long and torturous review and approval process beginning with our initial application in May 2007, almost ten years for a project designed to bring clean energy to our customers and to relieve congestion constraints on our system. Without PacifiCorp's Energy Gateway and other regional transmission projects, which must cross public lands, some of our nation's largest and best energy resources will remain unable to contribute as they wait for transmission lines to be cited and built.

The most critical path items to achieving this objective is schedule predictability within the federal permitting process. To achieve

this goal, we believe an effective federal permitting process should have: A, a single point of accountability establishing a lead agency rather than having the company deal with multiple agencies; B, have clear and permanent deadlines—changing deadlines by bureaucrats render business decisions uneconomic and meaningless; and C, avoiding redundant and unnecessary views every time there's a new government policy change, essentially grandfathering of prior action. In other words, as new policies and guidance are rolled out, the new policy guidance should clearly state that projects already under NEPA review are grandfathered under the policy in place at application. Ten years to permit a transmission infrastructure project, by any measure, is far too long.

While building new, modern infrastructure is vital to our nation's economic goals. It is also critical to keep trees away from power lines. We believe that integrated vegetation management is an environmentally sound and cost effective way of keeping trees from power lines and we suggest the Forest Service adopt a policy of integrating, utilizing integrated vegetation management on federal lands throughout the country.

To provide an understanding of how difficult it can be to obtain permission and access to provide necessary vegetation management, my company's facilities cross 33 different national forests. Each national forest is divided into three or four districts, each with independent decision-making authority. That means PacifiCorp foresters may have to work individually with well over 100 different governing authorities for the U.S. Forest Service alone. Add that to the number of regions of the BLM, National Parks and Federal Wildlife Refuges, and one can understand how working with federal agencies can be so uncertain and time consuming.

Investment in new transmission systems, upgrading older systems to be smarter and more efficient and accessing and maintaining the grid means energy security, economic opportunity and good jobs and wages for our country.

PacifiCorp wants to be part of creative and collaborative solutions that will help create the next American infrastructure expansion.

I want to thank you again for the opportunity to participate in this hearing. PacifiCorp and Berkshire Hathaway Energy look forward to working with you further on these important issues.

[The prepared statement of Mr. Stefan Bird follows:]

**STATEMENT OF STEFAN A. BIRD
PRESIDENT AND CHIEF EXECUTIVE OFFICER
PACIFIC POWER, A DIVISION OF PACIFICORP
BEFORE THE SENATE ENERGY AND NATURAL RESOURCES COMMITTEE
MARCH 14, 2017**

Introduction

Chairman Murkowski, Ranking Member Cantwell, and members of the Committee, I greatly appreciate the opportunity to appear before you today as you consider the need for investment and modernization of U.S. energy infrastructure. For the record, my name is Stefan Bird, and I am the President and CEO of Pacific Power, an electric utility serving 243 different communities located across Oregon, Washington and California. Pacific Power, along with its sister electric utility, Rocky Mountain Power, which serves customers in Utah, Wyoming and Idaho, comprises PacifiCorp, serving over 1.8 million customers with substantial assets located over 9 states in the Western U.S. With over 10,000 Megawatts of generation capacity from hydropower, coal, gas, wind, solar, geothermal and biomass resources, over 16,500 miles of high-voltage transmission, and more than 64,000 miles of distribution network, PacifiCorp can be safely described as an “all of the above” energy company. We are a proud member of the Berkshire Hathaway Energy family of businesses, but most of our customers know us as their local power company, and it is our customers and their communities that drive our business.

In my capacity as President and CEO at Pacific Power I have the responsibility to plan, manage and maintain PacifiCorp’s transmission assets. PacifiCorp is the largest private transmission owner in the Western U.S., touching 10 Western states. Our network is critical to the movement of electricity between and within the Pacific Northwest, Intermountain West, and Southwest regions.

PacifiCorp invests in cost-effective energy resources and develops competitive transmission projects to meet load service and electric reliability needs of its customers. The demands placed on the electric grid and need to enhance the reach, capacity and security of the grid have never been more pronounced. Consider that most of the U.S. high-voltage transmission system was built before 1980, when the prevailing model was to site large, bulk power plants in remote areas and run transmission through sparsely populated areas to reach load centers.

Today, most electricity is still generated from central station power plants and the last era of transmission build-out was designed to accommodate that design. But with the explosive growth of renewable fuels, electricity is increasingly coming from a growing number of smaller, technologically diverse energy sources that take advantage of where it is windy, or sunny, or has hot water below ground. These sources, at large, utility-scale, can be located far from load demand and need new electric infrastructure to deliver this cleaner electricity to consumers. Even with the growth of small-scale, distributed energy resources, the transmission grid still works as the best available “virtual battery” that can absorb excess generation and efficiently move it to where it is needed. With the growth of population across the West over recent years, it is also becoming increasingly important and necessary to maintain and modernize existing infrastructure and to site

and construct new electricity infrastructure. As great as the need is to do this, so too has become the challenges to overcome to do it. Community opposition occurs at all levels in all branches of government, and since 1980, the increase in environmental regulation and potential for endangered and threatened species habitat encroachment has created new challenges in siting, construction and operation of infrastructure. These changes and challenges are natural and understandable. And can be overcome with thoughtful and balanced public policy solutions. In order to fulfill our collective mission to ensure the necessary energy infrastructure to meet today's needs and help encourage tomorrow's growth and prosperity, I would like to share some specific considerations that would benefit from Congressional attention.

Industry and government should share a common commitment to modernize the Grid

I. Today's changing energy resource mix, reliability needs and security requires new investment

The U.S. bulk transmission system has served the country well for decades. But it is aging and does not reach key resource areas nor has the capacity to meet the growing needs of electricity consumers. And, there is a growing need for both cyber and physical security strengthening of the grid that can be addressed through new infrastructure.

As renewable energy becomes a bigger part of the nation's energy mix, new transmission is needed to reach these generating resources

As we have seen at PacifiCorp, the Western U.S. is blessed with a wide array of energy resources. The U.S. energy mix is diversifying, which creates tremendous opportunities to take advantage of them, as well as challenges. The opportunities lay in the ability to achieve diversified generation portfolios that are low cost and low risk for customers, as well as supporting local and state economies through creation of jobs and increased tax base. That is true whether we're talking about generating electricity through mineral and gas extraction or by harnessing wind, sun, biomass and water. The challenges occur in the need to reach areas of resource potential, especially those associated with renewable generation that is location specific. In order to best integrate these technologies and take advantage of their many benefits, relieving capacity constraints by building new transmission lines and modernizing existing assets where possible is necessary. Improving the transfer capability of the grid is crucial to efficient integration of all of these generation resource technologies at the lowest cost for consumers.

PacifiCorp is attempting to do this through the permitting and development of the Energy Gateway projects. The Energy Gateway projects are a series of proposed transmission lines across our service territory states, some of which have already been constructed and are in service, that add additional capacity and reliability benefits, both for our retail customers and our wholesale transmission customers. These projects also represent hundreds of living-wage construction jobs and millions in property and sales taxes in the communities where they would be sited. Energy Gateway consists of the following major segments:

- **Populus to Terminal** - 135 miles of double circuit 345 kV between Downey, Idaho and Salt Lake City, Utah. *Completed in November 2010.*
- **Mona to Oquirrh** – 100 miles of single circuit 500 kV and double circuit 345 kV between Mona, Utah and South Jordan, Utah. *Completed in May 2013.*
- **Sigurd to Red Butte** – 170 miles of single circuit 345 kV between Sigurd, Utah and the Town of Central, Utah. *Completed in May 2015.*
- **Gateway West** – 1000 miles of single circuit 230 kV and single circuit 500 kV between Glenrock, Wyoming and Murphy, Idaho. Planned in-service 2019-2024. *Bureau of Land Management Records of Decision granted in 2013 (for 8 of 10 sub-segments) and January 2017 for final two sub-segments.*
- **Gateway South** – 400 miles of single circuit 500 kV between Medicine Bow, Wyoming and Mona, Utah. Planned in-service 2020-2024. *Bureau of Land Management Records of Decision granted in December 2016.*

New transmission systems look like legacy systems, but have modern technologies

New transmission infrastructure will be more reliable, more efficient, and smarter. In addition to adding redundancy to the Western Grid and, PacifiCorp has added advanced metering and telemetry to its new and existing transmission assets to help create more real-time visibility to the system, as well as utilizing dynamic line rating equipment and composite core lines to increase line ratings and capability. Accelerating these investments will not only result in increased system reliability for customers, but also help avoid catastrophic impacts due to weather, natural disaster, or intentional disruptions.

Energy Gateway has been completely privately financed, no federal funding needed to date

Since becoming a Berkshire Hathaway Energy business, PacifiCorp has been fortunate to be able to utilize its strong credit and access to low-cost capital to privately finance its transmission projects, without need of government financial assistance, to the benefit of both its retail and wholesale customers. However, we are not the only transmission developers in our region and our system is only as modern as the systems we are interconnected with. It might very well be that other systems could be developed and modernized with federal assistance which would increase the reliability and efficiency of the entire region.

Congressional attention is needed towards improving the federal transmission permitting, siting, and review processes.

As the largest transmission owner in the Western U.S., PacifiCorp has long supported measures to better coordinate the existing federal permitting and siting processes for major electric transmission projects on public lands to reduce the uncertainty for project applicants and to streamline the approval process.

Additionally, as part of its ongoing effort to permit and site its multi-state Energy Gateway transmission project, among the nation's largest currently in development, PacifiCorp has first-hand experience in federal processes that require agency review and action. PacifiCorp offers the following observations and recommendations with the above experiences and perspectives in mind.

First, undue delays in obtaining federal regulatory permits only serve to postpone the construction of needed transmission projects and the clean energy, reliability and other benefits such projects provide for customers. To give you an idea of the delays we experience, consider the Record of Decision we received on the last day of the previous Administration for our Gateway West segment. It described the long and tortuous review and approval process beginning with our "initial application in May 2007"—almost ten years for a project designed to bring clean energy to our customers and relieve congestion constraints on our system. Indeed, in order to continue developing America's vast renewable energy resources and delivering them to customers, and maintaining an efficient and reliable electric grid, completing transmission projects on a timely basis will be essential, particularly where the life cycle of transmission development tends to be much longer than the life cycle of resource project construction. Without PacifiCorp's Energy Gateway and other regional transmission projects which must cross public lands, there will be no means to transport a diverse set of new generating resources to distant load centers. As a result, some of our nation's largest and best energy resources will remain unable to contribute as they wait for transmission lines to be sited and built. The most critical path item to achieving this objective is schedule predictability within the federal permitting process. We believe substantial process improvements, once realized, will deliver significant benefits to the nation's utility customers who depend upon adequate, reliable, and reasonably-priced electricity to carry on their daily business, and will support vital economic growth across the country while preserving and protecting our environment. The greatest efficiencies to be gained are through better permit application coordination and execution of NEPA, accordingly, BHE recommends focus on improving that part of the federal permitting and siting process. Previous efforts by federal agencies and congress to streamline the process although well intended, have missed the mark to gain efficiencies. DOE's effort in 2013 focused on an integrated interagency pre-application process which could not dove-tail well with NEPA resulting in duplicative requirements that simply added time and expense. It is not yet clear if the FAST-41 initiative will deliver permitting efficiencies or will add yet another layer of bureaucracy.

Second, PacifiCorp appreciates that Congress sought to improve the federal transmission siting process in 2005 when it added new Section 216(h) to the Federal Power Act giving the Department of Energy (DOE) new lead agency authority to coordinate the approval of all required federal authorizations and related environmental reviews for "national corridor" transmission projects on public lands and which sought to give FERC additional authorities to improve the development and permitting process. While the courts have restricted its value and DOE has tried to accomplish the intent of Congress to identify and coordinate permitting reviews, we hope this committee would review Section 216(h) to address concerns raised by the courts and to improve the coordination provisions.

PacifiCorp encourages Congress to ensure that the efficiency and effectiveness of multiple agency reviews and decisions on major transmission projects is improved, and the uncertainty with federal cooperating agency reviews is reduced so that needed transmission expansion can keep pace with the nation's revolving resource mix that is being driven by a rapidly changing policy landscape. Congress should take steps now to ensure that the federal agencies provide the schedule certainty lacking today and assign clear accountability within the cooperating agencies to meet permitting milestones on reasonable fixed timeframes. Ten years by any measure is too long for infrastructure projects. Similar measures are needed to ensure that national energy policies are infused into staff-level decisions and federal agency management must create feedback loops to obtain confidence that field staff is implementing their duties in light of current policies. Each of these recommendations, if adopted, would have the salutary effect of facilitating the timely release of critical review documents and mitigating the permit schedule uncertainties facing project sponsors by averting the potential for conflicting federal policy objectives.

Further, by taking more time, not only is the potential for more alternatives increased, but the federal agencies are continually adopting/developing/changing policies, manuals, and instructions that require additional analysis and create new compensatory mitigation requirements for projects that have been in permitting for many years. These projects don't get "grandfathered." This occurred on PacifiCorp's Gateway West and Gateway South projects with regards to sage grouse protection, landscape level mitigation, lands with wilderness characteristics, and new conservation easements funded by the Natural Resource Conservation Service – U.S. Department of Agriculture that conflict with proposed transmission line rights of way.

Above all, federal agencies must be required to meaningfully work together to assure consistent application of permitting requirements and clear communication of requirements between field/state/federal agency headquarter levels prior to the start of the permitting process and throughout the process. PacifiCorp's experience has been that this structure has worked fairly well where it has been implemented, *e.g.*, on PacifiCorp's Sigurd-to-Red Butte segment. This practice needs to be made a federal priority so the benefits can be more broadly realized. PacifiCorp believes it is reasonable for the federal lead agency to complete the NEPA process from right-of-way (ROW) application to the ROD and the ROW grant within three years. Schedule certainty is as critical if not more important than any actual benchmark.

Based on our experience, we hope you put further federal coordination around transmission permitting and siting on the list as a top priority, with the goal of assuring consistent and expedited treatment of transmission projects requiring interagency and intergovernmental coordination.

Congressional action should address the reliability benefits of vegetation management.

While building new, modern transmission infrastructure is vital to the nation's economic goals, maintaining that infrastructure is also a critical area that the Congress and federal government can help with. I will address two problems – the criticality of keeping trees from power lines, and the difficulties imposed by the decentralized decision making structure of Federal

agencies in achieving that goal. Put simply, we believe that integrated vegetation management is an environmentally-sound, cost effective way of keeping trees from power lines, and suggest the forest service adopt a policy of utilizing integrated vegetation management on Federal lands throughout the country.

The nation's electric system is comprised in part of hundreds of thousands of miles of transmission lines that reticulate North America. These lines are divided into three interconnects – eastern, western and Texas. Interconnected lines allow transmission of electricity to areas of greatest need, which can shift due to weather conditions. The system is efficient insofar as it has reduced the need to build power plants that may only be needed occasionally to cover peak loads in particular localities. While interconnects are efficient, they have been vulnerable to failure in cases of widespread high demand associated with region-wide heat waves. Failures have occurred three times in the past 20 years, when heavily-loaded lines were knocked out of service after sagging into trees. Electricity from these lines was diverted to other lines, overloading and causing them to trip off line, sending their lost capacity to other heavily loaded lines, knocking them out of service, eventually creating a series of cascading events that resulted in widespread blackouts. The most notorious of these three grid collapses occurred on August 14, 2003, where 50 million people in eastern North America were left without power, some for weeks.

The August 2003 blackout led to intense review by utilities, the Federal Energy Regulatory Commission (FERC), the North American Reliability Corporation (NERC) and others. For the utility industry, the most significant result has been development of a vegetation management standard by NERC approved by FERC. The standard is subject to potential compliance penalties of up to \$1 million a day per violation for utilities that allow trees to grow into transmission lines with the objective of preventing cascading blackouts caused by trees. The ramifications of the NERC vegetation management standard is that FERC has a zero-tolerance policy regarding vegetation contacts with power lines. The challenge for the utility industry is how best to comply with zero tolerance when they are confronted by hundreds of thousands of miles of lines that span a vast continent.

One way industry has responded is through development of national consensus standards through the American National Standards Institute. The American National Standard for Tree Care Operations (ANSI A300) was issued in nine parts by the green industry, including representatives from the USDA Forest Service and National Parks Service. The International Society of Arboriculture has also published best management practices to accompany the ANSI A300 series.

ANSI A300 part 7 (2012) adapts the principles of integrated pest management to a principle called integrated vegetation management (IVM). In the case of integrated vegetation management, the “pest” populations are “incompatible” plants. Incompatible plants might be noxious weeds, invasive plant species or any vegetation that managers consider inappropriate for a given site. In a utility context, the inappropriate plants are often those that have the potential to interfere with or limit access to electric facilities at some point in their life.

ANSI A300 Part 7 defines IVM as a system of managing plant communities in which managers set objectives, identify compatible and incompatible vegetation, consider action thresholds, and evaluate, select and implement the most appropriate control method or methods to

achieve their established objectives. The choice of control method or methods is based on their environmental impact and anticipated effectiveness, given site characteristics, security, economics, current land use and other factors.

The ideal objective for the utility industry is to use IVM principles to establish plant communities comprised of species that will never interfere with the electric facilities. A useful tool is a biological control known as cover-type conversion, which provides a competitive advantage to short-growing, early successional plants, allowing them to thrive and successfully compete against unwanted tree species for sunlight, essential elements and water. It often requires selective use of herbicides against incompatible species to enable desirable species to become established. The early successional plant community is relatively stable and tree-resistant. As this community becomes increasingly established, the need for intervention decreases. In the long run, industry considers this type of biological control to be the most appropriate method, at least where it can be done effectively.

The wire-border zone concept is an important management philosophy that can be used in many areas and applied through cover type conversion. W.C. Bramble and W.R. Byrnes developed it in the mid-1980s out of research begun in 1952 on a transmission right-of-way in the Pennsylvania State Game Lands 33 Research and Demonstration project.

The wire zone is the section of a utility transmission right-of-way under the wires and extending on both sides to a specified distance. The wire zone is managed to promote a low-growing plant community dominated by grasses, herbs and small shrubs (e.g., under three-feet at maturity). The border zone is the remainder of the right-of-way. It is managed to establish small trees and tall shrubs (e.g., under 25-feet in height at maturity). The concept may be modified to accommodate side slope and changes in topography. When properly managed, diverse, tree-resistant plant communities develop in wire and border zones. The communities not only protect the electric facility and reduce long-term maintenance, but also enhance wildlife habitat, forest ecology and aesthetic values. It can't be applied everywhere. For example, in some fire-prone areas, the border zone may not be indicated, as it may contribute ladder fuels that could exacerbate the spread of wildfire. However, wherever it can be applied, it has proven useful in enhancing wildlife habitat and protecting electric facilities.

The benefit of IVM and cover type conversion is that it works with nature, rather than against it, decreasing costs and the utility's footprint over time. Furthermore, IVM can create opportunities to enhance the environment. For example, the EPA is actively supporting pollinator protection. The National Pollinator Protection Campaign, a collaboration of over 140 groups dedicated to promoting pollinators in North America, endorses integrated vegetation management on utility rights-of-way for expanding pollinator habitat comprised of meadow or prairie species. Those communities are consistent with industry's objectives as well, as the species that comprise meadows and prairies will never interfere with the use of the transmission lines. A central point is that rather than looking at transmission corridors as sacrifice areas, industry, government, private environmental groups and the public working together can use them as areas of opportunity to provide much needed habitat that may be otherwise threatened, while at the same time protecting the nation's electric supply.

The utility industry considers integrated vegetation management to be a sustainable, cost effective and environmentally-sound approach to protect the critical electric grid. Federal agency management in Washington, DC has agreed insofar as they were signatories to the [2006] MOU with EEI Member utilities, which emphasized application of IVM principles. They have also participated in developing the American National Standard for Tree Car Operations (ANSI A300), including Part 7, IVM. Many local managers agree and consider IVM to be the best approach in maintaining electric utilities that cross Federal property. However, at least from industry's perspective, others seem to view electric rights-of-way as loss areas, and work to impede maintenance, including vegetation management.

The inconsistent viewpoints of Federal land managers creates difficulties for utilities because local authorities are empowered to make their own decisions for what is or is not appropriate in their jurisdictions. The arrangement creates unpredictable directives regarding what is or what is not authorized on utility corridors on Federal lands - in spite of land managers ostensibly working with the same policies and procedures. Many utilities express frustration that requirements can change dramatically at district boundaries, which are ecologically arbitrary. In other cases authorization changes substantially when one individual transfers or retires and is replaced with someone with different views. To provide an understanding of the degree of difficulty can create, recall that PacifiCorp's facilities cross 33 different national forests. Each national forest is divided into three or four districts, each with independent decision making authority. That means PacifiCorp foresters may have to work individually with well over 100 different governing authorities for the USDA Forest Service alone. Add to that a number of regions of the BLM, national parks and Federal wildlife refuges, all of which have ongoing personnel changes, and one can understand how working with federal agencies can be so problematic and time consuming.

Local decision makers who oppose utility vegetation management can delay timely authorization for required routine maintenance. They can add redundancy and repetition in reviews and work requirements and add delay without a corresponding benefit. At other times, they can deny permission to remove dead and dying trees or other vegetation that poses a threat to transmission facilities, which can create unnecessary risk. Living trees continue to grow towards the power lines and dying trees continue to threaten to fall on electric facilities regardless of a decision timeline, so the inability to carryout routine maintenance can lead to emergency situations. All of these factors can unnecessarily raise costs, expose the electric grid to outages, including catastrophic grid failure, and increase fire risk.

That is not to say these problems are universal. On the contrary, some districts understand the issues, and cooperate in the context responsible land management.

Yet, PacifiCorp and other utilities continue to encounter problems with local Federal decision makers. Cyber security, national security, industry, commerce and domestic life are dependent on flawless functioning of the electrical interconnects. That is why FERC has a zero tolerance policy for tree contacts on interconnected transmission lines. The benefits electricity provides are too important to be left to a patchwork of independent assessments made by individuals who may or may not have electric or vegetation management training and may or may not understand the ramifications of their judgment on the electrical system. Industry would like to

see broader policy directives that not only take into consideration important environmental and land management issues, but also take into account the importance of the electric interconnect, the negative impact trees can have on it and the cost maintenance of the electric grid has to the public. Moreover, industry would like to see decisions based on research, rather than opinion, and from that perspective, that means leveraging proactive integrated vegetation management in creating plant communities that contribute to the environment without threatening the nation's electric supply. If protecting the electric grid is so important that the Federal government cannot tolerate contacts between trees and interconnected transmission lines, all facets of the government should work with industry to help meet that objective.

I want to again thank you for the opportunity to participate in this hearing. PacifiCorp and Berkshire Hathaway Energy look forward to working with you further on these important issues.

CHAIRMAN. Thank you, Mr. Bird.
We next turn to Ms. Diane Leopold. Welcome to the Committee.

**STATEMENT OF DIANE LEOPOLD, PRESIDENT AND CEO,
DOMINION ENERGY, DOMINION RESOURCES**

Ms. LEOPOLD. Good morning, Chairman Murkowski, Ranking Member Cantwell and Committee members. I am Diane Leopold, President and CEO of Dominion Energy, the natural gas unit of Dominion Resources. I also chair the Interstate Natural Gas Association of America, although, I am not here in that capacity.

Thank you for inviting me to testify on the immense and well-documented economic, environmental and security benefits of expanding America's energy infrastructure. These investments improve our quality of life, global competitiveness and national security.

Our projects employ private capital, not taxpayer dollars. Dominion alone is working on about \$16 billion in infrastructure projects. However, to make these beneficial investments we need certainty from federal agencies, not a rubber stamp, but a rational path forward with clear processes, reasonable schedules and reasonable decisions. The result will be a cleaner environment, lower electricity and natural gas bills for consumers and businesses and more economic opportunity. Three of our projects illustrate the opportunities and challenges.

Our \$4 billion Cove Point Natural Gas Liquefaction Project is an addition to an existing LNG import terminal in Maryland. It has 3,700 workers on-site, including 3,000 skilled craft professionals. This exceeds the original forecast. Thousands more new jobs will come from producing, processing and transporting natural gas to the terminal and there will be \$40 million annually in new local taxes. Cove Point will provide a small portion of America's abundant natural gas to India and Japan, two vital, global partners. This strengthens our global footprint and reduces their dependence on less friendly gas producing nations. Shipments from Cove Point will reduce the U.S. trade deficit by about \$5 billion while having a negligible impact on domestic energy prices.

Federal and state permitting took about three and a half years, requiring more than 55 federal, state and local permits and reviews. This exhaustive process now looks simple compared with what we faced with the much-needed Atlantic Coast Pipeline, or ACP. ACP is a \$5 to \$5.5 billion, privately financed, 600-mile, underground utility project. Starting in Senator Manchin's home state of West Virginia, it will bring gas from the Appalachian region to Virginia and North Carolina.

Local electric and natural gas utilities urgently need more natural gas. Today, large business customers must have service curtailed on very cold days so residential customers won't literally be left out in the cold. Lack of natural gas is also slowing the shift to cleaner electricity and is strangling economic development.

Two independent economic studies make ACP's case. One projects over 17,000 construction jobs. The other estimates \$377 million in annual savings on utility bills resulting in more disposable income, a stronger economy, better quality of life for families and businesses, large and small.

ACP requires more than 18 major federal permits and authorizations, plus numerous other federal, state and local approvals. The process is already approaching three years and has a September 28th deadline to complete federal authorizations. A date that is later than it needed to be and not as certain as it should be.

To understand the delays, let me share some examples.

To protect the view from the Blue Ridge Parkway and Appalachian National Scenic Trail, we proposed boring under a mountain for nearly one mile using a much more costly method to ensure no disturbance or interference with the parkway or trail. The National Park Service took 14 months to review our 22-page application just to survey. We're still waiting for a decision on construction. And 21 of the 600 miles of ACP will cross national forests, just as hundreds of miles of natural gas pipelines run safely through national forests today. We rerouted 95 miles to meet its concerns though the Forest Service continues to move the goal posts with changing requirements and standards.

Similarly, our Skiffes Creek electric transmission line has been under Army Corps of Engineer's review for five years. The line is needed to provide reliable electricity on the Virginia peninsula when two aging coal units close to meet EPA regulations. This region hosts the world's largest shipyard, as well as eight military and DOE facilities.

Unfortunately, the Corps has not been able to complete the required consultation with the Advisory Council on historic preservation, the National Park Service and other parties. The project neither directly impacts Park Service lands nor requires a Park Service permit.

We were encouraged by the provisions of this Committee's legislation the Senate approved last year to help critical infrastructure projects advance. In particular, we support concurrent NEPA review by FERC and other permitting agencies, including agencies working with FERC's extensive NEPA process, rather than conducting duplicative reviews.

We also support an expectation that agencies notify applicants when their permits are complete to help stay within the timeline.

Chairman Murkowski and members of the Committee, the energy industry is poised to accelerate development of critical infrastructure serving the national interest. We're dedicated to safety and environmental protection. We believe in transparency and following regulatory processes. But to commit billions in private capital, we need a reasonable regulatory path to success if we follow the process.

Thank you.

[The prepared statement of Ms. Leopold follows:]

Statement by Diane Leopold
President and CEO, Dominion Energy
Dominion Resources

Before the Committee on Energy and Natural Resources
U.S. Senate
Opportunities for America's Energy Infrastructure
March 14, 2017

Good morning Chairman Murkowski, Ranking Member Cantwell and members of the Committee. I am Diane Leopold and I serve as President and CEO of Dominion Energy, the business unit at Dominion Resources with responsibility for all of our natural gas operations. I also am chair of the Interstate Natural Gas Association of America or INGAA – the North American natural gas pipeline trade association – although I am not appearing in that capacity today.

Thank you for inviting me to testify on the immense economic, environmental and security benefits fostered by expanding our nation's energy infrastructure using domestic sources. These benefits are well documented, as I will lay out in my testimony. Our projects – those of Dominion and many other companies – provide the added advantage of being done using private capital, not taxpayer dollars. We are ready, eager and able to make that commitment. However, to unleash this wave of investment and the benefits that result, we also need a reasonable level of certainty from federal agencies that there can be a rational path forward. Not a rubber stamp, but surety that agencies will establish fair schedules and keep to them. We need common-sense decisions. I firmly believe this can be achieved while maintaining transparency and full public participation in the process, as there rightly should be.

I am proud that Dominion has under way two of our country's most-important energy infrastructure projects: the Cove Point Liquefied Natural Gas (LNG) liquefaction project in Maryland and the Atlantic Coast Pipeline proposed to deliver natural gas from throughout the Appalachian region to customers in Virginia and North Carolina. These projects will generate tens of thousands of combined temporary and permanent jobs and billions of dollars in wages for the skilled craft professionals building our projects. Local governments will have significant new revenue streams, and industrial, commercial and residential customers will enjoy lower energy costs because of increased access to America's abundant natural gas resources. And, in the case of Cove Point, our trade deficit will be reduced by billions of dollars.

In addition, I will discuss a critically important electric transmission project Dominion has proposed. I include it in my testimony because it, too, will provide significant benefits and it, too, faces many of the same regulatory and permitting hurdles seen by Cove Point and the Atlantic Coast Pipeline.

Dominion is executing an aggressive growth strategy focused on public need and financed solely with private capital to better serve our customers. We are in the process of investing approximately \$16 billion from 2016 to 2020 in natural gas transmission and distribution pipelines, electric transmission upgrades, and building new generation from renewable sources and highly-efficient baseload natural gas.

By way of background, Dominion Resources is headquartered in Richmond, Virginia, and is one of the nation's largest integrated energy companies. We are a "Fortune 250" company with 16,000 employees and operations in 18 states, ranging from the Northeast and South Carolina to Utah and California. We

deliver electricity or natural gas to about five million homes and businesses in seven states: Virginia, North Carolina, Ohio, West Virginia, Utah, Wyoming and Idaho. Our portfolio of assets includes approximately 26,400 megawatts of nuclear, gas, coal, wind, solar, biomass, hydro, and fuel cell power generation; 15,000 miles of natural gas pipelines; and 6,600 miles of electric transmission lines. Dominion operates one of the nation's largest natural gas storage systems with 1 trillion cubic feet of capacity. And, our interstate natural gas pipeline system overlays the prolific Marcellus and Utica gas fields in the East and links the gas fields of the Rocky Mountains to markets in the West and Midwest.

Atlantic Coast Pipeline Overview

Our nation has a newfound and growing abundance of natural gas, but it has a shortage of infrastructure to get the natural gas from where it is to where it is needed. Meeting some of that need is the reason behind the Atlantic Coast Pipeline project and other similar projects by other companies. With any project of this scope and scale, one would expect a robust and thorough regulatory review process. Our nation has constructed a network of more than 300,000 miles of interstate and intrastate pipelines using a process built on the Natural Gas Act of 1938 and subsequent regulation. It is one of the safest and most-efficient energy networks in the world. In recent years, however, this process has not worked as smoothly as in the past. While we recognize that modern expectations and updated standards should be applied, we also believe that there is room for common-sense improvements and efficiencies.

There are two key drivers for the Atlantic Coast Pipeline. First, there is a specific, regional customer need. This need is for critical infrastructure to ensure the reliability of the power grid, to support energy security, to comply with existing environmental regulations, and to serve underserved and constrained areas. The second factor that made this possible was the low cost, prolific supply of nature gas reserves across the country which lowers energy bills to homeowners and makes businesses more competitive.

The result is that Dominion joined with Duke Energy, Piedmont Natural Gas and what is now Southern Company Gas in a joint venture to build the Atlantic Coast Pipeline. This project is a 600-mile, \$5 billion, 100% privately financed underground pipeline that will bring 1.5 billion cubic feet per day of new supplies of natural gas to gas-constrained areas of Virginia and North Carolina. The FERC pre-filing process started in September, 2014 and the application was filed a year later in September, 2015. We anticipate beginning construction later this year, and to be in service to meet our customers' needs in late 2019.

The ACP, as the pipeline is commonly known, has signed 20-year, binding transportation agreements with multiple end-use customers and over 94 percent of the gas capacity is under contract solely for domestic use. Over 76 percent of the 1.5 billion cubic feet per day of capacity is dedicated for use by utilities for power generation. The remaining amount will be for industrial users expanding operations and for local gas utilities for their residential and commercial customers in areas that are underserved today. One local gas distribution company, Southern's Virginia Natural Gas subsidiary, has advised FERC that its Hampton Roads Crossing pipeline is operating at design limits on peak demand days. Further, during frigid days Virginia Natural Gas has had to curtail service to large industrial customers to prevent residential and other customers from being left in the cold. Piedmont Natural Gas in North Carolina conveys similar concerns in that they cannot reliably meet the growing demand let alone be in a position to serve new industries who want to locate in eastern North Carolina.

To convey to the Committee the need and benefits of the Atlantic Coast Pipeline project, a statement from Jim Kibler, president of Virginia Natural Gas, the sole retail supplier of natural gas in Southeastern

Virginia, is compelling. “Since ACP was announced, Virginia Natural Gas has experienced an influx of interest from new, prospective customers. Manufacturers interested in relocating realize that Hampton Roads will have sufficient natural gas supplies upon completion of the ACP. Before the announcement of ACP, economic development authorities who are charged with bringing new business to the state and help diversify the economy were at a disadvantage when they communicated to prospects that there was insufficient natural gas infrastructure, which prohibited firm service contracts. This has undoubtedly cost Hampton Roads jobs, tax revenue and economic diversification. “

Greg Cummings, Director of Economic Development for Robeson County, North Carolina and Mayor of Pembroke, North Carolina urges approval of the project because of the many industries that have passed over the eastern region of North Carolina due to the inability to access natural gas. Mr. Cummings states, “without natural gas you can’t compete for new jobs and provide growth to your people.”

The economic case for the Atlantic Coast Pipeline is validated by two independent studies. From Chmura Economics in September, 2014, during the three-year construction period there would be over 17,000 jobs for skilled craft professionals – pipefitters, welders and other trade crafts. ICF International estimates that consumers and businesses would save approximately \$377 million annually in lower energy costs after the pipeline becomes operational.

Atlantic Coast Pipeline Outreach

Dominion takes very seriously our obligation for transparency and to reach out to all segments of our communities with information about our activities and plans for new projects. In fact, Dominion has engaged in an unprecedented level of outreach to all landowners, local governments, tribal governments, citizen organizations, and others. Since 2014, as the largest owner and the partner responsible for construction, Dominion has undertaken a concerted effort to communicate directly with and to meet with dozens of organizations along the route. Dominion held 33 open houses in the three states from September 2014 to March 2016. FERC held 12 public scoping meetings in March, 2015 and May, 2016 where Dominion attended to respond to questions. Recently, FERC held ten public meetings on the draft Environmental Impact Statements (EIS).

We understand that many communities and landowners are experiencing this process for the first time. We have a responsibility to listen and work with every landowner to accommodate their routing concerns as much as possible. From our outreach where we learned from residents and other stakeholders, we have made thousands of small and large adjustments to the route. Transparency in this process is essential to gaining public understanding and trust that we will meet and often exceed the federal and state requirements to ensure the project is built safely with as minimal impact and environmental disturbance as possible.

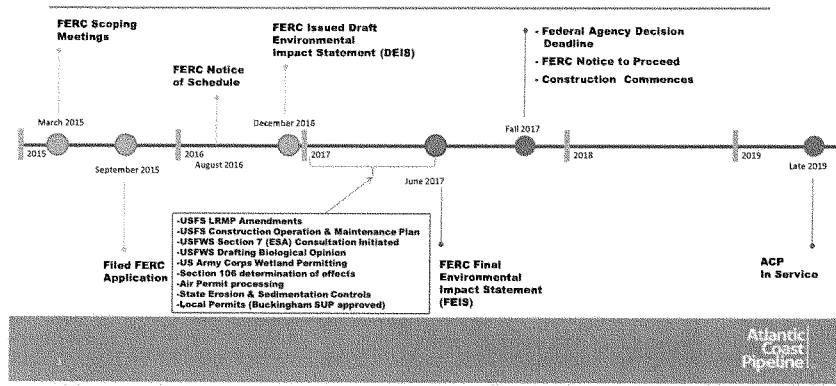
I am pleased to advise the Committee that on average over 90 percent of the landowners along the route have provided permission to survey their property to determine the suitability for the pipeline.

Atlantic Coast Pipeline Federal Permitting

Coordination among the several federal agencies is critical to the timely review of a project, and as designed today, the federal permitting process is challenging.

The Atlantic Coast Pipeline requires more than eighteen major federal permits and authorizations from FERC, the Army Corps of Engineers (Corps), the National Park Service (NPS), the U.S. Forest Service (USFS), the U.S. Environmental Protection Agency (EPA) and the U.S. Fish and Wildlife Service (FWS). FERC is the lead federal agency for reviewing and permitting the project and is preparing an Environmental Impact Statement (EIS) to assess the direct, indirect and cumulative impacts of the project. The Corps, EPA, Forest Service and Fish and Wildlife Service are cooperating in the preparation of FERC's EIS. Last August, FERC issued the Notice of Schedule, a major milestone for the project, indicating that the draft EIS would be issued in December, 2016 for a 90-day comment period and the final EIS would be issued by June 30, 2017. As provided under EPCA 2005, the Notice of Schedule also sets out a deadline to complete all federal authorizations by September 28, 2017.

Project Expected Timeline



Since May, 2014 – even before the FERC pre-filing process began in September, 2014 - Dominion has been actively engaged in discussions with these agencies. We value the time and engagement of agency staff and remain committed to providing all information necessary to complete the agencies' respective reviews. In addition, to facilitate interagency coordination, the Atlantic Coast Pipeline was placed on the FAST-41 list of high-priority, nationally significant projects. And, to address agency resource constraints, Dominion has entered into cost-sharing agreements with the Fish and Wildlife Service and National Park Service. As of this date, we are continuing to seek guidance from the agencies on a number of schedule-critical issues of great importance to the over project schedule.

To emphasize our concerns, let me share two examples. While virtually all of the 600-mile pipeline will be underground which significantly reduces the impact to view sheds, the ACP is going to extraordinary lengths to further protect the view scape from the Blue Ridge Parkway and the adjacent Appalachian National Scenic Trail, Virginia's and the Nation's premier sites. Instead of using traditional boring methods, ACP has chosen to use a horizontal directional drill (HDD) construction method. We will bore under a mountain for nearly one mile so the pipeline can cross under the Parkway and Trail. This construction method, while significantly more costly, was selected precisely to ensure that there will be

no surface disturbances, tree clearing or interference with public access to the Parkway or Trail. Even with this diligence, the Park Service took 14 months to review our 22-page application just to survey the area. Once permission was granted, the survey work was accomplished in one afternoon. This approval does not address the extensive permitting review underway by the Park Service for the permit to perform construction of the crossing itself.

As a second example, the ACP also crosses Forest Service lands with five miles in the Monongahela National Forest and 16 miles in the George Washington National Forest. Like all of our national forests, these serve multiple purposes and both have a number of activities going on within their borders. For example, hundreds of miles of natural gas pipelines have safely run through our national forests for decades. After many months of analysis and meetings, ACP, at the direction of the Forest Service revised the route by 95 miles, increasing the total route by another 30 miles and significantly increasing the number of affected landowners, to avoid potential impacts to sensitive species and reduce the miles within the two forests.

In addition to this re-route, ACP has committed to employ best-in-class construction techniques to ensure the forest lands are protected and the project is compatible with management efforts to protect the forests resources. ACP continues to respond to requests and provide detailed information on construction techniques, soil conditions, visual impacts and construction operation plans to this new route suggested by the Forest Service. Despite all of our earnest efforts, the Forest Service continues to deliver new information requests and has often revised its standards. As I said in the opening of my remarks, all we are asking for are fair and common-sense standards, and a reasonable schedule that is upheld.

Dominion has submitted on the public record at FERC more than 130,000 pages on numerous routing analyses, plans and protocols as part of our permit application and in response to questions and concerns from federal agencies and stakeholders. We are not seeking to limit any of the public review or detailed examination by resource specialists in federal agencies. We do believe, however, that there needs to be improved coordination among federal agencies, timely review and decision-making and a clearer path to present evidence so that there is a predictable, defined process to meet requirements by multiple federal agencies within a coordinated schedule.

Cove Point LNG Terminal

Some may challenge the forecasted benefits of the Atlantic Coast Pipeline, a project not yet built. However, the concrete results that are being realized at another Dominion project – the Cove Point LNG liquefaction project – show that if anything the potential benefits of the ACP may be underestimated. At Cove Point, construction jobs have been created in far greater numbers than originally anticipated. Increased taxes are about to be realized. And, long-term economic and diplomatic benefits are already clearly apparent.

The Cove Point project will make a small portion of our domestic energy resources available for overseas customers. In doing so, it will help meet the energy needs of two strategic U.S. allies and trading partners, India and Japan. Our ability to provide clean, reliable, long-term energy will only help to strengthen our relationships with allies and help insulate them from other energy suppliers who may use their influence in conflict with the best interests of the United States. Given the current state of world affairs, such a benefit cannot be undervalued. At the same time, we can do this while having a negligible impact on our domestic energy prices. In fact, it is easy to see how having this small “relief

valve” on domestic production could help stabilize U.S. energy prices by reducing the traditional boom-and-bust cycle that has plagued the natural gas industry for a century.

With the transformative changes in domestic gas production, we sought permission from the U.S. Department of Energy, the Federal Energy Regulatory Commission (FERC) and other federal and state agencies to add export capabilities to the facility. Overall cost of the project is about \$4 billion. This includes construction of natural gas liquefaction equipment as well as improvements to other facility components. We initiated the federal approval process in 2011 and began the pre-filing process with FERC in 2012 and received FERC’s final approval in October, 2014.

Cove Point construction began in 2014 and will be completed by the end of this year. There are currently over 3,000 skilled craft professionals and 700 other staff on site as construction has ramped up. To ensure the sufficient supply of skilled labor for this complex project, we directed our primary contractor to execute an agreement with the Building Trades Union. Expected to be operational by the end of this year, Cove Point as well as other LNG terminals will support thousands of additional jobs throughout the supply chain of producing, processing and transporting natural gas to terminals.

On a macro level, making gas from Cove Point available to our international partners in Japan and India will reduce our trade deficit by \$5 billion annually. Worldwide competition is fierce to deliver LNG to Asia. Our contracts cover only the liquefaction, storage and loading of the LNG; our customers must secure the supplies on their own. They have focused on pricing, energy security and diversity of supply in their buying decisions. Exports from the U.S. will generally be tied to lower U.S. prices. However, even with multiple US export terminals, the global competitive situation will ensure that exports to Asia will remain a small portion of those countries’ overall supply portfolio.

Federal and state permitting for the additional components at the Cove Point site were extensive. The project required more than 55 federal, state and local permits and reviews. As part of FERC’s very thorough process, more than 62,000 pages of information were submitted in our application to date on the expansion of this existing industrial site. Coordination with the Army Corps of Engineers and jurisdictional state agencies required ongoing involvement to ensure that each agency received the information it needed to complete its respective review within the FERC schedule. Each process required individual public hearings and outreach to ensure that the public had the opportunity to participate and be fully informed about the project.

Surry-Skiffes Creek-Wheaton Electric Transmission Line

The long-term nature of large energy projects and the millions in private dollars required to execute them demand regulatory predictability to proceed. Our Surry-to-Skiffes Creek-to-Wheaton 500kV/230kV electric transmission line is a prime example of the costs of delay to our communities and our national security.

Immediately following the issuance of the Environmental Protection Agency’s Mercury and Air Toxics Standard (MATS) rule, Dominion determined that retirement was the best course of action for two, aging coal units at our Yorktown power station. To replace this lost generation and to meet immediate load demands, Dominion identified the Surry-Skiffes Creek project that involves an aerial transmission line over the James River below Colonial National Historic Park and Jamestown. This project requires an Army Corps of Engineers permit, which I understand is not the jurisdiction of this Committee. The project does not directly impact any Park Service lands and does not require a Park Service permit.

The Corps permit application has been pending since 2012 and the Corps has undertaken extensive consultation with the Advisory Council on Historic Preservation, the National Park Service and other interested parties for three years as part of the National Historic Preservation Act's section 106 requirements.

Due to the lengthy permitting process and section 106 consultation, Dominion received extensions allowed under the MATS rule for the Yorktown coal units to operate until next month – April 2017. As required by law, Dominion will comply with the NERC reliability standards and has submitted a plan to shed load – or to say it more clearly - to cut off service to industrial, commercial and residential customers in order to prevent overloading the entire electric grid that could result in cascading outages along the Eastern seaboard.

To successfully complete the historic preservation consultation, an agreement is needed among the State Historic Preservation Officer in the Commonwealth of Virginia, Dominion, the Corps of Engineers, and the Advisory Council. At risk is the disruption of service to eight federal military and DOE facilities, as well as the world's largest shipyard building aircraft carriers and nuclear-powered submarines for the US Navy.

Permitting Modernization

Chairman Murkowski and members of the Committee, these projects serve a compelling public need and purpose. They provide reliability, serve a public need, support environmental goals, lower costs to consumers, add thousands of jobs and are 100% privately funded. We support and understand each federal agency's requirement for careful analysis to ensure the protection of the natural and cultural resources under their stewardship. We believe the NEPA process undertaken by FERC and the interagency coordination called for in the FAST-41 legislation strives for project schedule coordination and timely reviews.

We were encouraged by several of the provisions in the legislation that this Committee drafted and the Senate approved last year. Those of us involved in energy infrastructure would like to build on those ideas and offer the following concepts for your consideration:

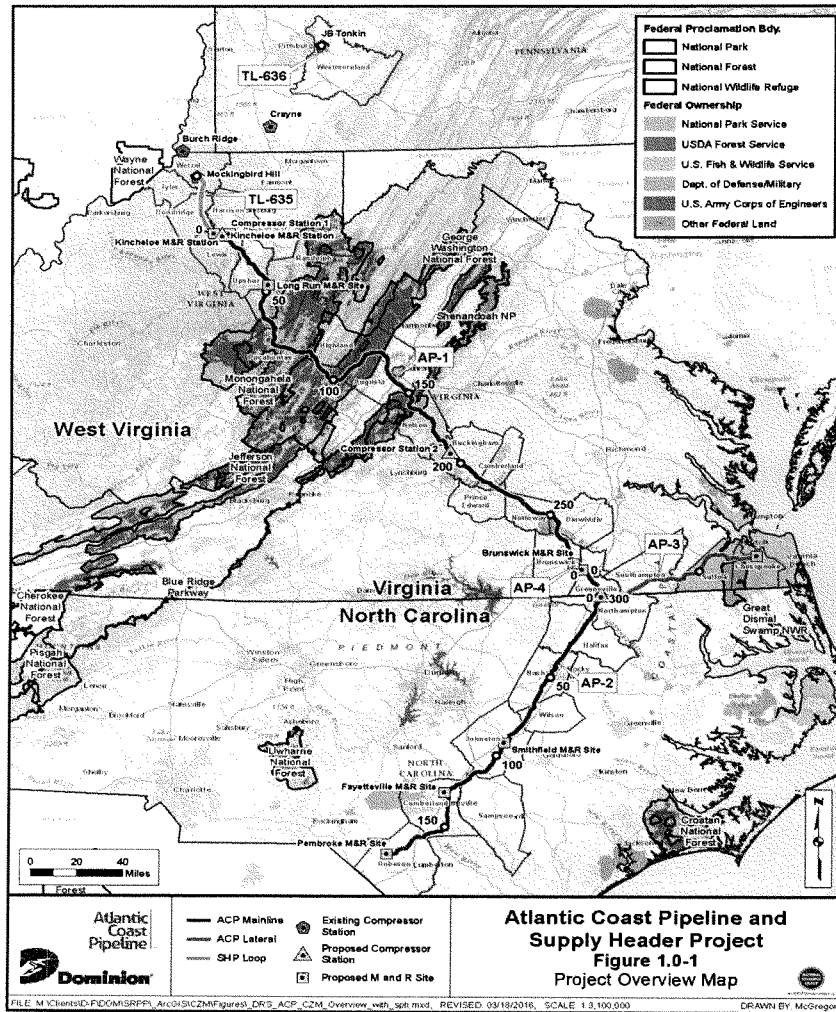
- Concurrent NEPA analysis and review of permits by FERC and other permitting agencies. Given FERC's lead agency status for the NEPA review of interstate natural gas pipelines, it is essential that there be a predictable schedule followed by other agencies as they complete permit reviews required by other laws.
- Require permitting agencies to determine when an application is complete to ensure compatibility with FERC's permitting timeline. To ensure that an agency has ample time to review an application within the FERC schedule, such a determination should be made within a specific time period. This action would improve the transparency of the FERC permitting process and put the applicant on notice if its permit application was deficient.
- Strengthen the coordination of FERC's NEPA environmental reviews with cooperating agencies. There is a very real need to give meaning to the responsibilities of "lead agency" and "cooperating agency" so that all federal agencies work together efficiently for a robust environmental review. It is equally important to ensure that once the NEPA process is

completed and a review is issued, that other agencies use the information already contained in the NEPA document as the basis for permits required under other statutes. Neither federal agencies nor project applicants are well served if multiple NEPA reviews are conducted by agencies who have declined to cooperate or those who do not fully participate in the FERC NEPA process so they can request "supplemental" NEPA reviews later in the process.

Conclusion

Chairman Murkowski and members of the Committee, I have confidence that the United States energy industry – both natural gas and electric utilities – is poised to accelerate the development of new infrastructure projects to meet identified, critical public needs. With Dominion's projects I have discussed today, there is ample evidence that these projects provide high-paying jobs for skilled crafts, provide new revenue to local governments, transports and facilitates the use of cleaner and lower cost natural gas, and strengthens the nation's energy security.

Thank you and I would be pleased to respond to any questions the Committee may have.



CHAIRMAN. Thank you, Ms. Leopold.
Mr. Zindler, welcome.

**STATEMENT OF ETHAN ZINDLER, HEAD OF AMERICAS,
BLOOMBERG NEW ENERGY FINANCE**

Mr. ZINDLER. Thank you.

I'm going to move a little quickly and skip some of the early remarks to make sure I finish on time here.

And thanks for the opportunity, once again, to participate.

I am here today in my role as an analyst for Bloomberg New Energy Finance, which is a division of the financial information provider, Bloomberg LP. My remarks today represent my views alone, not the corporate positions of Bloomberg LP and of course, they're not investment advice.

My testimony today will focus on the next generation of energy technologies and the infrastructure that will be critical to accommodate them. I think there are many on the panel here who can talk in real depth and expertise about our current challenges so I'll try not to be redundant with those.

The U.S. is transforming how it generates, delivers, and consumes energy. These changes are fundamentally empowering businesses and homeowners, presenting them with expanded choices and control.

Consumers today can, for instance, analyze and adjust their heating, air-conditioning and electricity use over their smart phones thanks to smart meters and smart thermostats.

Consumers in much of the country can choose their electricity supplier and may opt for "green choice" plans. They can produce power themselves with rooftop solar photovoltaic systems. They can even store it locally with new batteries.

Consumers can choose to drive vehicles propelled by internal combustion engines, electric motors or some combination of both of those. And that car can be powered by gasoline, by diesel, electricity, ethanol, perhaps even methanol, natural gas or hydrogen, and electric vehicle drivers who own homes can turn their garages into fueling stations simply by using the outlet on the wall.

Realistically speaking, few Americans today have the inclination or income to become high-tech energy geeks, but that is changing as prices associated with these technologies plummet. In the case of electric vehicles, such cars can be appealing simply because they perform better.

We at Bloomberg New Energy Finance believe that further growth and eventual mass adoption of these technologies is not possible, it's not probable, but it's inevitable given rapidly declining costs.

For instance, the price of a photovoltaic module has fallen by 90 percent since 2008, to approximately 40 cents per watt today. For millions of U.S. businesses and homeowners, "going solar" is already an economic decision, and last year the U.S. installed far more solar generating capacity than it did any other technology.

By the end of the next decade, cost competitiveness for distributed solar will arrive most places in the United States and without the benefit of subsidies.

Similarly, the value of contracts signed to procure U.S. wind power have dropped by approximately half as the industry has deployed larger and more productive wind turbines. Wind, last year, surpassed hydro-electricity to become the fourth biggest generator in the U.S. We expect current wind capacity to at least double by 2030. Many of these new energy technologies are, of course, variable. In other words, if there's no wind, there's no wind power. If there's no sun, there's no solar-generated power. Thus, the growth in these and other new energy technologies will be accompanied by unprecedented sales of new batteries of various shapes and sizes.

Utilities such as Southern California Edison and others have already begun piloting large-scale batteries in certain markets while providers such as Stem and Tesla offer so-called, "behind-the-meter" storage solutions for businesses and homeowners.

In the past five years, lithium-battery prices have fallen by at least 57 percent and we expect another 60 percent drop by 2025. That will contribute to 9.5 gigawatt/hours of battery capacity in the U.S., up from 1.7 today.

Continuing battery price declines will also make electric vehicles for the first time a viable option for middle-class U.S. consumers without the benefit of subsidies.

The new, empowered consumer poses inherent challenges to the traditional command-and-control/hub-and-spoke models of conventional power generation and power markets. We have already seen examples around the globe where incumbent utilities were caught flat-footed by rapid clean energy build-outs. In some cases it has been heavy subsidies for renewables that have catalyzed this change, but more recently, simple low costs are allowing wind and solar to elbow their way onto the grid.

So, where does this leave infrastructure in this conversation? First, conceptually, we must accept that the empowered consumer is here to stay. To some degree, this acceptance is already underway in the private sector where companies that once focused mainly on large-scale power generation are merging with consumer-facing utilities or buying smaller solar installers and battery solution providers. And second, policymakers should look to promote infrastructure that accommodates a new, more varied, more distributed world of energy generation and consumption.

Policy-makers may also seek to facilitate the development of high-voltage transmission lines across the U.S. It has long been an adage that the U.S. is the home to the "Saudi Arabia of wind", but a lot of that resource might as well be in Saudi Arabia given how difficult it can be to build across state transmission.

Investment is also needed at lower voltages as well. Our passive, one-directional, electricity distribution system is under strain as new distributed generation capacity comes online.

Now finally, policymakers may consider ways to support electric vehicle charging stations. As sales of such cars grow, consumers are already putting greater pressure on certain distribution nodes around the country.

And lastly, the changes afoot will require what might be best described as infrastructure software. Most importantly and pressingly, this must include the reform of electricity markets to take into account the new realities of 21st century power and sup-

ply and demand. It may also include expanded programs to educate, excuse me, educate energy professionals to the new realities of the energy markets. And, yes, of course, it could include some forms of software to improve energy monitoring and optimize system performance.

In closing, I would reiterate that none of this needs be done at the exclusion of investing in traditional energy infrastructures being discussed by others on the panel; however, any rational discussion about energy infrastructure today must do more than take into account the current situation. It must also consider where we're going to end up tomorrow.

Thank you.

[The prepared statement of Mr. Zindler follows:]

**Prepared testimony before the
Senate Committee on Energy and Natural Resources
Ethan Zindler
Head of Americas
Bloomberg New Energy Finance
March 14, 2017**

Good morning and thank you for this opportunity, Chairman Murkowski and Ranking Member Cantwell. I'm honored to contribute once again.

I am here today in my role as analyst for Bloomberg New Energy Finance, a division of financial information provider Bloomberg LP. Our group provides major investors, utilities, policy-makers, and others with data and insights on what we define as new energy technologies. These include renewables such as wind and solar, electric vehicles, energy efficiency technologies, power storage systems such as batteries, and natural gas, among others. My remarks today represent my views alone, not the corporate positions of Bloomberg LP. And of course, they do not represent specific investment advice.

Before I get to my main points, a quick note about "infrastructure". In the current climate, this term has become a Rorschach test of sorts representing different things to different constituent groups. In the case of energy, infrastructure can encompass a broad scope, including, among other things, building power-generating facilities, expanding oil and gas distribution pipelines, or hardening local power grids.

Those topics are worthy of discussion and I know my fellow panelists will shed light on them. However, my testimony today will focus on the next generation of energy technologies and the infrastructure that will be critical to accommodate them.

The US is transforming how it generates, delivers, and consumes energy. These

changes are fundamentally empowering business and home owners, presenting them with expanded choices and control. Consumers today can, for instance, analyze and adjust their heating, air-conditioning, and electricity use over their smart phones thanks to smart meters and smart thermostats. And they can make efficiency improvements through advanced heating and cooling systems and innovative building materials and techniques.

Consumers in much of the country can choose their electricity supplier and may opt for "green choice" plans. They can produce power themselves with rooftop solar photovoltaic systems. They can even store it locally with new batteries.

Consumers can choose to drive vehicles propelled by internal combustion engines, electric motors, or some combination of both (hybrids). That car can be powered by gasoline, diesel, electricity, ethanol, or perhaps even methanol, natural gas, or hydrogen. And electric vehicle drivers who own homes can turn their garages into fueling stations simply by using the outlet on the wall.

Now, realistically speaking, few Americans today have the inclination or income to become high-tech energy geeks. But that is changing as prices associated with these technologies plummet. In the case of electric vehicles (EVs), such cars can be appealing simply because they perform better.

We at BNEF believe that further growth and eventual mass adoption of these technologies is not possible, not probable, but inevitable given rapidly declining costs.

For instance, the price of a photovoltaic module has fallen by 90% since 2008, to approximately \$0.40 per Watt today. For millions of US businesses and homeowners, "going solar" is already an economic decision. Last year the US installed far more solar

generating capacity than it did any other technology.

By the end of the next decade, cost competitiveness for distributed solar will arrive most places in the US – without the benefit subsidies. We expect the current installed base of US solar to grow from approximately 3.6% capacity to 13% by 2030 then to 27% by 2040.

Similarly, the value of contracts signed to procure US wind power have dropped by approximately half as the industry has deployed larger, more productive turbines. Wind last year surpassed hydro-electricity to become the fourth biggest generator in the US. We expect current wind capacity to at least double by 2030.

Many of these new energy technologies are, of course, variable (no wind, no wind power; no sun, no solar power). Thus the growth in these and other new energy technologies will be accompanied by unprecedented sales of new batteries of various shapes and sizes.

Utilities such as Southern California Edison and others have already begun piloting large-scale batteries in certain markets while providers such Stem and Tesla offer “behind-the-meter” storage solutions for businesses and homeowners.

In the past five years, lithium-battery prices have fallen by at least 57% and we expect a further 60% drop by 2025. That will contribute to 9.5GWh/5.7GW of battery capacity in the US by 2024, up from 1.7GWh/0.9GW today.

Continuing battery price declines will also make electric vehicles (EVs) for the first time a viable option for middle-class US consumers without the benefit of subsidies. Last year, EVs represented 0.8% of global vehicle sales. By 2030, we anticipate that growing to one in four vehicles sold.

The most popular place to fuel such cars could be augmented gasoline stations... or the local grocery store, or simply your garage.

The changes we've seen to date are giving US energy consumers unprecedented opportunities to manage, store, distribute, and even generate energy. However, the new, empowered consumer poses inherent challenges to the traditional command-and-control / hub-and-spoke models of conventional power generation and power markets. Already, we have seen examples around the globe where incumbent utilities were caught flat-footed by rapid clean energy build-outs.

In some cases, it has been heavy subsidies for renewables that have catalyzed the change. But more recently, simple low costs are allowing wind and solar to elbow their way onto the grid.

So, where does "infrastructure" fit into this changing energy landscape?

First, conceptually, we must accept that the empowered consumer is here to stay. To some degree, this acceptance is already underway in the private sector where companies that once focused mainly on large-scale power generation are merging with consumer-facing utilities, or buying smaller solar installers and battery solution providers.

Second, policy-makers should seek to promote infrastructure that accommodates a new, more varied, more distributed world of energy generation and consumption. Most immediately, this can mean supporting greater deployment of so-called smart meters. To date, the US has installed almost 71m of these devices, which enable better communication between energy consumers and utilities. Compare that to Italy where all consumers have such meters and are now receiving a second generation with more

advanced functionality, or China which has installed 447m units, across almost its entire urban population.

Policy-makers may also seek to facilitate the development of high-voltage transmission across state lines. It has long been an adage that the Great Plains states represent the "Saudi Arabia of wind", given the exceptional resources there. To some degree, those states might as well be in Saudi Arabia, given the major challenges of building transmission that would move electrons generated there to more densely populated states in the east or west. The US has added approximately 1.5GW of high-voltage direct current transmission since 2010. By comparison, China has added 80GW over that time.

Investment is needed at lower voltages too. Our passive, one-directional, electricity distribution system is under strain as new distributed generation capacity comes online.

In addition, policy-makers might also consider ways to expand support for EV charging stations. As sales of such cars grow, consumers are already putting greater pressure on certain distribution nodes around the country. Ensuring that EV "fuel" demand is managed in an orderly manner will be important.

Finally, the changes afoot and to come will require what might best be described as infrastructure "software". Most importantly and pressingly, this must include the reform of electricity markets to take into account the new realities of 21st century power supply and demand.

It may also include expanded programs to educate energy professionals on the new realities of modern energy markets. And, yes, it could include more software to

improve energy monitoring and optimize system performance.

In closing, I would reiterate that none of this need be done at the exclusion of investing in traditional energy infrastructure where the needs are also pressing.

However, any rational discussion about energy infrastructure investment today must do more than take into account the current situation. It must also consider where we will be tomorrow.

Thank you.

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CHAIRMAN. Thank you, Mr. Zindler.
Mr. Imhoff, welcome.

STATEMENT OF CARL IMHOFF, MANAGER, ELECTRICITY MARKET SECTOR, PACIFIC NORTHWEST NATIONAL LABORATORY

Mr. IMHOFF. Thank you and good morning.

Thank you, Chairman Murkowski and Ranking Member Cantwell and also the Committee members for the leadership of this Committee in helping drive the nation's energy future forward.

My name is Carl Imhoff. I lead the Grid Research Program at the Pacific Northwest National Laboratory (PNNL) in Washington State. I also Chair, jointly with NREL, the DOE Grid Modernization Laboratory Consortium. It's a group of 13 national labs that, along with over 100 partners from industry, industry groups such as Gridwise Alliance and universities, supports the Department's Grid Modernization Initiative.

PNNL has long supported the power system innovation and reliability for the Northwest and for the nation.

The laboratory led DOE industry collaborations in deploying next generation transmission sensors to help avoid blackouts, and in California alone avoided outages result in an estimated savings of about \$360 million annual to consumers.

PNNL also led a demonstration to test transactive control in the Pacific Northwest validating smart grid benefits and new control approaches of Avista Corporation in Spokane, who also has a footprint, and consumers in Idaho and Alaska. They implemented a distribution automation and smart metering projects that reduced consumer outages by ten percent, shortened the duration of those outages by 21 percent and delivered 1.5 million avoided outage minutes in just the first year of operation.

These two examples illustrate some of the high return on investment achieved by utilities and national labs across the country when combining their efforts and new infrastructure innovation with private, public validation.

The DOE grid modernization initiative is an important source of innovation for the nation's efforts in terms of modernizing infrastructure. It's an innovative cross-cut effort spanning multiple DOE program offices, develop new concepts, tools, platforms and technologies to support grid modernization. A portfolio of ADA projects was funded for up to three years, beginning in FY'16.

Today I offer three primary points. First, that the electric sector is fundamental to a secure energy infrastructure and it's comprised of 21st century assets that go well beyond steel and concrete. Secondly, the electric infrastructure is changing dramatically and a modern grid requires the addition of a new metric, a metric of flexibility to add to the pantheon of reliability, affordability and security. Grid flexibility will be vital to an effective infrastructure in the future. And then third, there are substantial opportunities for low hanging fruit, if you will, of improving the infrastructure via public/private partnership. And I'll share some examples for these.

The grid infrastructure spans the nation providing essential services to the U.S. economy through over three and a half thousand utilities, but it also serves small, remote communities that must

provide, oftentimes, their own electric services predominately through local diesel generation and microgrids.

The new digital revolution is increasingly important to our economy creating new consumer services, businesses and jobs. But there is more to infrastructure than cables, towers and generators. Utilities rely on major control centers to operate the power system, requiring investment in software, communications and controls. Sensor networks that provide real-time sensing, both locally and across entire interconnections, are emerging to dramatically improve reliability and asset management.

Finally, utilities, vendors, universities and DOE laboratories maintain a network of research and testing and workforce training infrastructure necessary to support the revitalization of the grid. These 21st century assets are as critical as towers and wires when it comes to electric infrastructure modernization.

Trends toward distributed resources and the smart grid edge are reshaping utility business models as well. Today we have about two billion intelligent, connected devices at the edge of the grid. Utilities expect that to grow to 20 billion by 2025 and one of the big challenges is a number of those devices will be on the customer side of the meter, outside the direct control of utilities. So, it's changing dramatically, the business model.

Second, the emerging of distributed resources is accelerating faster than many in the industry expected it to. It includes distributed generation like photovoltaics, smart loads, demand response, electric vehicles and energy storage. These changes collectively require the grid to become more flexible and yet deliver more flexibility to a combination of better generator controls, better coordination across the boundary between transmission and distribution to engage smart loads at scale and energy storage.

Finally, the proliferation of internet and digital devices throughout our economy has increased the challenges of cyberattack on the electric infrastructure. The electric grid is under regular reconnaissance and cyberattack activities from both foreign-state and non-state actors.

The electric industry, in partnership with the government, has responded strongly to address these challenges including improving best practices through self-assessment and launching the Electric Sector Coordinating Council. In addition, PNNL developed the Cyber Risk Information Sharing Program (CRISP) with DOE and is now supporting NERC in the deployment of the program to utilities nationwide. The CRISP program provides cyber threat intelligence to identify tactics, techniques and procedures used by advanced threat actors from nation states as well as professional hackers.

In closing I offer three recommendations. First, consider in your deliberations adding the metric of grid flexibility to the fundamental metrics for outcomes for the grid of the future. Second, leverage the recent substantial base of successful demonstration system demonstrations that jump start the electric infrastructure modernization. Topics that have a wide base of lessons learned in successful business case development include, distribution automation, advanced metering, conservation of voltage reduction and the use of distribution management system software.

This last item is what enables utilities to know where outages are. Today, more than half of our utilities still have to wait for a phone call to inform them of an outage and broadening the penetration of distribution management system software would have great impact.

And then lastly, include public/private partnership to conduct infrastructure pilots at the regional level. These pilots can rapidly validate the emergency new modernization concepts and tools emerging from industry, the DOE research portfolio and elsewhere.

With that, I'll stop.

Thank you.

[The prepared statement of Mr. Imhoff follows:]

Statement of Carl Imhoff
Manager, Electricity Market Sector
Pacific Northwest National Laboratory
Before the
United States Senate
Committee on Senate Energy and Natural Resources
March 14, 2017

Good morning. Thank you Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee. I appreciate the opportunity to appear before you today to discuss U.S. energy infrastructure challenges and opportunities.

My name is Carl Imhoff, and I lead the Grid Research Program at the Pacific Northwest National Laboratory (PNNL), a Department of Energy (DOE) national laboratory located in Richland, Washington. I also serve as the Chair of DOE's Grid Modernization Laboratory Consortium, a team of national labs that, along with industry, industry groups such as the Gridwise Alliance and Electric Power Research Institute (EPRI), and university partners, supports the Department's Grid Modernization Initiative. The consortium members include PNNL, the National Renewable Energy National Laboratory, Sandia National Laboratories, Oak Ridge National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, Idaho National Laboratory, Argonne National Laboratory, the National Energy Technology Laboratory, Savannah River National Laboratory, Lawrence Livermore National Laboratory and the National Accelerator Laboratory at Stanford.

For more than two decades, PNNL has supported power system reliability and innovation for the State of Washington, the Pacific Northwest, and the nation. Over this period, the laboratory has:

1. Led DOE-industry collaborations in developing and deploying synchrophasor technology to help avoid blackouts. Phasor measurement unit networks are designed to enhance situational awareness of wide area systems. This new grid tool has demonstrated value by detecting impending system control and equipment faults for system operators thus avoiding major outages. In California, avoided outages resulted in an estimated \$360 million annual savings to customers, and \$90 million annual savings were the result of improved utilization of existing generation and delivery systems. In east Texas, phasor measurement units enabled Entergy to respond to major storm outages by synchronizing a temporary electrical island to reduce outages during the recovery. The Bonneville Power Administration has demonstrated savings of \$400,000 on average for testing generator controls settings on the Columbia Generating Station, an 1100 megawatt nuclear reactor in Washington State, without requiring a plant shutdown.
2. Led a public-private collaboration with utilities and vendors to develop and demonstrate transactive control concepts on the Olympic Peninsula in Washington and for the Pacific

Northwest Smart Grid Demonstration project—the largest of its kind—to validate smart grid benefits and new control approaches that engage demand and distributed resources at scale. Example outcomes include Avista Corporation implementing distribution automation and smart metering pilots that delivered a 10 percent reduction in customer outages, reduced consumer outage durations by 21 percent and resulted in 1.5 million avoided outage minutes between April 2015 and April 2016. Avista also saved 42,000 megawatt hours in 12 months. Idaho Falls Power implemented transactive control of end uses and utilized the concept to minimize customers' outages during an extreme winter storm when western system operators were calling for emergency load reductions.

3. Delivered the first applications of high performance computing to grid tools such as interconnection-scale contingency analysis, reducing run times from days to under two minutes. PNNL also applied high performance computing and phasor measurement unit data to deliver the first real-time dynamic state estimation to open the door to the future world of predictive grid tools. This parallelized state estimator tool enabled PNNL to meet an ARPA-E challenge to reduce dynamic line rating calculations from 24 hours to 10 minutes, creating the potential to operate the system with much higher asset utilization.

These examples illustrate the high return on investment encountered by utilities and national labs across the country when combining new electric infrastructure innovation with public-private validation and deployment.

The DOE Grid Modernization Initiative is an important source of innovation for the national efforts to modernize energy infrastructure. The Initiative is a DOE-wide effort across multiple program offices to accelerate the development of technology, modeling analysis, tools, and frameworks to enable grid modernization adoption. As a key component of this initiative, the Grid Modernization Laboratory Consortium is working closely with partners in industry, academia, and cities and states to deliver on the objectives outlined in DOE's Grid Modernization Multiyear Program Plan. These integrated efforts will deliver new concepts, tools, platforms, and technologies to better measure, analyze, predict, and control the grid of the future. The federal role is to invest in high risk research and then collaborate with vendors, utilities and state/regional regulatory entities to provide the tools and data and demonstration support. This accelerates the development of lessons learned and data that support states and utilities to develop business cases for their grid modernization efforts. The inaugural peer review for this effort is scheduled for April 18-20 in Arlington, VA and is open to the public. I respectfully request that the appended fact sheet on the Grid Modernization Laboratory Consortium be entered into the record along with my written testimony.

Today I will address three main points:

1. The electric sector is fundamental to a secure, robust and vibrant energy infrastructure, and it is comprised of assets beyond concrete and steel.

2. Electric infrastructure is changing dramatically due to technology and economic drivers. Plans for energy infrastructure modernization must account for a significantly different electric infrastructure over the next decade.
3. Opportunities exist to leverage technology innovation and public-private partnership to enhance the energy infrastructure modernization efforts.

Electric Power System is Vital to U.S. Energy Infrastructure

The electric grid infrastructure spans the nation providing essential services to the U.S. economy. It entails 640,000 miles of transmission lines and 6.3 million miles of distribution lines serving over 19,000 electric generators and is over one megawatt in size, ultimately engaging virtually all Americans via over 3,500 utilities. It also includes small, remote communities that must provide their own electric services, predominantly through local diesel generation and microgrids. The digital revolution is increasing the role that electricity plays in our gross domestic product, and the emergence of smart grid concepts and new advanced generation concepts is unleashing new opportunities for consumer services and choice.

But there is more to the electric infrastructure than cables, towers and generators. Utilities rely increasingly on major control centers to coordinate and operate the power system, requiring substantial investment in software systems, communications and controls. Sensor networks that provide real-time sensing both locally and across entire interconnections are emerging to dramatically improve reliability and asset management. Locally, over 64 million smart meters deliver advanced services to consumers and utilities. At the interconnection level, a fleet of high resolution phasor measurement units has recently been installed that provide unparalleled insights on real-time grid health protect against blackouts. Over 2000 of these devices are now networked across the North American grid, providing unparalleled system observability and a key new tool for delivering increased reliability of the high voltage system. High voltage transmission systems include complex control systems necessary to protect the system from damage during outages. Finally, utilities, vendors, universities and laboratories maintain a network of research and testing infrastructure necessary to support the health and revitalization of the electric infrastructure.

Major Forces of Change Facing the Electric Infrastructure

Recent industry trends are increasing the interdependence of traditional power system infrastructure with other critical infrastructures.

- Abundant, low cost natural gas generation has dominated new centralized generation additions, creating a growing dependence on the reliability of natural gas supply to electricity generators. System operators are modifying risk management and planning practices to reflect the important role that natural gas infrastructure plays in grid reliability.

- The advent of smart grid concepts and advanced system controls has dramatically increased the role of communications networks in power systems.
- Recent trends in extreme weather events including heat waves and droughts point to increased importance in the interaction of electric generation infrastructure and water infrastructure planning and operations.

This growing interdependence of the grid with other critical infrastructures dictates that modernization policy should address these infrastructures collectively.

In addition to growing interdependency across multiple critical infrastructures, changes in electric generation technology, grid controls, customer energy management systems and information technology are collectively reshaping utility business models and enabling new innovations and market participants. It is essential that plans for electric infrastructure modernization target the future power system as opposed to current system design and concepts.

Let me highlight a few of the main changes underway:

- The revolution in intelligent devices is creating an explosion of connected devices at the grid edge that will strongly influence the electric infrastructure; utilities expect over 20 billion intelligent devices to be connected at the grid edge by 2025, many of which will be on the customer side of the meter.
- The emergence of distributed energy resources is accelerating, including distributed generation (e.g. photovoltaics), smart loads and demand response, electric vehicles and energy storage.
- Renewable generation has increased significantly, providing more variable generation on the system and driving changes in the approaches for planning system expansion and operations.
- Potential new business models for the distribution system are being considered in states and regions as a potential response to the opportunities for distributed energy resources and pressures on the current utility business model. Commissions in New York, California, Hawaii, Minnesota, and Washington, D.C. are engaged with DOE and national labs now; new discussions are just starting with Ohio and North Carolina. This collective effort is exploring new models for distribution system platforms, with a focus on the objectives, functions, and components for distribution system planning, grid operations, and distributed energy resource markets.
- The proliferation of internet and digital devices throughout our economy has increased the challenges of cyber-attack on the electric infrastructure. The electric grid is under regular reconnaissance and cyber-attack activities from both foreign state and non-state actors. The electric industry, in partnership with government, has responded strongly to

address these challenges, including by improving best practices through self-assessment and launching the Electric Sector Coordinating Council to coordinate and prioritize national cyber resilience of the electric sector

In addition, PNNL developed the Cyber Risk Information Sharing Program (CRISP) with DOE and is now supporting the North American Electric Reliability Corporation (NERC) in the deployment of the program to utilities nationwide. The CRISP program is a collaboration with utilities to provide cyber threat intelligence to identify tactics, techniques, and procedures used by advanced threat actors from nation states as well as aspirational or professional hackers. This analytic capability is made possible by the unique partnership between the U.S. government and private sector partners. Currently CRISP participants represent over 60 percent of the total bulk energy transmission infrastructure in the nation. The program is actively engaging new participants with the goal of expanding this coverage to 70 percent of the bulk energy transmission by the end of 2017.

Suggested Technical Recommendations to Support Energy Infrastructure Modernization

As the Committee considers the needs of grid infrastructure, I offer the following technical suggestions.

1. **Account for interdependencies across multiple critical infrastructures** (e.g. electric, natural gas, communications, water, emergency response etc.) when defining an energy infrastructure modernization strategy. This could include:
 - a. Leveraging the emerging Grid Modernization Laboratory Consortium Consensus Grid Architecture work to identify and prioritize interdependencies to support planning at the federal, regional and state levels.
 - b. Utilizing emerging high performance planning tools, valuation tools and grid modernization metrics from Consortium to aid in infrastructure planning at state, regional, interconnection and national level.
2. **Include “grid flexibility” as an important attribute in energy infrastructure investments to accommodate the dramatic changes in the electric system.** Given the multi-decade lifetime of most energy infrastructure projects, planning efforts must include “grid flexibility” in the planning process for infrastructure improvements. Grid flexibility means the capacity of grid resources such as generators and responsive demand, to provide fast response—both up and down in supply or load—to help the system adapt to variable generation, requirements for frequency or voltage support etc. The benefits to the nation would include increased capacity to manage increasing distributed energy resources such as renewable generation and demand response, improved resilience to grid outages—caused by all hazards— and improved emergency response and recovery.

3. **Leverage recent successful results in recent public-private demonstrations of distribution system modernization to jumpstart electric infrastructure modernization** that will directly improve consumer service and add quality jobs to the economy. These include distribution automation, advanced metering, conservation voltage reduction, and use of Distribution Management System software control systems. Today the majority of utilities still depend on customer phone calls to alert an outage. Rapid modernization of distributions systems can make a significant difference as already demonstrated in successful public-private demonstrations in all regions of the country. These completed projects, in concert with new planning tools from the GMLC and grid data repositories being developed by ARPA-E, offer lessons learned and tools that can help the utilities balance their plan and implement upgrades that make sense for their customers.
4. **Use emerging high performance planning and risk assessment tools to augment current practice to mitigate risks from system threats.** This could include:
 - a. Accelerating industry utilization of DOE's new dynamic contingency analysis toolset to improve planning for mitigation of large dynamic cascading outages.
 - b. Extending recent DOE/NERC efforts in use of "design basis threat" tools to better plan physical security of energy infrastructure.
 - c. Supporting extension of self-assessment tools, training and information to mid-sized and small utilities to broaden the cyber resilience of the entire utility industry.
5. **Consider the use of public/private partnerships to conduct infrastructure pilots at the regional level.** These pilots can rapidly validate the emerging new modernization concepts and tools emerging from industry, the DOE research portfolio and elsewhere.

Traditionally, energy infrastructure is thought of as the energy generation and delivery system, such as the electric grid and the various means associated with transporting energy. However, it is important to note that creating the means to move energy requires smart scientists and engineers—which we have, including at our national laboratories—and modern laboratory space and equipment, which faces a significant backlog in infrastructure investment. The DOE Office of Science's Science Laboratories Infrastructure program supports science and technological innovation at national laboratories by funding and sustaining mission-ready infrastructure. It is this mission-ready infrastructure that enables the national laboratories to collaborate with academia and industry to solve our nation's most pressing challenges, including regarding the electric grid.

In conclusion, the electric grid is a critical component of our nation's infrastructure and economy. Infrastructure investments are required to integrate the connected nature of our economy and energy resources and to transition to the grid of the future. Should Congress make such investments, it is important to look forward in grid infrastructure planning to ensure grid flexibility and other traits that will continue to advance our economy as the grid is modernized.

Physical and cyber security of the grid will remain a critical issue into the foreseeable future, and any infrastructure investments must consider these challenges to ensure the resiliency of the grid.

The work of DOE's Grid Modernization Initiative and Grid Modernization Laboratory Consortium is designed to address these and other challenges associated with grid modernization. I appreciate the opportunity to discuss this important issue with you today, and I am happy to answer your questions. Thank you.



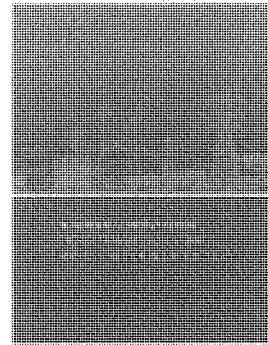
Delivering a Power Grid for the 21st Century

The United States power system is a strategic investment for our nation, and new paradigms for designing, operating and securing our grid are critical for our national economic and security goals. To meet this challenge, the U.S. Department of Energy established the Grid Modernization Initiative. Through this initiative, DOE is working with public and private stakeholders to develop the concepts, tools, and technologies needed to measure, analyze, predict, protect, and control the grid of the future.

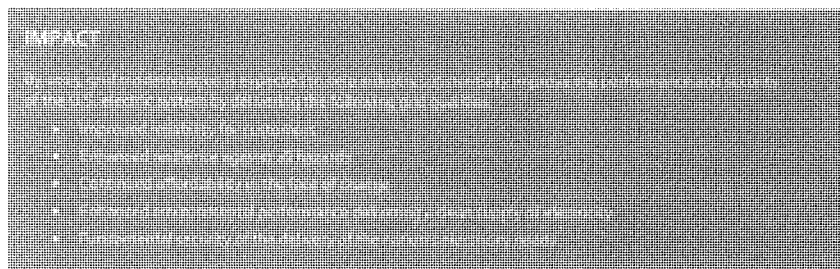
In support of this Initiative, the DOE launched the **Grid Modernization Laboratory Consortium** to engage the national laboratories working on DOE grid programs to frame a new integrated approach for planning and delivering innovations and thought leadership in support of grid modernization. This new, crosscutting approach ensures that DOE research and development investments and capabilities are fully coordinated to enable a modern U.S. power system.

Comprised of 65 leading scientists and engineers from across the DOE national labs, the technical teams are aligned with **six technical thrust areas**:

- **sensing and measurements**
- **devices and integrated systems**
- **system operations, power flow, and control**
- **design and planning tools**
- **security and resilience**
- **institutional support.**



Released in April 2013, the Quadrennial Energy Review (QER) highlighted fundamental challenges and new opportunities for transforming the grid to meet new demands of U.S. energy and economic priorities of the 21st century. The QER recommended focused investment in Grid Modernization research and development as a national imperative.



THE CHALLENGE

For the next several decades, the Grid Modernization Laboratory Consortium will coordinate grid modernization activities to address the following challenges:

- increasing the grid's digital capacity
- enabling two-way power flow for distributed generation (renewables)
- improving security and resilience to all hazards—cyber, physical and other risks
- developing tools and control paradigms that leverage the capabilities of new digital grid technologies to deliver improved reliability and economic productivity.

STAKEHOLDER INVOLVEMENT AND OUTREACH

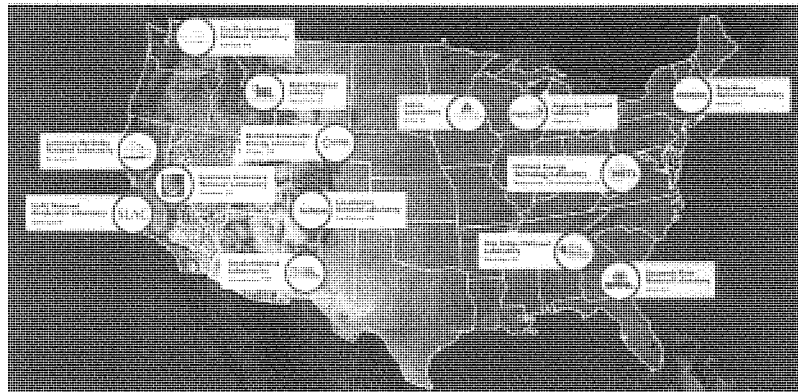
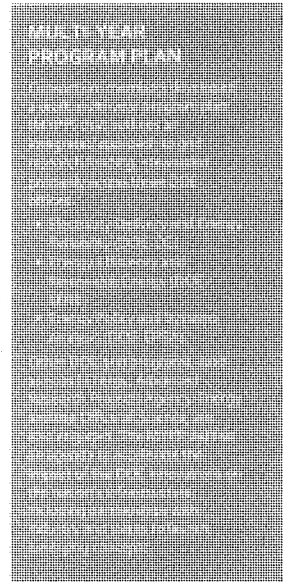
Modernization of the U.S. electric grid entails dramatic transformations, with close collaboration required across industry, states, federal agencies, regulators and numerous other stakeholders. In addition to leading the lab-to-lab technical teams to best leverage intellectual and scientific assets, the labs also play a key role in engaging regional stakeholders in new concepts.

For example, the labs are providing institutional support to states, local communities, tribes, and others to develop new regulations needed to unleash the potential of the modern grid. The labs will also engage in the development and implementation of regional and local demonstrations, co-funded by industry, to accelerate the rate of impact of the new innovations emerging from the DOE Grid Modernization efforts.

CONTACTS

Carl Imhoff
Pacific Northwest National Laboratory
carl.imhoff@pnl.gov
509.375.4328

Bryan Hannegan
National Renewable Energy Laboratory
bryan.hannegan@nrel.gov
303.275.3009



CHAIRMAN. Thank you, Mr. Imhoff.
Mr. O'Sullivan, welcome to the Committee.

**STATEMENT OF TERRY O'SULLIVAN, GENERAL PRESIDENT,
LABORERS' INTERNATIONAL UNION OF NORTH AMERICA**

Mr. O'SULLIVAN. Thank you very much.

Chairman Murkowski, Ranking Member Cantwell and members of the Energy and Natural Resources Committee, on behalf of the 500,000 strong, proud and united men and women of the Laborers' International Union of North America (LIUNA), I want to thank you for the opportunity to testify here today. It's both an honor and a privilege to do so.

As the people who build, repair and maintain our nation's critical energy infrastructure, LIUNA members support a reasonable, rational, fact-based, energy policy. We support regulatory reform that streamlines the permitting process, allows reviews by separate agencies and entities to proceed concurrently and provides for timely, definitive decisions that enable approved projects to proceed without delay.

LIUNA joins others in the energy industry in calling for the swift filling of vacant spots on the Federal Energy Regulatory Commission.

LIUNA also supports the responsible exploration and development of energy resources within the Arctic National Wildlife Refuge, ANWR.

Permitting energy production on just one-tenth of one percent of ANWR's total acreage will create tens of thousands of good paying, family supporting jobs over the next few decades. Its royalties, lease payments and corporate income taxes will generate billions in state and federal revenue that could be reinvested in our failing infrastructure.

Chairman Murkowski, for decades your state has demonstrated that natural resource development can co-exist with nature, building family sustaining careers while maintaining a natural beauty of wild places. Your state has shown that there is no need to pit jobs against the environment. Yet, on his way out of office, President Obama removed key Arctic and Atlantic offshore areas from future leasing, destroying good jobs. LIUNA hopes that Congress and President Trump will reverse this, what we consider, a bad decision.

Developing sound, thoughtful energy policy that takes into consideration the men and women who work in the energy sector should be a bipartisan agenda creating millions of new jobs across many sectors of the economy while modernizing our vital energy infrastructure and ensuring America's energy independence. The American society, as civil engineers, has given our energy infrastructure a grade of D plus. The men and women of LIUNA and other building trades union are eager to go to work to address this problem, yet opposition to almost every energy project, especially pipelines, has threatened to derail all serious attempts to address this issue.

It also threatens the creation of good, middle class jobs. For workers in communities throughout the United States, pipeline

projects and other energy projects are lifelines. It's not the pipelines that are dirty, it's the politics.

Today, LIUNA has more than \$50 billion worth of pipeline work under contract. Tens of thousands of highly trained, safe, skilled building trades members will be put to work for years to come on projects such as the Keystone XL pipeline, the Dakota Access pipeline, the Atlantic Sunrise pipeline, the Rover pipeline, Atlantic Coast pipeline, Sable Trail pipeline, Penneast pipeline and the Cove Point LNG facility that was talked about earlier. And these are just the tip of the iceberg.

Although these jobs, like all construction jobs, are temporary by nature, anyone who has a clue about the work we do knows that by stringing together one temporary job after another construction workers are able to create a career allowing them to provide for their families and save for their retirement. At a time when it's harder and harder to succeed without a college education and a debt that goes with it, LIUNA and other building trades unions are one of the few places where a high school graduate can enter an apprenticeship program, learn a trade, become a qualified journeyman and build a rewarding, middle-class career.

LIUNA does not deny climate change. In fact, we are one of the few unions that supported cap and trade legislation. But we take issue with "keep-it-in-the-ground" pipeline opponents who ignore the reality that these resources continue to be pulled out of the ground anyway and transported by means that are riskier and less environmentally sound than pipelines.

Rather than wasting time and resources fighting over individual pipeline and energy projects, we believe it's time to embrace a comprehensive, rational, common sense energy policy that provides for the safe and responsible development of all domestic sources of energy, including wind, solar, hydro and nuclear. Unleashing these resources will create economic opportunities in communities across the country while making us less dependent on energy from nations that seek to undermine the American ideals of freedom and liberty.

Finding realistic, environmentally responsible solutions to our energy infrastructure problems isn't a Republican issue or a Democratic issue. It's not a conservative issue or a liberal issue. It's an American issue.

Thank you for the opportunity to offer this testimony. I look forward to any questions you might have and to working with you, Chairman Murkowski and with the entire Committee in the future.

[The prepared statement of Mr. O'Sullivan follows:]

Laborers'
International
Union of
North America

LIUNA!

Feel the Power

TESTIMONY OF TERRY O'SULLIVAN

GENERAL PRESIDENT

LABORERS' INTERNATIONAL UNION OF NORTH AMERICA

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

MARCH 14, 2017

Chairman Murkowski, it is an honor to be invited to this hearing. On behalf of the 500,000 strong, proud, and united men and women of the Laborers' International Union of North America (LIUNA), thank you for the opportunity to offer testimony to your committee. Thank you, as well, for your longstanding support for the members of our Union, and for your work to protect the living standards of all workers and their families. I also want to thank Ranking Member Cantwell, and all the committee members, for all your work.

As the people who build, repair, and maintain our nation's critical energy infrastructure, LIUNA members support a reasonable, rational, fact-based, energy policy that creates middle-class jobs, meets America's growing energy needs, fosters energy independence, protects the environment, and minimizes greenhouse gas emissions. Our union proudly represents 5,500 laborers in the great state of Alaska. They work across the state from the North Slope to the Valdez Terminal, the end of the Trans-Alaska Pipeline, which Laborers proudly helped build.

Our country needs a common-sense energy policy. Replacing foreign sources of energy with domestically produced energy makes sense. Fostering domestic job creation instead of funding foreign extremists is a rational goal. Incrementally lowering emissions makes more sense than the "all or nothing" approach embraced by the political extremes.

Moving forward with a non-partisan energy agenda will facilitate significant private investment that will create millions of new jobs across all sectors of the economy. It is also critical to

addressing and improving the vital energy infrastructure that keeps our lights on, that heats and cools our homes and businesses, and that moves people and goods across the country. This infrastructure is in desperate need of repair and modernization. In its most recent report card on the state of America's infrastructure, the American Society of Civil Engineers gave our energy infrastructure a grade of D+.

Projects that address this energy infrastructure crisis translate into jobs that put food on their families' tables, roofs over their heads, and gas in their cars and trucks. These jobs enable them to put their children through college, to save for retirement, and to spend money in business establishments that employ others. Although, like all construction jobs, these jobs last only as long as it takes to complete the project, a steady succession of such so-called "temporary" jobs is what enables construction workers to build rewarding, middle-class careers. It is ironic that among those who dismiss these jobs because of their "temporary" nature are Hollywood celebrities whose careers are built on similarly temporary jobs in the entertainment industry, and politicians whose own jobs have specific end dates.

LIUNA and the other building trades unions invest hundreds of millions of dollars in training that enables our members to develop the knowledge and skills they need to work safely and productively while constructing energy and other infrastructure to the highest standards. At a time when it is harder and harder to succeed without a college education and the debt that goes with it, LIUNA and Building Trades Local Unions and training funds are the only places where someone can graduate from high-school, enter a training and apprenticeship program, become a qualified journeyperson, and build a rewarding middle-class career, all without spending a dime in tuition. Indeed, apprentices earn while they learn, bringing home steady paychecks that increase as their training progresses. LIUNA is proud that for 114 years, we have provided generations of working-class Americans a pathway to the middle class. We are equally proud that, from the start, we have made that pathway available to all, regardless of race, ethnicity, or national origin.

During the Great Recession, the unemployment rate in the construction sector reached nearly 30%. Were it not for the jobs created by the boom in North American energy development, tens of thousands more workers would have been forced into unemployment. These were good unionized jobs that require a high degree of training and expertise; pay family-sustaining wages with good health insurance benefits; and help provide pensions for the workers when they retire.

Chairman Murkowski, for decades, your own home state has demonstrated that natural resource development can coexist with natural beauty, building family-sustaining careers while maintaining the natural majesty of wild places. The Trans-Alaskan Pipeline has provided employment opportunities for tens of thousands of Alaskans, including many members of LIUNA. Pitting jobs against the environment is a false dichotomy that benefits neither.

That is why LIUNA supports regulatory reform that:

- Streamlines necessary review processes
- Allows reviews by separate agencies and entities to proceed concurrently
- Provides for more definitive permitting processes that enable projects to move forward without delay once all regulatory concerns have been addressed.

Recent reauthorizations of the Surface Transportation Act and the Water Resources Development Act have contained provisions intended to help expedite project approval, and your colleague from Alaska, Senator Dan Sullivan, is working on legislation that would also help achieve these needed goals. These efforts may help with permitting hurdles that have delayed other job creating projects in the Northwest such as the Tacoma Methanol Plant, the Port of Tacoma LNG Facility, the Kalama Methanol Plant, and the Jordan Cove LNG Terminal, in Washington and Oregon.

LIUNA also calls for the speedy filling of vacant spots on the Federal Energy Regulatory Commission (FERC), so that FERC has the quorum necessary to complete regulatory reviews and approvals in a thorough, and timely, manner.

LIUNA applauded President Trump's executive order clearing the way for the completion of the Dakota Access Pipeline, a project that has employed approximately 4,400 building tradespeople, including 1,000 LIUNA members. The President's approval of the Atlantic Sunrise and Rover pipeline projects will generate several thousand construction jobs, including approximately 2,000 for LIUNA members.

These projects are among 20 unionized pipeline projects spanning 20 states that are either under construction, about to begin construction, or awaiting approval. At their peak, we expect all of these projects will employ tens of thousands of highly trained, safe, skilled union tradespeople, including approximately 13,000 LIUNA members. The more than five thousand miles of state-of-the-art pipeline these projects are leaving behind are safer, more environmentally sound, and emit

fewer greenhouse gases than any other method of transporting energy resources. For workers, their families, and the communities through which these projects pass, these pipelines are lifelines to the middle class.

Finally, I appear here today to urge Congress and President Trump to reopen the key Arctic and Atlantic offshore areas recently closed off to future leasing. Sadly, on the way out of office, the prior Administration took a parting shot at workers and the state of Alaska by removing key Arctic and Atlantic offshore areas from future leasing. This “midnight decision” removed lease sales in the Chukchi and Beaufort Seas that were key parts of the five-year Outer Continental Shelf oil and gas leasing plan, slowing Arctic investment and resource development.

Blocking offshore exploration destroys good jobs. Developing Alaska’s outer continental shelf could create an annual average of 54,700 new jobs lasting through 2057 according to the University of Alaska’s Institute of Social and Economic Research. Developing the outer continental shelf could create \$145 billion in new payroll through 2057, including \$63 billion to employees in Alaska and \$82 billion to employees in the lower 48. In addition to Governor Bill Walker, 76% of Alaskans support offshore resource development including 72% of Alaska Natives.

LIUNA supports the responsible exploration and development of energy resources within the Arctic National Wildlife Refuge (ANWR). Opening up parts of ANWR will create jobs, generate government revenue, and increase our nation’s energy security. Studies by the University of Alaska’s Institute of Social and Economic Research have shown that permitting energy production on just 0.1% of ANWR’s total acreage (2,000 acres out of 19 million) could create an annual average of 54,700 new jobs lasting through 2057.

In addition to the safe, environmentally responsible development of America’s abundant oil and natural gas resources, LIUNA supports the development of *all* domestic energy resources, including wind, solar, hydro, and nuclear. Unleashing these energy resources will create economic opportunities in communities across the country, while making us less dependent on energy from nations that seek to undermine the American ideals of freedom and liberty. Adequate investment in surface transportation, water infrastructure, and domestic energy will create millions of jobs for workers across all segments of the economy. We can help grow our economy, rescue struggling working Americans, and leave behind real assets that will benefit taxpayers and our entire nation for generations to come. This isn’t a Republican issue or a Democratic issue; it’s an American

issue. Every American benefits from good roads, safe bridges, clean drinking water, and affordable energy.

Thank you for the opportunity to offer this testimony. We are eager and excited to work with you in the future. Together we can build America so America works.

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CHAIRMAN. Thank you, Mr. O'Sullivan. I think it is a good way to wrap up by reminding us that when we are talking about infrastructure, whether it is pipelines, whether it is hydro, whether it is what we're doing with our smart grid, it, at the end of the day, is an opportunity for us to create good jobs.

I think, if there has been a common thread throughout the testimony that we have heard, it is that the regulatory process is one that, unfortunately, can yield uncertainty, can yield delays and that adds to cost. So I want to just speak to everyone and direct my questions in that vein this morning.

Let me begin with you, Mr. Koplin, and then I will incorporate Mr. Leahey in this as well. When we are talking about small projects, you mentioned the possibility for Crater Lake there in Cordova. What barriers do you have in front of you as you work to develop a small scale hydro facility in your community? How can Cordova move forward more readily, more quickly, with this from a regulatory perspective? If we could clear things out of the way, what would it be?

Mr. KOPLIN. I'm going to give you a little longer answer.

Our utility co-chairs, statewide co-chair, the State Utility Organization and, in general, the biggest barrier is regulatory to developing any renewable.

Fortunately for us in this case, we broke down the biggest barrier by getting the site declared by FERC as non-jurisdictional. So that gives us the opportunity to, frankly, develop this as an agile project and a team that can work together through the finish line. Otherwise we wouldn't be doing it.

We literally had been told by the Forest Service that it was on their land, so we hadn't even considered this project until we found out it was private property.

CHAIRMAN. Yes, which made all the difference, all the difference in the world.

Mr. KOPLIN. Yup, go or no go.

CHAIRMAN. Yes.

Let me ask you, Mr. Leahey, when you provided your testimony you talked about the fact that only three percent of the existing dams out there are actually electrified. When we think about opportunities, it is not like we need to go out and build a brand-new dam here. We have an opportunity to really do so much more with what we have in place.

Now, I understand that FERC and the Corps have entered into an MOU to facilitate the development of these non-powered dams. Do you think those MOUs are sufficient? Is there more that we can be doing here in Congress to help facilitate the electrification aspect?

Mr. LEAHEY. Sure.

We believe that the MOU is going to be a step in the right direction and will solve some of the problems, but the problem is generalized for hydro licensing.

While FERC is the issuer of the license, they are not the only ones who are involved. There are many state and federal resource agency approvals that are needed in order to get a final approval done. We believe all of this, all of those, are important and are part of the process, but they're all independent authorities.

And so, it's very hard to enforce timelines. It's very hard to provide that certainty either in a relicensing of an existing project or a new project going forward.

With respect to non-powered dams and the Corps facilities, I also think there could be some additional work that could be done within the Corps itself in streamlining some of its approval procedures to make that internal work that they do, as well as the external work, in coordination with the Corps much more coordinated.

CHAIRMAN. We would like to work with you on defining and outlining that.

The reality that the hydro sector is facing right now, not only with the licensing of a new dam but the relicensing of existing facilities is something that, just, most people would say is mind boggling. Ten years and millions of millions of dollars for a relicensing. Now, you compare this with a natural gas plant developer who can move through this regulatory process in a couple years.

Why is it that when it comes to hydro the regulatory process is so much more difficult and then the bigger question is what can we do to address it?

Mr. LEAHEY. Right.

Well, again, as I talked about there are so many different agencies and statutes that are involved in the relicensing of the project because water is a public resource and many interests are involved in the use of that water, and rightfully so that those people are involved.

Again, however, coordinating all of that and the meetings and the studies and the information that has to be put together to do that kind of work takes a lot of time and cost. And if, as Clay mentioned, if people are not all, sort of, rowing in the same direction then you can see delays in the process.

And so—

CHAIRMAN. Delays and then cost.

Mr. LEAHEY. And then additional costs.

CHAIRMAN. Right, yes.

Mr. LEAHEY. And again, how that lines up with tax credits that have short-term extensions that we've seen and a process that could take five, ten years or longer, provides no certainty to utilities, developers or investors.

CHAIRMAN. It is absolutely something we have got to work on.

Senator Cantwell had to take a meeting just briefly, but she will be back to the Committee.

Let's turn to Senator Franken.

Senator FRANKEN. Thank you, Madam Chair.

It seems to me there is something, sort of, looming over this whole hearing that should be mentioned. When I read the testimony of the experts gathered here today it was clear that federal investments in R&D have paid off handsomely in the past and are vital to our continued success as a nation and grappling with our future energy needs.

I believe it was the last hearing we had in this room, we were considering the nomination of Rick Perry to be the new Secretary of Energy. On that day, it was leaked that the Administration planned to gut our federal commitment to energy R&D, a process that also severely threatens the energy R&D infrastructure and ex-

pertise that we so carefully built up at our national labs. It is striking me that there is no one from the Administration at this hearing today.

I just am raising that because so much of what we are talking about is at least related, in a very strong way, to R&D that has been done by the Energy Department. We are in a situation where the future of energy and our planet is related to renewable energy. We have received testimony on hydro and other renewables, such as solar power, and there are all kinds of renewable energy and energy efficiency technologies and energy storage that are part of our infrastructure.

The Chinese are spending \$361 billion through 2020 on energy R&D, and I do not want them to beat us. I want them buying our technology and not us having to buy theirs. But I am very worried about this Administration's commitment to R&D.

Mr. Zindler, you noted in your testimony that last year we installed more solar capacity than any other electricity generation technology. In the past ten years, we have installed more renewable energy capacity than anything else.

Your company tracks investment and deployment in the clean energy sector. In recent years this sector has shown significant growth. Do you have a sense of how many people are currently employed in the clean energy sector?

Mr. ZINDLER. So, well one thing we don't actually do is count jobs ourselves, but there are certainly others that have. One of the estimates from the Solar Foundation, which is an industry group, is that they are employing, I think, about 250,000 to 300,000 people in the solar industry today.

Senator FRANKEN. That is solar.

Mr. ZINDLER. Solar alone, wind another, maybe 90,000 or 100,000 jobs.

In terms of the dollars, which is something that we do track, the U.S. has attracted over half a trillion dollars in renewable/clean energy investment over the last 10 or 12 years or so which is certainly a lot of money. But in the context of, as you point out, you know, China typically is investing about twice that amount per year or somewhere in the neighborhood of \$100 to \$120 billion over the last several years.

Senator FRANKEN. What kind of growth are you projecting in the future for solar in particular?

Mr. ZINDLER. So, I mean, look, we have our own long-term forecast—the EIA does, Shell, others do as well. We're certainly more optimistic and bullish about these technologies than others have been, but I'll also point out we have typically been more optimistic and bullish and we've been wrong on the low side. In other words, there's been more solar build than people, than most people, would have predicted five years ago, already.

And last year the majority of new investment that went into power generating and equipment around the world was in lower carbon technologies, not in conventional fossil generation.

Senator FRANKEN. That is good.

Mr. ZINDLER. So already that shift—

Senator FRANKEN. Well, that is good.

Mr. ZINDLER. That shift is taking place to some large degree. And we think, you know, solar represents a very small slice right now of generation in the U.S., maybe one to two percent, but we think capacity for solar could get up to as high as 25, 27 percent over the next 25 years. It's a long way to go, but it's also a long amount of time to get there.

Senator FRANKEN. Well unfortunately, I have run out of time here, but I just think that we have to continue this commitment to doing research and development and including in the valley of death and all that stuff we did. We still have the \$40 billion in the Loan Guarantee Program. I think we should use it.

I want to thank all of the witnesses today for your testimony. Thank you, Madam Chair.

CHAIRMAN. Thank you, Senator Franken.

Senator Daines.

Senator DAINES. Thank you, Madam Chair.

Ms. Leopold, in your written testimony you discussed the Cove Point Project and its importance to bring American energy to allies overseas, specifically to Japan and India.

In Montana, we have more recoverable coal than any state in the United States. I am struck by some stats the U.S. Chamber provided a while back that show in the course of the next 33 years, between now and 2050, the energy demand in the world will increase by 84 percent from where it is today. We are going to add 1.6 billion people to the planet.

The question is how are we going to meet the needs as we look at an 84 percent increase in energy demand in the next 33 years? Thirty-three years seems like a long ways away until I realize I graduated from college 33 years ago, it doesn't seem that far away now.

Montana coal is low in sulfur content. It is cleaner than Indonesian coal. Our allies would very much like to depend on U.S. resources and natural resources instead of being dependent on countries around the world that are not always friendly.

Here is some perspective. If you look at the global leaders in fossil fuel resources, the global leaders, number one is the United States; number two is Russia; number three, Saudi Arabia; number four is China; number five is Iran. Our allies are asking, "Can we depend on you, the United States, for our future energy security instead of these other nations right now" that if I were allies, I would be very hesitant to continue to develop relationship and dependence on them.

So I believe energy security is center to our national and economic security. The question is can you discuss the importance of expanding access to our allies overseas for abundant American energy resources?

Ms. LEOPOLD. Thank you, Senator.

Obviously I'm not an expert on coal export facilities, but what I can share with you is while we were negotiating with our partners, our customers, for Cove Point in India and Japan, it was a significant piece of what they were trying to look at. It was not solely price. It was looking at their long-term national security. When they looked at the countries that they could get exported natural gas from—Japan does not have a lot of natural resources on their

own. They must import some type of fuel to be able to meet their needs, especially after their nuclear issues. And India is a very largely expanding economy and has choices on where they get it from.

Senator DAINES. By the way, on the Japan point, I think, needs to be made that there are 2,400 coal-fired plants on the drawing board right now. Two-thirds will be in India and China going forward.

So this nonsense that somehow fossil fuels are going to go away in the course of the next 30 years is just, it is nonsense. We are either going to be a part of this equation or we are not. And well, 54 nuclear plants in Japan following the Fukushima issue and incident. They are going to replace about 45 coal- and natural gas-fired plants. That is where it is headed.

Excuse me.

Ms. LEOPOLD. Their coal-fired generation is at a much higher capacity factor than it used to be.

Senator DAINES. Right.

Ms. LEOPOLD. So they are looking to bring in more natural gas to be able to serve their needs.

Senator DAINES. Right.

Ms. LEOPOLD. And so, what I would tell you is, is the countries that you mentioned are the options that they have on the table realistically, along with a few others. And so, it seems not only in our allies' national interest to want to look toward us, but it's also in our national interest.

Senator DAINES. Thank you.

Mr. O'Sullivan, I was pleased that President Trump took the bold and much-needed action to move forward with the Keystone pipeline. It is a major piece of our nation's infrastructure. It will create \$80 million a year in tax revenues for a lot of struggling Eastern Montana counties.

Our region also has other needs like approval of rights-of-way across federal land for gas gathering lines to help producers capture flaring gas. It seems to be a common theme from several witnesses today that there needs to be more coordination among federal agencies in the permitting process and more certainty in that process.

I strongly support these efforts. They are also resulting in good paying family wage jobs that are currently at risk.

My question, number one, is how does uncertainty in project timelines and approvals like we saw with the Keystone XL pipeline affect the workforce? Second question, can you expand on the importance of Keystone XL project to your members?

Mr. O'SULLIVAN. Well, Senator, it's critically important.

I mean, we represent middle-class jobs. We work with companies that are represented at this table and across the United States in creating those middle-class family supporting jobs.

The Keystone pipeline, to me, is a prime example of a permitting process that doesn't work. I mean, my view, and not to be, I'm not being political, but when the State Department says something five times in five reviews, it was pretty clear to me and pretty clear to those that I probably represent, that until it got the way that

somebody wanted it to be, they were going to drag their feet and drag out the permitting process for Keystone pipeline.

That pipeline would put about 3,900 members of my organization, just the laborers, to work. We're one of 14 building trades unions, so it's critically important to their livelihood.

As I talk, Senator, about our ability to piece together, project by project, these are huge job opportunities for our members. They're huge projects for our members.

It's not typical. My average member works on probably anywhere from five to seven construction projects a year.

Senator DAINES. Right.

Mr. O'SULLIVAN. And so, projects like this that are multi-year, that create opportunities for them to work for 7 months, for 12 months, for 14 months, on one project, are—we view those as a real plum and a real golden opportunity for those that we represent.

Senator DAINES. Thank you, Mr. O'Sullivan, because it is important that point is made, because sometimes the folks on the side of this issue will say well, these are not permanent jobs. I am the son of a contractor. You keep food on the table stringing together a bunch of temporary construction jobs.

Thank you.

CHAIRMAN. Thank you, Senator Daines.

Senator HIRONO?

Senator HIRONO. Thank you, Madam Chair.

A number of you have, as the Chair mentioned, talked about regulatory delays and that we should have concurrent regulatory review as opposed to sequential. So, is there anything in the various laws that apply to these agencies that prevent them from entering into MOUs or whatever other arrangements they can make to promote concurrent review?

Mr. LEAHEY. I'll take that one.

Senator HIRONO. Mr. Leahey?

Mr. LEAHEY. Yes, the agencies can enter into MOUs and that does happen on occasion. At the end of the day they are working under their statutory authorizations for the types of work that they have to do.

We've also found, generally, that even direction from Washington, DC, does not always filter out into the regions. And so, the person who might be working on your project in Hawaii or a project in California or wherever may not have the same view of cooperation as what has been coming down from headquarter staff.

Senator HIRONO. Well, what—

Mr. LEAHEY. So, I think it's an attitude that needs to look—

Senator HIRONO. Yes.

What I am getting at, are there any statutory prohibitions that result in subsequent or sequential review as opposed to people just not being on the same page at these various agencies?

Mr. LEAHEY. In hydro, not necessarily statutory, that I'm aware of statutory prohibitions, but there certainly have been court cases and others that say the Federal Energy Regulatory Commission, for another, can't force another agency to act on its timeline. That the agency, because of its independent authorities under another statute, can work under the timeline that it decides.

Senator HIRONO. Yes, but that still does not prevent them from entering into an MOU, such as the example of FERC and the Corps of Engineers coming together.

I think, Ms. Leopold and Mr. Bird, you both also mentioned the regulatory process. Should we just encourage more MOUs among agencies so that we can have a concurrent review?

Ms. LEOPOLD. Well I guess I would say—

Senator HIRONO. Ms. Leopold?

Ms. LEOPOLD. Thank you.

I guess I would mention two aspects there.

For the natural gas pipelines, FERC is meant to be the lead agency and the other federal agencies are cooperating agencies. And while they still have full discretion for their expertise, FERC is meant to work together with them to develop a schedule.

So two things that can happen here. The first is some agencies may choose not to be a cooperating agency and they could go do their own NEPA analysis. Having better definitions around the role of a lead agency and the role of cooperating agencies would certainly be helpful.

Senator HIRONO. Okay.

Ms. LEOPOLD. The second aspect that can come into play is, I guess what I'd call a do loop, where one federal agency will say, I'm pencils down. I can't process your permit until this agency finishes the work. And then that agency says, well, we can't until some other agency. And it's very hard to break that deadlock. So, any clarification on being able to have that concurrency of review.

Senator HIRONO. I think if we can hear some very specific ways, as opposed to generalizations, how we can have more concurrent review, it would be helpful for me, at least.

For Mr. Zindler, tomorrow the White House is expected to release its budget outline and Bloomberg News reported that DOE's Office of Energy Efficiency and Renewable Energy which is currently funded at \$2.1 billion a year could see its funding cut by at least \$700 million. That is a huge part of its budget. As I observed to Secretary Perry during his nomination hearing, DOE has been a key supporter of Hawaii's efforts to transition from importing oil to renewable energy, including a goal of 100 percent electric renewable energy by 2045.

My question, Mr. Zindler, can you comment on the importance of public investment in clean energy technologies, like funding provided by DOE, and what the impacts would be on the pace of clean energy technology innovation if these programs experience major funding cuts?

I am running out of time so you have to keep your answer short.

Mr. ZINDLER. I'll be real quick and just say that outlook in the short, short run we see a strong pipeline of wind and solar and other renewable projects that will be built over the next several years, frankly regardless of the budget cuts.

In the long run, that office and other offices at DOE have played a very important role in thinking about the next generation of technologies and supporting the research and development that needs to go on.

To be clear, if we look out 25 years our very optimistic assessment is based on the assumption that there will be technology ad-

vancement going forward. And the question is whether or not the U.S. wants to lead in that or we want to allow some other country to take the lead on that. So certainly those programs have been vital to supporting that kind of R&D work.

Senator HIRONO. Well, that is not exactly where this Administration is going.

Thank you, Madam Chair.

CHAIRMAN. Thank you, Senator Hirono.

Senator Cassidy.

Senator CASSIDY. Thank you.

Mr. O'Sullivan, I am from Louisiana and there are so many working families that have the kind of jobs you are describing and they just make a good living. As you say, it is one job after another, but they are always steadily working. Hats off to you for your testimony and for representing the folks whom you represent.

Ms. Leopold, wait, it took you 14 months to get a permit to do a survey?

Ms. LEOPOLD. Yes, we actually completed the survey in one afternoon. It was for one-tenth of a mile.

Senator CASSIDY. Did they give you any feedback as to why it took 14 months to survey one tenth of a mile?

Ms. LEOPOLD. We met with them quite a few times. We resubmitted an application, we answered questions, and we eventually got our right to survey.

Senator CASSIDY. Now I feel like there is a back story which you must diplomatically, because you are on national TV, so to speak, not convey. That is just mind-boggling that an agency would be so inefficient, ineffective, that something as harmless as a survey which is not a permission to go forward rather just a survey, would take 14 months. As my daughter would say, OMG. I am truly flabbergasted.

Now Mr. Zindler, I really enjoyed your testimony, as I enjoyed all of your testimony. You mentioned that there has only been 1.5 gigawatts of high voltage direct current transmission over a preceding number of years. But I know that eight years ago, when the Obama Administration came in, both through the stimulus package as well as through regulatory changes which allowed utilities to bill ratepayers for such lines, there was a concerted effort to put them in. What happened?

Mr. ZINDLER. So actually, some of my other panelists may want to comment on this as well, but I guess I would argue that the challenges around building transmission isn't really necessarily always related to funding and to whatever stimulus efforts or infrastructure efforts, if you want to call that now; it is related often to the nuts and bolts of getting permitting done across state lines.

Senator CASSIDY. Wait, so the green initiative of the green President was thwarted by permitting?

Mr. ZINDLER. I would say anybody on this panel would probably tell you that building large scale power infrastructure has issues regarding permitting, whether it's green, yellow, purple, whatever color you want to call it.

Senator CASSIDY. I will just say, again, now quoting Pogo, "We've met the enemy, and he is us." It is incredible.

Okay. You mentioned in your testimony the need to reform electricity markets but you stopped, period, new paragraph, different topic. What kind of reforms do we need to the electricity market?

Mr. ZINDLER. It's a good question and of course, I stopped, period, because that's incredibly complex and boring topic. But I could go on all day about it.

But I would say this, and Mr. Imhoff identified this. As we enter a new era of power generation where we have sources of generation literally coming from people's roofs, coming from small projects here and there and not producing when we want them to, necessarily. So you can't, sort of, just send a signal and say okay, turn on the solar power. We need to build a market that reflects that and takes a look—

Senator CASSIDY. So let me ask.

In a sense this is a passive versus an act of right. I think I have that right, although I am not an attorney. So, you are generating solar. You have a right to sell it on to the grid, at least getting avoided cost. In the meantime, you are putting a nuclear power plant out of business.

But you need that for base generation. Now there does seem to be a quandary we have developed in which you're given a right to sell back to the grid but doing that disrupts the business model of those who've made billion dollar investments for carbon free energy that provides base load to industry. Do you follow my point?

Mr. ZINDLER. I follow, but I don't agree with your point.

Senator CASSIDY. No, I'm not even sure it's an agree or disagree. That is an observation.

Mr. ZINDLER. I would say that, first of all, your point about nuclear being challenged by current market conditions is a very good one. And I think you're right that we have 100 gigawatts of nuclear power online, by our estimate maybe a third of it is facing very challenging economic conditions right now in being profitable.

The challenges that it is most often facing come from low-priced natural gas and the impact that that's having on pricing which, by the way—

Senator CASSIDY. I thought that stuff in Illinois was from subsidized wind coming out of Iowa.

Mr. ZINDLER. Listen, you could—there are different people who will tell you different reasons. I will tell you that generally speaking we're talking about 30 or 35 gigawatts of nuclear across the country and you look at the wholesale effect of lower natural gas prices—

Senator CASSIDY. Let me ask though, specifically of Illinois, I am told that it is the subsidized rate in Iowa which actually sometimes pays a user to use their electricity that is—and I see this gentleman nodding his head—what is undermining what is happening in Illinois.

Mr. ZINDLER. There are different—I'm not going to speak to the Illinois example. I think it's certainly fair to say that there are different pressures.

I would agree with the basic point that is if we want to think about a 21st century U.S. energy economy that does generate power in a low carbon way, I think your point is entirely well-taken

that nuclear has to be part of the picture. And I also think there hasn't been an entirely rational discussion about it to date.

Whether that means you need to go and pick on some other technology, I don't necessarily agree with that, but I think looking at nuclear and how you may understand the value that it provides and the importance of keeping it online, I definitely would agree with that point.

Senator CASSIDY. I thank you. It has been a very stimulating panel, thank you all.

I yield back.

CHAIRMAN. Thank you, Senator Cassidy.

Senator Duckworth.

Senator DUCKWORTH. Thank you, Chairwoman Murkowski and Ranking Member Cantwell, for convening this important conversation.

As you know the Trump Administration has called for a trillion-dollar infrastructure package. I am very encouraged by the bipartisan conversations we are having on the scope and breadth of this package, and I am very much supportive that any type of an infrastructure package includes an energy title to go with it.

I am looking for several things when it comes to this infrastructure package, when it comes to energy. I think we need to support greater use of clean energy, including nuclear. Illinois has more nuclear reactors than any other state in the nation. We also need to have strong "buy America" and labor standards that support construction jobs and go further in job creation by reviving our manufacturing sector. We also need energy that is affordable.

President O'Sullivan, I was very much encouraged by your passionate discussion of the jobs that could be created by the pipelines for your members. Could you speak a little bit to the Administration's proposed new rule saying that the pipelines would not have to buy/use steel manufactured in America? What would it do to your brothers in labor and unions, such as the Steel Workers Union, if we rely on Chinese steel and the steel that is being illegally dumped in this country?

Mr. O'SULLIVAN. Senator, when we had the meeting with the President and Keystone pipeline was brought up, I anticipated there was going to be a problem with that one because TransCanada had already bought the pipeline from India, actually. When the President mentioned buy American steel going forward, I always anticipated that the TransCanada, the Keystone pipeline, was going to be a potential issue but I guess that that became a reality.

But the commitment to build pipe in the United States going forward, we are certainly encouraged about that. I mean, we love building the pipe manufacturing facilities and the United Steel Workers, our brother and sister steel workers, operate them.

Keystone aside, pipe was already on the ground, already purchased. We anticipated that one would be pushed aside, but going forward we're encouraged that we can build more pipe manufacturing facilities and that they will be built union and they will be operated union.

Senator DUCKWORTH. So beyond the pipe that has already been purchased, and future pipe, would you support a buy America requirement for that, for example, the Dakota Access pipeline as

well, because we have steel workers who have been unemployed for months now, laid off, because of the illegal dumping of Asian steel and manufacturers here in this country?

Mr. O'SULLIVAN. We would unequivocally support that, Senator.

Senator DUCKWORTH. Thank you.

Mr. Zindler, I would like to chat a little bit about the electricity-generating states in the country. You know, Illinois is a leading net exporter of electricity to other states. We have extensive wind resources, but we also have nuclear. We are second in the Midwest in installed renewable power capacity and third in the region for biofuels production capacity.

I have heard from stakeholders across my state, small town mayors and Fortune 500 companies, that in order to fully realize the benefits of our generating potential, we must build new transmission lines.

Mr. Zindler, in your testimony you make similar observations about the need for transmission. In your view, should we be concerned that the budget cuts the Trump Administration is seeking from our government agencies will make it harder, not easier, to get the federal permitting approval that industry seeks? Even if we throw out every standard, don't we need the personnel and expertise to execute these reviews?

Mr. ZINDLER. I guess I can't really comment, having not seen what this budget is going to be. I will say this, that certainly there are—I think under the last eight years the U.S. Department of Energy has focused more and more of its attention on next generation technologies and how to facilitate that, both by funding through the labs, but also efforts and outreach.

So, I do think that the personnel is a critical part of this question. I think Mr. Imhoff could probably comment more about that at the lab level. But your point is very well taken, although, like I said, we really would want to see what the actual programs are that get cut potentially.

Senator DUCKWORTH. Well, so if they cut the inspectors and there were fewer to go through to execute the review process. Would that make it harder?

Mr. ZINDLER. That wouldn't be great news.

Senator DUCKWORTH. Okay, thank you.

Mr. Bird, as you know our transmission system is privately owned, not publicly owned. What type of policies would help industry to invest in new transmission lines outside of federal permitting reviews? For example, would state revolving funds be useful? Are there investments in workforce that need to be made?

Mr. BIRD. Again, I think as my colleague mentioned earlier, you know, funding is really not the primary constraint for us to expand our transmission infrastructure. It's really working through the permitting process. That's the key thing.

I think I would comment that there are other transmission owners and operators that we connect to that are also important to manage the entire reliability of the grid and even serve our own customers. And so, there are entities like the Bonneville Power Administration, for example, and other public entities that might benefit from some sort of public financing opportunity that could be a possibility. But again, our key constraint is, frankly, really getting

through the permitting process to bring good projects, you know, into being.

Senator DUCKWORTH. Well, let's hope the hiring freeze and the budget cuts do not affect the folks who actually do that review.

Thank you. I am out of time. Thank you, Chairman.

CHAIRMAN. Thank you, Senator.

Senator Gardner.

Senator GARDNER. Thank you, Chairman Murkowski, for holding this hearing today, and thanks to the witnesses for your expertise and your participation in the hearing.

I know Senator Cantwell brought this up in her opening comments. She was talking a little bit about cybersecurity concerns, but I, too, have read the article that was in the Houston Chronicle—the title of the article was “Opportunities to Improve American Energy Infrastructure.”

It talked about, I think, a subject called “Hacked, cybersecurity experts easily infiltrate energy company's networks.” It was a story about how, for just a couple hundred bucks, a security team, using a blanket and a couple of 16-foot ladders, were able to hike a fence, go into the computer network building of a power plant and basically infiltrate the network that way. That was just a way for the team at the plant to test its security and make sure that they were doing it right.

The Senate has held 20 hearings this year in nine different committees on cybersecurity. One of the concerns that I bring to this Committee, to this hearing and to the industry is the cybersecurity risks in the energy sector. A big concern of mine is how we have to have infrastructure conversations that include a dialog on protecting and recovering electricity, critical infrastructure from cybersecurity threats.

Mr. Imhoff, I will start with you. I know that the National Renewable Energy Laboratory (NREL) works with PNNL in the Grid Modernization Laboratory Consortium. Thank you for your work with the consortium, and obviously, your lab's role in cyber resilience of the grid.

A concern is about the process for recovery of the electricity grid should there be a widespread outage from a cybersecurity or cyberattack. Could you describe the process for conducting exercises with the industry regarding potential cyberattacks?

Mr. IMHOFF. Happy to, Senator, and thank you for all the good support we get from NREL and the overall good modernization effort.

The industry has, as driven by the NERC-set requirements, incident plans that they put in place to deal with cyber issues. They have conducted over the last several years four national exercises, called Grid X. These exercises are designed around specific scenarios of threat.

These exercises are led by NERC, and their member utilities are invited to come in and participate in this artificial exercise and demonstrate how they would implement their incident response plan.

These exercises include participation from federal officials, including the Department of Energy and other federal entities, Department of Defense and others who have infrastructure in these

locations. It also includes law enforcement and vendor community, et cetera. It is a very large stakeholder group, a multi-day activity, with very complex scenarios where they basically exercise and test their incident response plans, extract lessons learned and look for how they can improve them into the future.

We are currently designing Grid XV. PNNL helps drive those activities. We participate as an infrastructure with substantial national security information, all within our firewalls and we are—we monitor and drive the activity. So, it's a large national exercise.

And then I would add to that conversation, Senator, that with the FAST Act, the authority for it rests with the Department of Energy in terms of those emergency response activities. The President needs to make a declaration of an event. The Secretary then needs to identify what the path forward is going to be. There is dialog, consultation with industry in that activity, and then the utilities would begin to implement their incident response plans accordingly. So, that's the high level, general approach that I can share with you.

Senator GARDNER. What percentage of industry has participated in such an exercise?

Mr. IMHOFF. I don't know the exact percentages. We have three and a half thousand utilities. I'm guessing you're having 30 to 60 utilities participate in those exercises.

But the utility industry is like a wedding cake, with lots of layers. And the risk in cyber events tends to be higher in those entities that have a broader span, PacifiCorp, Pacific Power, Bonneville and others, the Western Coordination Council, et cetera. They're all at the table and playing. You may not have a small, municipal utility from Eastern Washington participating so I think while it's small in fraction in number, it's probably a large fraction in terms of those strategic partners that need to be there.

Senator GARDNER. What more ought we be doing in terms of the cyber structure, cybersecurity structure, that government can use to help utilize with industry?

Mr. IMHOFF. Excuse me, could you repeat the question?

Senator GARDNER. Yes, how can we work, how can the Federal Government better work with industry to create a more proper or better cybersecurity system?

Mr. IMHOFF. So, several dimensions.

One of the key issues is around training and workforce development. And so, what the Federal Government can bring to bear is advanced techniques and concepts that are developed in support often on the high side of the activity. We can bring those tools, techniques and concepts available and forward to industry. And that's what's going on in the CRISP Program today.

The government can also bring its fundamental science in deep learning and advanced computation to help develop better situational and awareness tools that take advantage of the broad sensed information that we're now receiving from the utilities.

General Electric reported two weeks ago, at a House hearing, that only two percent of this vast digital data flow coming in off the grid is actually being utilized and analyzed. So, we have opportunities for better leveraging advanced computer, advanced analytic concepts, visualization, to give us a better state of awareness

in terms of what's going on with the grid, where is the risk. And that's a process where, I think, the Federal Government could deliver those tools to the private sector to enhance security.

Senator GARDNER. Great. Thank you.

Thank you, Madam Chair.

CHAIRMAN. Thank you, Senator Gardner.

Senator Cantwell.

Senator CANTWELL. Thank you, Madam Chair.

Following up on those same questions, Mr. Imhoff, that my colleague from Colorado asked. In our energy bill we really tried to focus on the workforce side since there's a huge shortage of workforce well prepared to help us on cybersecurity. So we definitely want to do that and also on that supply chain that we talked about earlier. We want to make sure that we know where the supply chain is coming from, where the products are coming from.

You talked a lot about distribution, automation and management control systems. When you think about Homeland Security, protecting or thinking about how to harden our targets on a critical side or, you know, in the old days we had a pipeline that we might want to protect. Now we have an entire network that is increasingly linked as our economy has become more and more wired.

The points of contact are very diffused and coming up with this critical infrastructure network that we can defend against both various small malware attacks, you know, such as the one that happened in Vermont against a utility up there (people believe that was some sort of Russian malware) and then the state attack response where a foreign entity actually does something like what has happened in Ukraine. You mentioned a few of the tools that we need. Why do we need DOE to play more of a leadership role of this area?

Mr. IMHOFF. Well, I think that the solution is very much a partnership between DOE and industry. So it's a joint, kind of, community that needs to work together on this activity.

There's a lot of just fundamental blocking and tackling that needs to transpire. When DOE conducted the modernization four or five years ago, all of the investment grants required cyber protocols as standards put in place, a phenomenal benefit to the small and midsized utilities who don't have the large engineering staffs and all that deal with cybersecurity. So it really raised the bar in terms of small and midsized utilities understanding good practice around cybersecurity.

I think there remains a lot of opportunity for training and education and demonstration to raise the bar to good, basic practice of both around cyber operations, even around simple things like supply chain acquisition language. The small utilities that are just now moving into the advanced metered would be told to have the right language in their acquisition to reduce their vulnerability to the supply chain risk.

Another big issue that I would raise, and it really fits the energy infrastructure question, is the very tight and increasingly tight dependence between energy and our communication networks. Ten years ago it was pretty easy for PacifiCorp to run their system with not a lot of communications. Today's communication is very fundamental. It's a real-time operation and situational awareness. And

as we have the explosion of the devices at the edge, we need to rethink how do we provide those communications and how do we make them secure?

There's, today the practice is an application brings us the communications with it. Tomorrow, we think we need to look at a different architecture, more of a layered architecture, infrastructure architecture, around communications that will serve multiple applications. It's easier to secure. It's easier to train so that it's implemented to maintain effectively.

So these are some of the changes we probably need to think about and frame.

And here again, I think, is a very good partnership between some of the fundamental science knowledge coming out of the government linked with the very good work of our vendor community. And this just goes to the world and many others. It could bring to bear in terms of how do we re-architecture and provide the traffic capacity that we need for a more distributed, more intelligent and more digital energy future.

Senator CANTWELL. So we could have a bulk attack like we have seen in other places?

Mr. IMHOFF. Well, there's a wide range of attack scenarios that could be applied, and we need to design systems and have the human training to resist those.

The current, for instance, you mentioned the Ukraine activity. I was not personally involved in that diagnosis, but I do know that most of the NERC requirements have a defense in depth activity that would have been very resistant to what occurred in that case. There again, architecture, training, preparation, incident response planning, I think, are the ways that we help defend.

Senator CANTWELL. And this is why I want DOE to make sure they are playing a leadership role. I want to make sure when the President puts out an Executive Order, he doesn't say that that is for the Homeland Security Department.

What you just described is a key responsibility that only DOE can carry out because you are talking about this system. To me it is worrisome that these attacks happen. Every time there is some story line in a movie or TV show about cyber, I always am constantly asking my staff for an analysis of whether that really can happen or not.

I find it very interesting that most of those plots involve attacks against energy systems. Why do they attack the energy system? A disruption of our energy supply would make us so vulnerable.

So thank you for your testimony and outlining those things. I think it was very clear about why we need a more aggressive role by DOE and all of these cyberattack issues.

Thank you.

CHAIRMAN. Thank you.

Senator King.

Senator KING. Thank you, Madam Chair. I apologize for my lateness. I was at an Armed Services Committee hearing.

Mr. Imhoff, the grid, if Edison woke up tomorrow, would look pretty much the way he envisioned it and saw it developing 100, more than 100, years ago. Don't we need to be thinking about the grid in a different way, at least in terms of the potential of distrib-

uted energy, that is, generation at the factory or at the home level and also load management, demand management? These are things that can fundamentally change the grid from the model of big plant wires and passive receiver of the power. Is that something that you think we need to be thinking about?

Mr. IMHOFF. Absolutely, Senator.

You're right. Many of the same components that Edison was familiar with are still there and they're still, in most cases, performing very well. But we have a transition to much more distributed activity, particularly down at the distribution system level.

And pretty soon it's going to challenge our ability to control those devices. It's going to challenge our ability to communicate with those devices, and oftentimes the grid reliability coordinators can't actually see what's going on at that level. Twenty years ago, it didn't matter. They were, distribution and transmission, were separate worlds.

Senator KING. But in Maine, for example, we have smart meters. Isn't that part of the answer? My sense is we have the technology. It just isn't utilized.

Mr. IMHOFF. Well, so the nation has 64 million in smart meters this year. That's about a 50 percent penetration. Most of the utilities I talk to have extracted much more value out of that investment than they estimated going in. So it's delivered a lot of value in terms of customer choice, reliability management and other things. At the national level, we have 2,000 phasor measurement units that are networked across the U.S. We can see the system like never before.

Senator KING. And that gives us the potential to do things like load shifting.

Mr. IMHOFF. Yes.

Senator KING. Load management. And we don't have to cook our water at four o'clock in the afternoon.

Mr. IMHOFF. That's right, but we need some new approaches for how we control and how we communicate, interact, with these resources.

Senator KING. Well, I would point out that one of the things people always talk about is energy costs. Everybody focuses on the energy. Again, in Maine, the cost of distribution and transmission is now equal and in some cases more than the cost of the energy itself. We need to be thinking about how to make the grid more efficient and perhaps how to avoid future infrastructure investments that may be unnecessary given the role of distributed resources.

Mr. IMHOFF. Correct.

The DOE initiative that we mentioned earlier, the Grid Modernization Initiative, has some projects looking at next generation tools and platforms that connect across distribution and transmission operations. So we can actually run that system closer to the edge, get better asset utilization. That gives, that would keep the delivery system more affordable and lets you exchange value across that membrane.

We did conduct six workshops around the country for grid modernization—Austin, Atlanta, Minneapolis, Boston, Seattle. And we come—had a common feedback that increasing, there's so much going on at the lower distribution level in terms of photovoltaics

and demand response and other things, that the bulk system operators reliable for reliability are now saying that they need to be able to see down into that system and vice versa, the distribution companies want to be able to see what's going on with the bulk system. Our digital opportunities mean we need to have a better exchange of information and operate in a more unified fashion.

Senator KING. But as you know the grid is, by definition, an inefficient animal because it is designed for the hottest day, the most use of the year. It's like building a church for Christmas and Easter and you have a lot of empty pews the rest of the year. There is a lot of slack in the grid. It is that target of opportunity, it seems to me, that we need to be thinking about in terms of things like demand management.

One more quick point before we leave. I am really worried about grid vulnerability to cyberattack. Ukraine was a warning shot. How many warning shots do we need?

Somebody observed the other day that we are looking at the longest wind up for a punch in the history of the world. We know it is coming. And I know everybody says well, we are working on it and we have the architecture and everything else.

I am just worried that we really don't have the sense of urgency that, I believe, is called for in this situation. I am going to mention a bill that Senator Risch and I have sponsored before this Committee to have your lab examine the idea of analog, putting in some of the grid architecture, some old fashion analog switches because that is one of the things that saved them in the Ukraine, that they had to—they weren't as fully digitized as we are and therefore, in one sense, less vulnerable. Do you have a thought on that?

Mr. IMHOFF. So, there are several different approaches being considered. One is the use of analog systems, the other is looking at separate networks, and the other is looking at creating air gaps between certain networks. Some of these have been tried in various venues in the past.

I acknowledge that in the case of Ukraine, it was a bit of a back-stop for them that was helpful. It remains to be seen whether that's the right path to go forward as a nation. If you move into some of those directions, you let go of some of the other benefits you're getting from the digital systems.

Senator KING. And our bill does not mandate that we move forward. It mandates that your lab and utilities, on a voluntary basis, study this as an option. It does not require anything.

Madam Chair, my time has expired. I will yield, but I would like a second round, if possible.

Thank you.

CHAIRMAN. Thank you, Senator King.

Senator Cortez Masto.

Senator CORTEZ MASTO. Madam Chair, thank you. I also apologize for my tardiness. I am also attending the Banking Committee hearing, so I appreciate you being here today, appreciate the written comments ahead of time, that was very helpful.

I just have a few questions, starting with Mr. Bird. Nevada has the most public lands of any state in the nation. You brought up a salient point in your comments, written comments, that there is sometimes tension between protecting public lands and expanding

access to renewable energy through expanded transmission lines. Do you believe that collaborative agency implementation of the westwide corridors has improved that issue?

Mr. BIRD. Thank you, Senator.

My first comment would be we've seen, you know, good examples of coordination amongst federal and state agencies. The best example of that was in our energy gateway project in the Sigurd to Red Butte, a 170-mile project in Utah, you know, that crossed federal lands.

In that state there was very good planning and coordination up front by the agencies and then that was executed and that was a project that was then permitted on a timely basis. We were able to get it completed and provide the value that it needed to customers.

I'm not as familiar with the western corridor, specific questions, so I'd like to follow up with that, you know, following the hearing today, if I could.

Senator CORTEZ MASTO. No, I appreciate that. Again I apologize for being late and you may have already talked about this, but how do you think federal agencies can better provide schedule certainty to meet the permitting targets?

Mr. BIRD. And again, thank you for the question.

I think that is really the most important issue that we have. Schedule certainty is, frankly, much more important than how long it takes.

I mean, I've described the process that took ten years with our Gateway West Project and what was particular to causing that long delay was the fact that we had to restart the permitting process all over again as soon as a new policy or guideline was issued. That's what really contributed to a very long delayed project that would otherwise bring in tremendous amounts of new clean energy and relieve constraints.

So that really is fundamental to our recommendation that, you know, there would be a policy enactment that would provide deadlines and accountability, single point of accountability. That's how we run our business. You know, I ask a single person, that's going to be responsible to deliver a project, on schedule, on budget, you know, if we could get more of that incorporated into how the Federal Government operates in a permitting process, that would be much appreciated.

Senator CORTEZ MASTO. Thank you.

And then Mr. Zindler, geothermal is a very important energy industry in my state, like the FORGE Geothermal Project that I recently had the opportunity to visit. They are concerned about their exclusion from the investment tax credit as well as the production tax credit. What incentives should be available to support the renewable energy sector, especially as the ITC and PTC are phased out?

Mr. ZINDLER. That's a very good question. And as you know there was an extension for the wind and solar industries, I believe, at the end of 2015, but not for some of the other technologies.

I would, sort of, caveat this by saying that the ITC or the tax credits for geothermal were never a perfect fit anyway because of the long lead time that it takes to explore a geothermal resource

to determine whether or not it's sufficient and then make the determination to go forward with developing a project.

So, the long timelines associated with that process don't necessarily fit and on again, off again schedule on the tax credits which is what we'd seen previously. So, that wasn't a great fit to begin with, but of course, not having it at all is certainly worse.

Senator CORTEZ MASTO. Right.

Mr. ZINDLER. And I think that's really where the industry is today.

But geothermal, in particular though, we have seen other kinds of examples in other countries in other contexts where they're trying to figure out a way to, sort of, offset the early risk associated with doing exploration. And that is something, I think, that is important to the specific, but very important to the geothermal industry to, sort of, oversimplify it and with geothermal the developer and the explorer has a lot of the risk that's similar to exploring, say, for oil or gas. But the upside is not as high because you can't sell what you get out of there at the same price.

A rational way to try and support the industry that we've seen in other places is to try to help defray some of the early stage risk that's associated with geothermal, and that might be something at least worth considering in the U.S. context.

Senator CORTEZ MASTO. I appreciate that, thank you. And I see my time is almost up.

Let me also just make a comment about cyberattack issues. In the State of Nevada, as Attorney General, I chaired a Technology Crime Board. This was one of the issues that we focused on because it is real and it is just a matter of time, and a concern of mine as well and something I would like to see, working with the industry, how we address this.

There is no doubt in my mind. There are attacks that have already occurred, will continue to occur and we need to be very proactive and work together to address this issue.

So, thank you.

CHAIRMAN. Thank you.

I have, probably, a wrap up comment, but I know Senator King, you had asked for a second round.

Senator Cantwell, do you have another question?

Senator CANTWELL. I wanted to get Ms. Leopold or Mr. Imhoff on the record about the larger benefits of pumped storage to the grid, if any of you have any comments about that, or Mr. Zindler.

Mr. IMHOFF. So, pump storage fits in that category that I called flexibility. Back in the old days in the West when we had lots of excess storage capacity, they just used that pump, the hydro system, for a lot of the flexibility in the system.

Pump storage is an awesome resource for maintaining grid reliability. I think the big challenge is just the siting issues, you know, the economics behind pump storage, I think, are very challenging today. But, as a part of a grid infrastructure for reliability, it's a phenomenal resource for reliability surfaces and flexibility.

Senator CANTWELL. Anybody else? Yes?

Ms. LEOPOLD. I would just add that it very much can partner with a diverse set of energy resources, such as renewables, to be

able to use that at the times when it is available and then be able to use the hydro at other times.

So, I very much echo that comment, but it really does add to a lot of flexibility, both for grid reliability as well as partnering for increased renewables.

Mr. LEAHEY. And I would just add that there is, right now, about 15,000 megawatts of proposed pump storage projects, different sites across the United States, mostly in the West. One of the reasons why we are seeing that is because of integration of intermittent renewables.

Projects are now being asked to do more, and they're responding. Years ago, my utility members telling me they never would have considered pumping during the daytime, you would always pump at night or on the weekends. Now in California, with as much solar penetration as there has been, they're actually using some of that solar energy to pump during the day.

So the grade is changing, the world is changing and pump storage, I think, has a tremendous role to play. Even though traditionally it's been grid, large grid storage, we are now looking at smaller sized facilities as well.

Senator CANTWELL. And what geographic region do you think can look at projects like that?

Mr. LEAHEY. Well, you know, the proposed projects right now are across, I think, something like 10 or 12 states. Obviously, you have to have certain characteristics. You have to have the head differential between the upper and the lower reservoir.

But again, I think, we're looking at a variety of different projects. There's even a project in Hawaii that they're looking at as well.

So, I think, you're, we're looking at traditional projects which were larger scale projects, but we're also looking at some new technologies that the DOE has been looking at as well that would be smaller in size and scale.

Senator CANTWELL. Well it just strikes me, as we look at battery storage that some very smart people are working on, there is a basic storage technology that is already proven here and can provide that flexibility and reliability. I definitely think we should focus more on what it can do for us in providing that flexibility to the grid. So thank you.

Mr. LEAHEY. We would agree.

Senator CANTWELL. Thank you, Madam Chair.

CHAIRMAN. Thank you.

Senator King.

Senator KING. On the point of storage which, I think, is one of the key issues going forward. I became familiar with a really fascinating project in, I think it is in Nevada.

It is called Solar Reserve where it is a solar facility with concentric rings of mirrors, a tower in the middle, but the key is that in that tower at the top where all the energy is concentrated, is molten salt which stays liquid at over 1,000 degrees. The salt is heated up. It is then pumped down into a heat exchanger and it can hold its heat overnight.

So this is essentially a solar plant that is also a base load plant. It can deliver power 24 hours a day/seven days a week which is, I believe, a kind of breakthrough in the technology. Molten salt ap-

parently has much better characteristics for this than water which vaporizes at 212 degrees. So this is very interesting, and I think this is a lot of work going on in batteries and in other kinds of things.

The question I wanted to ask, Mr. Leahey, is that for example, in Maine we have something like 700 dams, very small a lot of them, a megawatt or so. A lot of them are facing relicensing at high cost. Do you have some thoughts on how we cannot lose sight of hydro as a clean energy source and be sure that the regulatory system is tailor made to the size and potential impacts of the projects?

Mr. LEAHEY. That's a great question.

There are approximately 400 projects that are coming up for relicensing, existing projects by 2030, representing over 18,000 megawatts of capacity. That's a tremendous amount of capacity in the existing hydropower system that if you lose flexibility, if you lose capacity or if projects start to get surrendered because of cost concerns, you're going to have to replace that clean, renewable power with something else. And will it be renewable or will it be low carbon? Who knows?

I know Maine does have this issue. I've spoken with Kennebec Power and Light, who have a very small project. And smaller projects, in particular, face, in many ways, the same licensing process that the larger projects have but they don't have the economies of scale. In that sense, a lot of transactional costs get placed onto those projects because of the long timeline, some of the duplication of effort that is in that system.

So I think, this Committee, and I commend Senator Murkowski, Senator Cantwell and the entire Committee on what they tried to do for hydro licensing last year. I think a lot of what was proposed in that bill would have helped projects like those in Maine.

Senator KING. If you have any further thoughts about how this, and we don't want to give up the regulatory regime all together, but how we can scale the requirements to the size of the project so that we don't lose these resources, many of which have been in place for 100 years.

It is a settled ecosystem. In fact, there would be as much or more environmental disruption if the dam came out than if you can maintain it. So to the extent that you can provide thoughts and suggestions, any of you, on the licensing challenges so that we can right size the regulations, if you will.

Mr. LEAHEY. I would be happy to follow up with your staff and look at this more closely.

And again, I think there are different types of hydropower projects, as I highlighted in my written testimony, from new builds to small conduit projects to marine energy. And I think, looking at those individual technology types and trying to determine what is the appropriate scope of review of those projects, it may not be necessary to give the same kind of scope of review that you would give to a large, new build project that you would be proposing, as opposed to, building on a conduit on an existing dam or something like that.

Senator KING. Thank you.

Thank you, Madam Chair.

CHAIRMAN. Mr. Koplin?

Mr. KOPLIN. Senator King, if I could just share something actionable there.

If you could take one representative from each of the federal and state agencies that are going to touch those projects and find champions in those departments that are advocates of hydro and put together a working team that they could go out in the field and be that economy at scale, that that's all they work on.

The FERC did something similar on their side, I think back in the 80's or 90's. They had a whole bunch of licenses that came due at the same time. They hired a contractor to handle the FERC side.

It's a trillion-dollar question. How do you streamline the regulatory process? I'm not sure that you can if you have bad actors out in the field and I've seen those in state agencies. I've seen them on the federal side. But if you can get the people who really have the agility and the desire to promote those projects and get them out in the field where they can still execute their responsibility to the environment and to the other stakeholders, I think you can achieve economy at scale that would be orders of magnitude, frankly.

Senator KING. Particularly because you are developing projects that are, themselves, environmentally beneficial. It's not like you are building something that would be necessarily damaging. We are talking about clean energy and renewable energy here.

Mr. KOPLIN. Exactly, and that's—the accountability has been mentioned a couple times.

We had non-governmental organization, I think this is a good, little story that fiercely opposed one of our hydroelectric projects, but they never read a plan set when we offered them. They never came out in the field and looked at the project site. They advertised nationally and got well intended funding to oppose the project. And at the end of the day, three years later, we actually hired them to re-vegetate some of the project. Once they saw it, they were impressed and actually approached us and asked if they could partner on future projects.

So, people have to—there has to be an accountability to actually see what's going on and be answerable to their opposition, I guess.

Senator KING. And let's be clear, nobody here is advocating abandoning regulation or giving a free pass to any project. Again, it is a question of having the regulation meet the specifics of that situation and particularly, given the scale of the project, you do not require 10,000 pages for a home mortgage at a bank, although, I fear, we are heading in that direction sometimes. But it is a question of right sizing the regulation, I think.

Thank you.

Thank you, Madam Chair.

CHAIRMAN. Thank you, Senator King.

I know that a couple of our witnesses have to leave at 12:15, but I just wanted to ask Senator Cortez Masto, if you had any further—

Senator CORTEZ MASTO. No.

CHAIRMAN. Okay.

I want to thank our witnesses for being here today. I think there was great discussion, a lot, certainly, on cyber which is on everyone's mind.

The discussion about renewables is always important and I think, particularly, when we hear some of the discussion about where the winners and losers are with some of the policies that we lay down.

We know that we have got production tax credits that are still out there for wind and for solar, but you mentioned the geothermal aspect of it.

We also talk about hydro and the fact that because it is not designated as renewable, it misses out on some of these opportunities.

I think it was very important, as we talk about the infrastructure, to recognize the potential for jobs and job creation. And Mr. O'Sullivan, I appreciate your testimony.

Mr. O'SULLIVAN. Thank you.

CHAIRMAN. Whether it's how we build out pipelines, whether it's how we access amazing resources like ANWR or other energy sources around the country, these are jobs and this is our economic future here, so it is good to hear.

I will say, though, that some of what we heard today about the regulatory impediments to our infrastructure, we can have as many shovel ready projects as we can possibly line up on paper, but when we meet the regulatory overlay or delay or just the bureaucracy that, unfortunately, hits and causes that uncertainty, causes increased costs, it really does complicate so much of what we do.

And to hear your comments, Ms. Leopold, about a 14-month process to get a permit to survey—a survey that takes basically a day. It just reminds us of what we are dealing with with hydro relicensing, ten years and I am told relicensing costs of tens of millions of dollars, \$20 to \$50 million, in that range for relicensing of an existing facility.

We saw what happened to Shell a couple years back, seven years and \$7 billion into a project that they walked away from. Conoco-Phillips, the NPRA was looking at about seven years to permit a bridge, three of that for the review of the bridge, four of that for litigation. It causes you to wonder how we get anything done around here.

I think, Mr. Koplin, you kind of summed it up when you said, "Our little project is at the bottom of the regulatory dog pile." Sometimes it must make you feel just like that. How do you crawl out from underneath it?

I think part of our job here is to, again, we don't want to abandon the regulations that allow for safety and good environmental considerations, but we want to allow for a process that is a workable process and one that is fair to the investors and fair to the project and fair to the workers that want to create them.

So this has been a good discussion. I appreciate it all.

Again, thank you all for making it through the weather to be here today and to contribute to the testimony.

Senator Cantwell.

Senator CANTWELL. I would just feel remiss if I did not say to Mr. O'Sullivan, three days before St. Patrick's Day, and he's wear-

ing a green tie—we're not going to be here on St. Patrick's Day—
Happy St. Patrick's Day.

Thank you.

[Laughter.]

CHAIRMAN. We stand adjourned.

[Whereupon, at 12:13 p.m. the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to the Honorable Clay Koplin**

Questions from Chairman Lisa Murkowski

Question 1: As a part of the Senate passed energy bill, we included a provision that would tweak the Department of Energy's loan guarantee program by authorizing lending to states, like Alaska, for energy infrastructure that would help reduce high energy prices. Our provision was scored as costing taxpayers nothing since we would be lending to states.

- a) Do you think this type of infrastructure financing mechanism would benefit Alaska, particularly our remote communities? This mechanism would be extremely beneficial to Alaska, particularly rural communities with limited economic bases. It would be helpful if State of Alaska loan qualification criteria were applied rather than the Federal Government's. The Federal regulatory compliance required for constructing projects is mirrored in Federal loan qualification requirements. These administrative regulatory overheads are largely responsible for the underutilization of the Rural Utilities Services (RUS) and other Federal energy loan programs.
- b) With 'price tag' already a looming concern, should we be looking for low-risk, no-cost provisions, like that one, as we try to cobble together an infrastructure package? Yes, many of the federal lending and tax credit programs would facilitate the development of infrastructure if 1) The programs were equally available and applicable to all technologies (i.e. not picking "winners" like wind and solar over "losers" like hydro), and 2) The terms of federal loan programs exceeded those of commercial lenders for long-life infrastructure, i.e. 50-year loans for hydro projects, transmission lines etc., and 3) Regulatory compliance is decoupled from financial criteria for lending eligibility.

Question 2: The energy bill that passed the Senate last year also included a provision to promote the development of hybrid microgrid systems for isolated communities. Can you discuss the importance of hybrid microgrid systems to Cordova and other rural communities in Alaska? Hybrid microgrid systems provide the opportunity to use local sources of energy to meet community needs in remote locations to offset costly imported fuels like diesel. This reduces economic outflow and improves the affordability of energy which serves as the economic base. Energy is necessary to enable other basic social infrastructure – clean water, sanitary disposal, and communications. Frankly, the viability of many rural communities in Alaska relies on access to affordable, reliable energy, and hybrid micro grids are often the only feasible solution.

Question 3: While you mentioned the costs you faced in rebuilding the Humpback Creek hydro project damaged by a storm last decade, can you be more specific? Exactly what are the policies of either FERC or other federal agencies through conditions placed on projects under Section 4(e) of the Federal Power Act that in your view needlessly add to the cost of installing renewable energy? One primary cost driver was the conflict between FEMA's Stafford Act, which prevents modification of the pre-disaster design, function or capacity of a project and FERC standards, which require that a dam be rebuilt to a safe standard. CEC finally reached a compromise solution with FEMA and FERC to secure partial funding for the reconstruction without compromising safety. The other primary driver was 4(e) type conditions placed on the project

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to the Honorable Clay Koplin

during reconstruction, particularly for the storm water pollution prevention plan (swppp) which added nearly 10% to the total project cost, ultimately delaying the project completion a full year. The resources agencies in the field conceded that the requirements were unnecessary and ineffective; the flood had moved many acres of forest, soil and all, during and after the flood, and salmon native to the stream had been decimated by the flooding. These requirements were imposed despite the fact that all lands were owned by partners CEC and The Eyak Corporation. Ultimately, it took nearly six years and \$23,000,000 through 2012 to repair only a portion of the project that had been built in its entirety in four years for \$11,000,000 in 1992.

Question 4: I understand that Cordova Electric Cooperative is working with Sandia National Laboratory on an energy storage project. Can you provide me with additional details of the project? What are the anticipated benefits that this project will provide for your community? Through the Department of Energy's (DOE) energy storage program, the Alaska Center for Energy and Power (ACEP) performed a static model and Sandia formed a dynamic model to determine the optimal size and location of an energy storage device (battery or flywheel or other). This will allow CEC to right-size and "best fit" the technology that will meet our complex system's need to utilize renewable energy that is currently going to waste at some times, while running diesel generators that could otherwise sit idle at other times. In plain English, Sandia laboratories is using their world class modelling and technological expertise to help Cordova store hydro power that is currently going to waste late at night and during storms that can be delivered to meet community needs during the daytime and dry spells where we are currently using diesel fired electricity. This represents a small investment that better utilizes existing infrastructure to deliver additional economic and environmental benefits. Note that Sandia, ACEP, and DOE benefit from this collaboration through their exposure to the replicable lean and agile processes a small, innovative energy frontier system like CEC's offers.

Questions from Senator Debbie Stabenow

Questions: Mr. Koplin, I regret having to leave the hearing before getting the chance to ask you this question.

As Ranking Member for the Senate Agriculture Committee, a large focus of our work over the next two years will be getting the next Farm Bill done. The Rural Development title of the Farm Bill recognizes the important role that cooperatives play in rebuilding rural communities across the country. During the last Farm Bill, we created a program called the Rural Energy Savings Program, which issues zero-interest loans to any electric cooperative to lend to their customers to make energy efficiency improvements. Does your company have an energy efficiency program for customers? If so, how does it work, and what more could we do to help encourage such energy efficiency efforts throughout the country? Cordova Electric Cooperative (CEC) has implemented many successful efficiency programs, especially to our residential rate class, that has resulted in a steady 3% per year decline in annual use from 569 kWh per meter to the current average of 411 kWh per meter. However, we have picked all of the low hanging fruit from the tree and are now evaluating the USDA Rural Development programs such as "red leg" and

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to the Honorable Clay Koplin**

others with low interest rates that CEC can pass through. These programs are essential to meeting the needs of ratepayers in low income brackets that often have the highest energy bills, but cannot afford to invest in the efficient lighting and appliances that would reduce their bills. They are also critical to the agriculture based businesses (like fishing in Cordova) that often operate on thin margins and uncertain crops. Frankly, the application, approval, and administrative processes are a big bite for a small utility like ours that owns and operates a diesel generation plant, two hydroelectric projects, 160 miles of underground lines, and all the administrative and business functions of the organization with 15 employees. That burden falls even harder on smaller businesses and residents that have even less professional and administrative capacity than a cooperative, so these programs develop a local economy of scale by empowering the cooperatives to become the local lender, expert and administrator.

Question from Senator Catherine Cortez Masto

Question: Rural communities tend to form cooperatives. There are many rural communities in my state, so what recommendations do you have for cooperatives that wish to increase their share of renewable generation? Most cooperative are 100-year experts in the distribution and utilization of energy, and contributing to their communities' economic development and other important value streams. However, they have little experience developing, owning, operating, or maintaining power generation facilities. Alaskan cooperatives are an exception and frankly should be primary advisors to cooperatives who seek to move in a self-sufficiency direction. The direct conversations between operational and managerial staff of two cooperatives is much richer than trying to share information through third parties or "published" information. There are also changes that may need to be considered for the governance structures and processes of the cooperatives that acknowledge the additional risks and financial commitments associated with the development of energy projects. Some of the hard questions these cooperatives should answer for themselves:

- 1) Is this project a good fit for our community?
- 2) Do we have the capacity to develop this project?
- 3) Is this a proven technology offered by a proven vendor in a similar environment?
- 4) What are the risks, the likely points of failure, and our exit strategy?

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey**

Questions from Chairman Lisa Murkowski

Question 1: Could you please provide me with the number of people currently employed in the hydropower industry, both directly and indirectly?

Answer 1: According to estimates in the 2016 Department of Energy Hydropower Vision Report as of year-end 2013, hydropower O&M supported approximately 118,000 ongoing full-time equivalent (FTE) jobs nationwide. These include onsite (23,000), supply chain (54,000) and induced jobs (41,000). The Report also estimates an additional 25,000 jobs are supported by hydropower construction and upgrades – onsite (8,000), supply chain (6,000) and induced (11,000) (Pages 202-204) for a total of 143,000 jobs.

Hydropower also provides significant economic benefits. The Report concludes that should the U.S. achieve the Vision of 50 GW of new capacity by 2050 that \$148 billion in cumulative economic investment can be achieved (defined as capital investment and annual operating expenses) with over 195,000 hydropower-related jobs.

Question 2: Last Congress, the Senate tried to reform the hydropower regulatory process by, among other measures, establishing FERC as the lead agency and eliminating duplicative or unnecessary studies. Can you explain, for the Committee's record, why these reform provisions are needed? What other steps can Congress take to ease the regulatory burden for these clean, renewable projects while still protecting the environment?

Answer 2: The hydropower regulatory process, which includes the processes for relicensing existing facilities and for new project deployment, is one of the most complex of any electricity resource. While FERC is the license issuer under the authority of the Federal Power Act (FPA), many other federal and state statutes are involved. These include: the National Environmental Policy Act, the Clean Water Act, the Endangered Species Act, the Coastal Zone Management Act, National Historic Preservation Act, the Marine Mammals Act, the Migratory Bird Treaty Act, the Rivers and Harbors Act of 1899 and others. In addition to these federal statutes, there may be similar state statutes requiring additional approvals, including participation in a state NEPA process.

As a result, the hydropower regulatory process is one in which there is diffused authority among multiple federal and state agencies, with no one agency that can set a schedule and work to promote schedule discipline and enforcement. Several agencies have the ability to indefinitely delay projects. For example, FERC cannot issue a license without receiving the Clean Water Act Section 401 water quality certificate from the state. Currently, according to FERC data, there are approximately 20 projects in 10 states (CA, SC, ID, NC, ME, OR, VT, MD, PA, and MT) for which FERC has completed its NEPA analysis, but is awaiting the state Section 401 certificate. Ten of these projects have been waiting for the state decision for 7 years or longer.

Another example is the issuance of biological opinions under the Endangered Species Act. Again, according to FERC data, there are 14 projects in 9 states (SC, CA, ID, WA, OH, MD,

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey**

OR, AK, and NE) for which FERC has completed its NEPA analysis, but is still awaiting the biological opinion from NMFS or the F&WS. Seven of these projects have been waiting for the resource agency decision for 7 years or longer.

In addition to the aforementioned examples, the industry has also experienced significant delays in obtaining approvals from the Corps of Engineers for development of non-federal hydropower projects on Corps infrastructure. And lastly, delays, as well as conflicts, between the mandatory conditioning agencies further complicate the process, which also increases costs.

The uncertainties, added time and costs of the licensing process make investment and re-investment in hydropower a much less attractive venture than other electricity resources with which hydropower projects compete, like wind, solar and natural gas. This is true for developers seeking investors in a new project, as well as for asset owners seeking to relicense an existing facility. In fact, NHA is aware of several licensees (particularly owners of small projects) that are surrendering, or are contemplating surrendering their existing projects. The ultimate fate of these projects is unknown, but there is a significant risk that the benefits of these clean, renewable generation resources will be lost.

NHA supports improvements to the licensing process that add transparency, accountability, efficiency, and reduce costs, unnecessary duplication of effort, and delays. We thank you and others on the Committee for your work last year to advance proposals to address these process issues. NHA believes process improvements can be implemented in a way that respects our environmental values and the authorities of the various agencies charged with protecting species and habitat as part of the project review process.

Ultimately, a hydropower licensing process that routinely includes years of delay does not benefit the license applicant, customers, or the environment. License applicants, through negotiations with regulators, stakeholders and the public, often reach agreement on significant environmental mitigation and enhancement measures. Delaying the issuance of the license delays the deployment of these measures as well.

Question from Senator Ron Wyden

Question 1: Mr. Leahey, you mentioned in your testimony the importance of investing in hydropower research and development. As you know, the Northwest National Marine Renewable Energy Center--a partnership of Oregon State University, the University of Washington, the University of Alaska Fairbanks and others--was recently awarded funding to build a DOE test facility to support research and development of marine hydrokinetic (MHK) energy technologies. Could you comment on the need for early-stage federal investment in MHK energy and its potential benefits?

Answer 1: As discussed in my written statement, the Department of Energy has identified significant energy potential from MHK resources (ocean wave, tidal, current, OTEC and

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey**

instream hydrokinetic). However, the MHK industry is a nascent one. Currently, there is not a single commercial scale project deployed in the United States, though there are several technologies that are in testing. On a related topic, full scale testing facilities are a critical need for the U.S. marine energy industry at this time.

The marine and hydrokinetic R&D efforts of the Department of Energy's Water Power Technologies Office focus on technology development, market acceleration and deployment, and resource assessment and characterization. Just as with other technologies, like wind and solar, that have benefitted from historically substantial and continuing R&D support, comparable investments are required in the MHK sector to encourage partnerships with private companies and academia to develop these new technologies and speed them toward commercial viability. However, to date, the Water Power Technologies Office continues to be one of the smallest programs in the DOE Energy Efficiency and Renewable Energy Office.

Around the world from Great Britain to China, countries are heavily investing in MHK technology development as well as project deployment, recognizing the significant domestic jobs opportunity and other energy and economic benefits these resources can bring in the future. And they are doing so at levels that far outpace our country. If the U.S. wants to be a leader in this emerging sector, early stage federal R&D support is critically needed.

Questions from Senator Joe Manchin III

Questions: I think it's fair to say that everyone knows West Virginia as an energy exporting state. Our state's coal miners helped power this nation through war and into prosperity in the second half of the last century. And we continue to produce energy for our neighbors. But, we are an all-of-the-above energy state, and I think it's important to note that we have some critical hydropower resources. Hydropower is the most prevalent form of renewable energy used today to generate electricity. While hydro in West Virginia is small, it is also growing. The Glen Ferris project on the Kanawha River powers about 4,500 households. The Hawks Nest project is a 102 megawatt plant on the New River. These plants' licenses will expire later this year. Then there's the New Martinsville Hydroelectric Plant - a 36 megawatt project in Wetzel County that produces enough power for a city seven times the size of New Martinsville which has a population of about 7,000. And, furthermore, it's my understanding that there are untapped opportunities for additional hydropower on the Ohio River.

I'd even love to see a plant along the Hatfield-McCoy Trail. So, what are the challenges facing the expansion of hydro today – whether those challenges be licensing, re-licensing, aging infrastructure, etc? What can Congress be doing to encourage the cultivation of additional hydroelectric facilities?

Answer 1: Today, the business environment for hydropower is full of challenges and complexities. Two of the top policy issues affecting hydropower's competitiveness are: 1) the need for regulatory improvements to the licensing process; and 2) more equitable treatment of

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey

hydropower under policies and incentives designed to spur the growth of clean/renewable resources.

Regulatory Reform: Please also see the answer to Senator Murkowski's question above.

It has been 10 years since Congress enacted major reforms to the Federal Power Act (FPA) provisions governing the licensing, relicensing and regulation of the nation's non-federal hydroelectric power projects. While an important step forward, over a decade later there is mounting evidence that the 2005 reforms did not work as well as intended and did not go far enough - particularly at a time when the immense benefits provided by the nation's hydropower resources are gaining greater recognition from electric customers, power developers and providers, and the environmental community.

Without meaningful reform, the current regulatory regime will continue to present a disincentive to developing new clean and reliable hydropower projects. Prolonged regulatory approvals for hydropower, with their accompanying front-loaded costs, disadvantage hydropower as a cost-competitive resource. For existing projects requiring relicensing, those same regulatory requirements increase costs to consumers, reduce operational flexibility, and actually remove renewable power from the grid. In both cases, electric consumers and the environment lose. Opportunities for clean renewable power development are artificially foregone. Consumers bear higher costs for electricity and job creation is lost. NHA urges the Committee to continue on the work started last Congress to advance improvements to the hydropower licensing process for both new and existing projects and commit to working with you and other stakeholders to achieve meaningful reform.

Incentives: NHA agrees that an "all of the above" energy policy should not be choosing winners and losers in the nation's energy mix. Unfortunately, in the area of incentives and tax policy, in particular, this is currently not the case and has not been for many years.

As background, although hydropower was made eligible for the section 45 production tax credit (PTC) in 2005 and marine and hydrokinetics (MHK) in 2008, the applicable credit rate for our technologies, as well as other baseload renewable resources, has been only 50% of the tax credit rate provided to wind facilities. There was, and continues to be, no policy basis for this differential, which was based solely on revenue concerns at the time.

2015's PATH Act further exacerbated the competitive imbalance between incentives for wind and solar and other renewables, including hydropower. While the PTC for hydropower, MHK and other 50% credit rate technologies was extended only through the end of 2016, (now expired) the section 45 PTC for electricity produced from wind facilities was extended through the end of 2019. The 30% investment tax credit (ITC) for both residential solar energy property (sec. 25D) and business solar energy property (sec. 48) was extended through the end of 2019. In addition, the placed-in-service requirement for solar property under sec. 48 was replaced by a "beginning of construction" rule and the permanent 10% solar ITC will be retained.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahy**

NHA members report that the certainty provided by the long-term extension of the wind and solar credits, combined with the lapsing of the hydropower credits, has sent a heavy negative signal to the market, basically sidelining most potential investors in hydropower projects.

NHA urges the Congress to address these issues in whatever legislative vehicle is appropriate and advancing whether that be an energy bill, an infrastructure bill or other.

Questions from Senator Catherine Cortez Masto

Question 1: Hydropower accounts for about 40 percent of the renewable energy produced in Nevada. Do you believe that hydropower is affected by aging infrastructure?

Answer 1: Yes, the issue of aging infrastructure, both on the civil works side and the power generation side, is affecting the hydropower industry (both federal and non-federal asset owners) as it is with other industries. NHA notes that from an infrastructure perspective, there is a particular need to examine opportunities for re-investment in the federal hydropower system. The existing U.S. fleet of hydropower plants is aging. The 2016 Department of Energy Hydropower Vision Report states that, as of 2014, the average age of Corps hydropower facilities was 49 years, and as of 2015, the average age of Bureau of Reclamation facilities was 58 years. (P. 80.) As such, investment in both civil works and on the power generation side (such as increased maintenance and refurbishment of turbines, generators, and other mechanical and electrical generating equipment) is needed.

Question 2: What do you recommend in terms of better utilizing hydropower in times of drought?

Answer 1: Almost all hydropower facilities are used to serve other purposes beyond electricity generation. These include providing instream flows for fish and habitat, water supply, irrigation, flood control, navigation, and recreation. Hydropower projects and their associated infrastructure play a critical role in meeting these various needs, particularly in times of drought. The reservoir storage available at these projects assisted Nevada, California and other western states, for example, in minimizing and mitigating the impacts and hardships from the most recent drought.

Hydropower operators continuously examine and re-examine the management of their projects to maximize the benefits they provide, while ensuring safe and reliable operations. However, in the relicensing of existing projects, storage capacity which provides operational flexibility in the time of droughts is too often lost. As such, NHA encourages policymakers and stakeholders to re-examine how reservoir storage and its benefits are viewed and valued both in the relicensing of existing projects and licensing of new ones.

In addition, new technology development and deployment can assist asset owners in meeting the challenges in responding to droughts and to floods. As such, continued robust investment in the Department of Energy's hydropower R&D program is critical.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey**

The program, which is a part of the Water Power Technologies Office under the Energy Efficiency and Renewable Energy Office (EERE) conducts work in several areas including: technology R&D, market acceleration and deployment, and resource characterization and grid integration. In 2016, the DOE released a Hydropower Vision report that contains a roadmap to optimize the U.S. hydropower resource including many new R&D initiatives. These include technology advancement programs that would develop the next generation of hydropower equipment, enhance environmental performance and more. Another program area includes sustainable development and operation with activities designed to increase hydropower's resilience to climate change and improve the contribution of water management.

Unfortunately, the hydropower program has, over time, been the least funded program of the renewable energy technologies at the Department. While gains have been made in recent years, the investment in the program has not come close to matching that for others like wind and solar. Increased funding for the hydropower program is needed and NHA encourages the Congress to make those investments.

Lastly, NHA notes that the DOE hydropower program continues to investigate and provide reports to Congress on the effects of climate change on federal hydropower as authorized under Section 9505 of the SECURE Water Act of 2009. The second report to Congress was in fact released this past January.

Questions from Senator Luther Strange

Question 1: In your testimony, you noted that there is significant untapped capacity at non-hydro dams. In Alabama, we have quite a few non-power dams including dams operated by the Corps of Engineers. Do you know whether these dams have hydro potential, and if so, is there any interest in developing those non-power dams?

Answer 1: In 2012, the Department of Energy and the Oak Ridge National Lab released a report that identified potential capacity at the nation's non-powered dams. According to that report, there are 14 dams in Alabama with a total potential capacity of approximately 250 MW. Of these, 6 are located at Corps of Engineers dams. The 6 sites are the largest of the group with capacities ranging from 14 to 66 MW. Combined they represent the greatest opportunity to increase hydro capacity at existing non-powered dams making up about 235 of the 250 MW of potential.

According to FERC data, several developers are actively looking at Alabama project opportunities, including on the Corps dams. Preliminary permits have been granted to developers to investigate Selden Lock and Dam, William Bacon Oliver, George W. Andrew, and Coffeerville Lock and Dam.

Question 2: I am aware that Alabama Power has in recent years been very active in relicensing many of its projects through the FERC process. I also know that these licensing proceedings

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Jeffrey Leahey

have taken a long time to complete. What problems can these long relicensing proceedings cause in terms of delaying the implementation of measures for enhancements to the environment and public recreation?

Answer 2: Though I am not familiar with the particulars of Alabama Power's recent hydro licensing proceedings, I do know that in most licensing proceedings, delay in finalizing a new license can mean delay in the implementation of enhancements proposed by license applicants and included in new licenses issued by FERC. In many instances, these enhancements are the result of settlement agreements among many different stakeholders in a relicensing proceeding who spend years developing consensus on what enhancement measures are appropriate for a project. For various reasons, such as the uncertainty of what the final license requirements will be and the inability in most circumstances of a licensee to recover the cost of these project enhancements until after the license becomes final, the longer the licensing process takes, the longer it takes for these enhancements to be implemented. So it is not uncommon for things like the implementation of measures to improve water quality, the development of a large public recreation facility or increases in the minimum flow from a project to be held up for years while the licensing process works its way to completion.

Question 3: Could some of the relicensing proposals supported by NHA potentially be of benefit to hydro owners in Alabama?

Answer 3: Yes. NHA has supported several proposals, including those that advanced significantly in both the Senate and the House last Congress, which would provide benefits to asset owners in the state. These proposals sought to add certainty, accountability, transparency and efficiency to the licensing process. The goal of many of these proposals is to eliminate redundancies, delays, duplication of effort and conflicts; reduce costs; and encourage better and early coordination between agencies and with stakeholders and the public.

Alabama has approximately 3100 MW of capacity and ranked eighth in the U.S. in 2015 in net electricity generation from renewable energy resources. That year conventional hydroelectric power supplied 75% of Alabama's generation from renewable resources. Provisions that achieve these goals will have the mutual benefit of preserving the existing system in the state while also promoting new project deployment, including the implementation of project enhancements required in a new license much sooner than is possible under the existing licensing paradigm.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird**

Questions from Chairman Lisa Murkowski

Questions: *As the largest private transmission owner in the Western U.S., touching 10 Western states, PacifiCorp certainly has experience with the federal permitting process. Your Energy Gateway projects have taken a decade to navigate the federal permitting system. Based on this experience, you testified that Congress should put “federal coordination around transmission permitting and siting on the list as a top priority.”*

- a) *How important is the concept of fixed deadlines for federal action on permitting? Would such deadlines create a perverse incentive for an agency to say “no” if it cannot meet the timeline?*

PacifiCorp believes that there is significant value in promoting a greater degree of regulatory certainty by federal land management agencies. Fixed deadlines help create that certainty by providing clarity on when an applicant should expect final decision involving a major infrastructure project. Regulatory timeline certainty translates into greater efficiency and economic benefits through project financing and budgeting, procurement and materials management, and also by providing a better sense of when the workforce needs to be in place to begin construction.

The company does not know if fixed deadlines would lead to an incentive to negatively view a proposed project, but it would expect that permitting deadlines would be set at the outset to ensure adequate process time for the agencies and stakeholders to meet all regulatory requirements. Congress should consider changes to Section 1221, “The Siting of Interstate Electric Transmission Facilities,” of the Energy Policy Act of 2005 to instruct regulatory authorities and the courts that no such perverse incentive is or was intended by Congress, particularly for transmission lines within a designated national interest corridor. Reasonable regulatory timelines should not be a disincentive to permitting necessary energy infrastructure projects, particularly those, like our Gateway projects, that make renewable resources affordably available to our customers.

- b) *Does part of the solution need to be “one-stop shopping”? That is, can we create a process where a utility wanting permitting authority only needs to submit information to one place?*

Certainly a “one-stop shopping” concept can offer greater efficiencies both for the applicant to have a more simplified point of entry with permitting agencies as well as for the government itself to better coordinate within its regulatory and stakeholder needs. One example of “one-stop shopping” is Sections 311 and 313 of the Energy Policy Act of 2005, which set up the Department of Energy as the sole agency to authorize the import and export of LNG and established the Federal Energy Regulatory Commission (FERC) as lead agency to coordinate and set reasonable timelines for the state and federal permitting process. The Senate proposed a similar process in Section 3103 of its energy bill in 2016 for natural gas projects. These proposals could be improved by incorporating

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

changes proposed in Section 2005 of H.R. 8 passed last Congress. The above approaches are more likely to provide effective relief than Section 2308 proposed in S. 2012 for electric transmission lines. Whether Congress looks to these past attempts or not, as I testified, PacifiCorp believes an effective federal permitting process should have a single point of accountability, clear and permanent deadlines, and avoid redundant and unnecessary reviews every time there is a new government policy change.

- c) *How would you propose to ensure that any new effort to improve the permitting or siting process actually reduces regulatory burden?*

Processes are most successful when it is clear to agency personnel and other stakeholders that the effort is a priority, both within the Administration and with Congress, which can provide strong oversight over implementation and performance. PacifiCorp also believes that few regulatory processes are perfect in their design, so ensuring there is sufficient flexibility to have an iterative “lessons learned” approach to streamlined permitting will make the process better as it goes.

- d) *Many people have asked for better communication between agencies. Can this be mandated by rules, or is it more dependent on the federal government hiring managers who are more skilled at communicating their needs across agencies?*

PacifiCorp believes that rules alone do not ensure good outcomes for stakeholders. Federal agencies that embrace a customer service culture and are oriented toward problem-solving will be more successful in working with infrastructure developers and interested stakeholders. Certainly hiring for these skills would lead to improved experiences. Congress has mandated agencies to enter into MOUs by a date certain to ensure better communication between agencies on a variety of matters including energy infrastructure projects. See Sections 225, 311, 1221 and 1281 of EPCA of 2005.

Questions from Ranking Member Maria Cantwell

In 2011, 17,425 electric vehicles (EVs) were sold in the United States. Last year that number grew by more than 800%, to 159,139 EVs. But electric vehicle infrastructure is still lagging. Across the country, for every one EV fast charging station we have 188 gas stations.

As more electric vehicles enter into the marketplace and are on the road, this presents an opportunity for infrastructure development.

Question 1: *What are some of the obstacles to deploying electric vehicle charging infrastructure?*

As the CEO of a major electric utility, I can tell you that the single biggest obstacle to deploying charging infrastructure is the current level of market penetration for EVs. My company, as well as many of our peers across our industry, stand ready to deploy infrastructure and charging

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

programs that can scale relatively quickly to meet EV drivers' needs. We have seen the cost of charging infrastructure go down in recent years and our systems can accommodate a significant expansion of transportation electrification. And unlike traditional internal combustion vehicles, most "fueling" will occur in the home or workplace and not need the same commercial infrastructure model as gasoline and diesel fueling stations. In order to accelerate the current pace of charging infrastructure, the best solution would be to accelerate demand for EVs among consumers through incentives or credits.

Question 2: *How can industry partner with the Department of Energy to bring about increased electric vehicle infrastructure?*

The federal government and DOE in particular, through its extensive national labs, provide the vast majority of research and development to the electricity sector. Researching technologies to make charging quicker, more efficient, and more scalable to consumer demand would be helpful. DOE has the expertise and my sector has the customer base, so there seems to be a good opportunity for partnership there, especially with respect to customer education regarding the costs and benefits of EVs.

Question 3: *What role do utilities play in electric vehicle charging infrastructure development?*

The utility role is still evolving as EV adoption and building out charging infrastructure is still in its early stages. As electric utilities, we are the fuel supply chain to these vehicles and so our role today is 1) helping address the adequacy of public charging infrastructure, and 2) ensuring we have the right pricing within our model of cost-of-service provision of electricity that doesn't shift costs to non-EV customers while also avoiding any disincentives to electric charging. PacifiCorp is also helping educate our customers about the costs and benefits of EVs through direct engagement with our customers and through exploring pilot programs to increase EV awareness.

Questions from Senator Steve Daines

Questions: *In your written testimony, you detail the challenges associated with vegetative management within rights-of-way and around power lines, which can lead to blackouts and wildfires. I often hear similar issues from power providers in Montana, especially our electric cooperatives. In fact, the Missoula Electric Cooperative testified in front of the House Natural Resources Committee last Congress in support of then-Representative Zinke's H.R. 2358, the Electricity Reliability and Forest Protection Act, which would have facilitated vegetation management on federal lands with electric transmission and improved the associated challenges. Efforts also were underway to adopt similar language in S. 2012 last Congress. This problem is indicative of a larger issue of forest management reform, which because of endless litigation and unnecessary rules have led to build up of dead trees, loss of jobs and unhealthy forests. I cannot underestimate the importance of active management of our National Forests—not only to benefit*

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

wildlife, outdoor recreation, and our timber economies, but also to strengthen transmission security.

a. What are some of the benefits of active forest management around transmission lines?

PacifiCorp believes that strong vegetation management programs help keep critical transmission infrastructure resilient from fire, storms, and other events where the system can be compromised by vegetation contact with energized lines. That requires timely access and well-funded and active company vegetative management programs. Resiliency equals reliability. There are significant costs to our customers when the power goes out. Large enough events can cascade through other interconnected systems. And there is significant risk and expense if electrical contact results in fires. Electric utilities have a strong role to play, and we dedicate substantial time, effort, and dollars to effective right of way vegetative management. But we are also very aware that fires that start outside of our right of ways can have significant impacts inside of them. Not only is the transmission system impacted, but forest fires can have devastating impacts on the communities we serve, as well as on animal and plant species, and they also create significant air pollution. As a utility in the rural West, we know these impacts first hand. Accordingly, during the last Congress PacifiCorp, along with a significant number of other western electric utilities, supported S. 235, which sought to fix the negative spiral involving budgets supporting active forest management being cannibalized by fire suppression costs, only leading to more fire risk in the future. We still support that proposal and would urge the committee's review.

b. Is your company subject to NERC reliability standards on vegetation management? If so, what are the penalties for non-compliance?

Yes. The potential maximum civil penalty for non-compliance is \$1 million per violation per day.

c. What specific reforms are needed? What can be done administratively and where does Congress need to legislate?

Forest management and health is a broad topic with many affected stakeholders, electricity providers being one. Our view is that policies that help us manage our transmission rights of way and prevent vegetation contacts will improve the reliability and resiliency of the grid. The primary cause of the cascading blackouts of August 2003 was lack of vegetation management due to no mandatory standards and Congress took the steps to address lack of mandatory reliability standards. Similarly, policies that reduce fuel loading and fire risk are also helpful in preventing damage to the grid and avoid the expense of replacing damaged equipment. So while DOE, FERC, and the North American Electric Reliability Corporation understand the importance of mandatory standards for vegetation management, the permitting authorities for vegetation management typically are agencies within the Department of Interior and the

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

Environmental Protection Agency, which do not have the same statutory mandates to ensure reliability and resiliency of our bulk power system.

d. Did Pacific Power support H.R. 2358 last Congress? Please explain.

Yes. The bill in general provided common sense direction to federal agencies, much of it in response to industry testimony at the May 7, 2014, House Natural Resource Committee hearing entitled *Keeping the Lights on and Reducing Catastrophic Forest Fire Risk: Proper Management of Electrical Rights-of-way on Federal Land*. The hearing focused on the need for greater responsiveness from federal agencies to allow timely vegetation management to not only protect reliability and resiliency, but also to comply with NERC's CIP standards on vegetation management. H.R. 2358 was developed as a result of hearings on the topic and was reported favorably out of committee with bipartisan support by a vote of 22-15. The bipartisan bill was added to the House energy bill, H.R. 8, which passed the House with bipartisan support.

Specifically, PacifiCorp particularly supported the following provisions:

- Section 512 VEGETATION MANAGEMENT, FACILITY INSPECTION, AND OPERATION AND MAINTENANCE ON FEDERAL LANDS CONTAINING ELECTRIC TRANSMISSION AND DISTRIBUTION FACILITIES.
 - (a) ... the Secretary of Agriculture, with respect to National Forest System Lands, shall provide direction to ensure that all existing and future rights-of-way... direction that ensures all existing and future rights-of-way include provisions for utility vegetation management, facility inspection and operation and maintenance activities ... for electric transmission and distribution facilities on such lands include provisions for utility vegetation management, facility inspection, and operation and maintenance activities that, while consistent with applicable law -
 - (3) minimize the need for case-by-case annual approvals for
 - (A) routine vegetation management, facility inspection and operation and maintenance activities within existing electric transmission and distribution rights-of-way; and
 - (B) utility vegetation management activities that are necessary to control hazard trees within or adjacent to electric transmission and distribution rights-of-way and
 - (4) When review is required, provide for expedited review and approval of utility vegetation management, facility inspection, and operation and maintenance activities, especially activities requiring prompt action to avoid an adverse impacts on human safety or electric reliability to avoid fire hazards.
- 512(b)(2)(A)(i) assures prompt review and approval not to exceed 90 days
- 512(b)(4) CATEGORICAL EXCLUSION PROCESS. – The secretary and the Secretary of Agriculture shall apply his or her categorical exclusion process under

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) to plans developed under this subsection on existing electric transmission and distribution rights-of-way under this subsection.

- 512(b)(5) IMPLEMENTATION.- ... Once the plan is approved, the owner or operator shall provide the agency with only a notification of activities anticipated to be undertaken in the coming year, a description of those activities, and certification that the activities are in accordance with the plan.
- 512(c) RESPONSE TO EMERGENCY CONDITIONS. —...
 - (1) may prune or remove the vegetation to avoid the disruption of electric service and risk of fire;
 - (2) shall notify the appropriate local agent of the relevant Secretary not later than 24 hours after such removal...
- 512(f) LIABILITY.- An owner or operator of an electric transmission or distribution facility shall not be held liable for wildfire damage, loss, or injury, including the cost of fire suppression, if—
 - (1) The secretary or the Secretary of Agriculture fails to allow the owner or operator to operate consistently with an approved vegetation management, facility inspection, and operation and maintenance plan on Federal lands...
 - (2) the Secretary or the Secretary of Agriculture fails to allow the owner or operator of the electric transmission or distribution facility to perform appropriate vegetation management activities in response to an identified hazard tree, or a tree in imminent danger of contacting the owner's or operators electric transmission or distribution facility.

Questions from Senator Joe Manchin III

Question: *Today, our reliability organizations and electric utilities are tasked with maintaining our electric grid in an increasingly challenging environment. A perfect storm of factors has put baseload units at risk, particularly in deregulated markets, and states are more frequently using out-of-market solutions to rescue these units and ensure their citizens and businesses have reliable affordable electricity. In the meantime, aging infrastructure, extreme weather events, the threat of cyberattacks, a rapidly changing fuel mix, and overregulation are increasingly testing our nation's electric grid. Several times throughout the month of January 2014, the upper Midwest and Mid-Atlantic experienced temperatures below zero. The Eastern portion of the PJM grid flirted with rolling blackouts. On January 7, a winter record was set when 141,132 megawatts of electricity was used. PJM, the nation's largest grid operator oversees 180,000 megawatts. That's cutting it pretty close in my book. Interestingly, following the winter of 2014, AEP reported that nearly 90% of its coal plants scheduled for retirement ran during the Polar Vortex. Coal helped keep the lights on. While near-term assessments do not cite major challenges in PJM, I remain very concerned that the additional baseload coal units scheduled to retire or shutdown will jeopardize the delivery of electricity.*

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird**

In the event of another extreme cold weather event, particularly one that coincides with increased demand like we saw during the Polar Vortex of 2014?

PacifiCorp's experience is in the Western U.S. where we operate under different market rules than in PJM. However, PacifiCorp consistently plans for resource adequacy and evaluates all energy resources as part of an overall portfolio approach to ensuring we meet our customers' needs, when they need it, at the most affordable price. Extreme weather events must be planned for and adequate resources must be available to meet customer demand.

What about 3 to 4 years from now? What do regulators need to do to help move natural gas into a position where it can serve as baseload and provide the 24/7 reliability attributes that coal and nuclear power offer?

As with the permitting of electric transmission lines, natural gas pipelines need to be sited, permitted and constructed within a reasonable time period. An effective federal permitting process should have a single point of accountability, clear and permanent deadlines, and avoid redundant and unnecessary reviews every time there is a new government policy change. Section 3103 of S. 2012 of last Congress is one way to address problems experienced with gas projects.

Questions from Senator Catherine Cortez Masto

Question 1: *Nevada has the most public lands of any state in the Nation. You brought up a salient point that there is sometimes tension between protecting public lands and expanding access to renewable energy through expanded transmission lines. Do you believe that collaborative agency implementation of the West Wide Corridors program authorized by Section 368 of the Energy Policy Act of 2005 has improved that issue?*

No. The Section 368 corridors were largely established by following existing transmission lines and pipelines on federal land. There was no environmental review conducted for the corridors. While use of the corridors is not mandatory, they provide no incentives or efficiencies for project proponents to attempt to use them. In our experience, when we attempted to site projects in many of the corridors we encountered significant opposition by state and local jurisdictions, as well as private property owners. In many cases these corridors already have several utility rights of way existing within their established boundaries with little room for expansion. Congress should consider changes to Section 1221, "The Siting of Interstate Electric Transmission Facilities," of the Energy Policy Act of 2005 to fix any statutory infirmities regarding FERC backstop authority.

Question 2: *LS Power and NV Energy, a major energy provider in Nevada, are currently engaged in building a transmission line across Nevada to California on one end and Idaho on the other. This expanded transmission line will be crucial for bringing more renewable energy online and exporting more energy to California. What are your experiences or recommendations regarding shared state financing of transmission line construction and operation?*

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

Typically, PacifiCorp's shareholders finance the funding of project planning, permitting and development costs prior to the project's completion and going into service. Once the line goes into service, PacifiCorp traditionally recovers the costs transmission line expansion across states through its wholesale and retail regulatory processes. At wholesale, PacifiCorp includes the cost of network transmission in its wholesale transmission rates, which are approved by FERC through a formulaic rate structure and which are charged to wholesale transmission customers. At retail, PacifiCorp has typically included large transmission projects in its Integrated Resource Planning processes with each of its states prior to seeking recovery of project costs in retail rates. PacifiCorp's states share transmission costs according to the multi-state allocation protocols approved by the state regulatory commissions. It's not a simple process but ensures states pay their relative share of costs based on the system benefits they receive.

Regarding the One Nevada project you refer to, once the portion of the line from Idaho to Ely is constructed, along with the portion from the Apex area of southern Nevada to the California-Nevada border, additional renewable capacity on the line could become a reality. The current line is necessary to integrate more fully the grids of northern and southern Nevada to ensure the reliability and robustness of the Western grid for many years to come.

Question 3: *How have you financed transmission line expansion across states?*

As mentioned above, at PacifiCorp we typically use shareholder funds to develop and construct interstate transmission lines then recover approved costs in wholesale and retail rates, approved by FERC and state commissions, respectively. In the case of the One Nevada transmission line, it was approved by both FERC and the Nevada state commission. One of NV Energy's partners, an affiliate of LS Power, obtained a loan guarantee from the U.S. Department of Energy in 2010 to secure financing for its 75% share of the line. NV Energy financed its 25 percent interest in the line with a combination of internally generated funds, debt issuance and capital contributions. The portion of the line from Apex to California is a CAISO approved and funded project.

Question 4: *How have state renewable policies affected your business model?*

PacifiCorp serves six states across the West, three of which have renewable portfolio standards. However, all six states have significant renewable resource development, whether it is wind in Washington and Wyoming, biomass and hydro in Oregon, or solar in Idaho and Utah. While renewable portfolio standards have had an impact on driving the deployment of renewable resources in the United States, in PacifiCorp's experience none of the extensive renewable resources we have acquired were obtained because of a state renewable portfolio standard. We have been able to add significant renewables to our system that have been shown under rigorous six-state public utility commission review to be the least-cost, least-risk option for all our customers. We have made these substantial renewable resource investments because they were the best resource choice for our customers, not simply to meet state mandates. Due to the cost-effective nature of these additions, our renewable energy portfolio exceeds our immediate state renewable portfolio standard requirements, and our states without a renewable portfolio standard

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Stefan Bird

are able to realize customer benefits by selling renewable energy credits in the market. Our ability to comply with state renewable standards has been incidental to what we would otherwise have invested in our system for the benefit of our customers.

We have also found that as utilities in other states add renewable generation, whether to achieve compliance with renewable portfolio standards or because of other reasons, the availability of low-cost energy in the wholesale market is increasing. Because of PacifiCorp's unique transmission footprint, we are able to capture that benefit for our customers and change the way we operate our diverse portfolio of resources to maximize value and reliability for our customers and the Western grid as a whole. For example, in particular during the spring and lower load conditions in the Western U.S., we are able to import large volumes of low-cost renewable energy production in the middle of the day and ramp down our other generation resources. When the sun goes down we ramp up our non-renewable generators to serve our customers. In effect, we operate our system like a battery without incurring any additional capital costs. As a result we have saved our customers substantial costs and reduced emissions while capturing value from our assets in new ways. For example, in 2016, we reduced our total emissions by 12 percent and saved PacifiCorp's customers \$45 million in the energy imbalance market that leverages technology to optimize generation across eight Western states in real-time.

Question 5: *What are your company's goals to increase its share of renewables?*

Our integrated resource plan is the tool we use to develop our long-term resource portfolio strategy. The purpose of the plan, which we update every year, is to identify the least-cost, least-risk resource portfolio. For the past several years, these plans have maximized the addition of renewable resources primarily because they are least-cost. However, the plan also considers the constraints of transmission availability and maintaining the diverse flexible resource supply needed to maintain reliability under a wide variety of conditions. Our most recent integrated resource plan includes new transmission to access and integrate low-cost renewable resources in eastern Wyoming. We plan to continue to add renewable resources as long as they can be cost-effectively integrated into our portfolio. Some of our states have recently increased their renewable portfolio standard or are considering increases to the existing renewable portfolio standard. Although, as discussed above, these requirements have not influenced our resource acquisitions to-date, they could influence our decisions in the future to serve the policy interests of our individual states. In addition, we increasingly hear from many of our customers that they desire a cleaner energy future, and our plans going forward will be designed to serve their needs while maintaining our core responsibilities of safe, reliable, and affordable energy supply.

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold

Questions from Chairman Lisa Murkowski

Question 1: You testified regarding the extensive permitting process for Cove Point LNG and the worldwide competition that exists for LNG contracts. In our energy bill that passed the Senate last Congress, we included provisions that would improve timeliness and certainty in the LNG export application process. What should be done to improve this process to ensure American competitiveness for the LNG market?

Answer: Dominion appreciates the efforts of the Committee last year to bring greater certainty to the permitting process, and we support those provisions as well as efforts to build upon those ideas as I indicated in my testimony. With regard to our LNG export facility, as you indicate, Dominion went through a lengthy permitting process. That process was very thorough – as it should be for a project of this magnitude. The public input and record created by the process are important. However, that robust engagement and record could be achieved while enhancing coordination between FERC as the lead federal agency for the NEPA review and related permitting requirements of other federal agencies and providing greater certainty to the timeline.

With regard to LNG export facilities in particular, the competition for these contracts is fierce worldwide. For LNG facilities going through the export application process, I could easily envision a partner choosing to look elsewhere – potentially to countries that are not our allies – to secure a supply of natural gas if they were uncertain of when they could rely on a project securing the necessary permits. Certainty about the timeline for a project is an important criteria for potential partners in these facilities. To be clear, however, we believe certainty about timely reviews to meet a federal agency schedule does not mean a diminishment of fully examining all potential impacts or fully considering the views of citizens, local governments, state agencies or other interested stakeholders.

Question 2: In your testimony, you highlight the positive impact making gas available from Cove Point will have on the trade deficit. Specifically, you note that “making gas from Cove Point available to our international partners in Japan and India will reduce our trade deficit by \$5 billion annually.” Can you detail how the timely approval of permits and increased transparency in the process could further reduce the trade deficit?

Answer: The federal and state permitting for Cove Point was extensive – requiring more than 55 federal, state and local permits and reviews. Continued and careful coordination was required to ensure that each agency received the information needed to complete its respective review within the FERC schedule, including public hearings and outreach. Such a robust and transparent process is certainly appropriate for a project of this magnitude. Ensuring that the process remains on schedule is also critical for large infrastructure investments such as Cove Point.

In the case of Cove Point, the addition of export capabilities to the facility enables our international partners in Japan and India to access a small portion of domestic gas supply. Providing capabilities for our allies to access natural gas from the U.S. reduces our trade deficit

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold

by approximately \$5 billion annually. Competition to deliver LNG to Asia is fierce. In selecting Cove Point, our partners in India and Japan focused on price as well as on energy security and diversity of supplies.

Any delay or uncertainty in the permitting process could have caused our partners to look elsewhere for more certain deliveries. And any extension of the process delays not only the annual trade deficit reduction, but also the local economic benefits for the projects. For example, at Cove Point, the project will generate \$22 billion in new government royalty and other revenues to federal state and local governments during the project period 2018-2040 and will allow Calvert County, MD to receive an additional \$40 million annually in increased property tax revenue. We estimate that royalty payments to the owners of the gas produced would total about \$9.8 billion over 25 years. Earlier approval of the permits would have enabled these economic benefits to begin accruing earlier.

Having certainty for the schedule is a key aspect of any contract for gas delivery, and even once contracts are in place, benefits are delayed when the permitting process is not on schedule. As I indicated during the hearing, certainty for the schedule would be a welcome improvement to the existing permitting process.

Question 3: The Atlantic Coast Pipeline permitting process requires extensive work with six federal agencies and thousands of pages of application materials. What permitting activities do you believe could be streamlined to make the permitting process move more efficiently?

Answer: As I indicated at the hearing, the most helpful thing for the permitting process would be better coordination among the federal agencies as envisioned by FAST-41 and certainty with regard to schedule and analysis. We appreciate that different agencies have different responsibilities and expertise, and we think that a robust process benefits Dominion, the public and the permitting agencies. However, that robust process could be improved by bringing more certainty to timelines and scope of review.

During the ACP process, we have been frustrated at times by lack of transparency on the part of federal agencies with regard to completeness of information they require and a timeline for their review and decision of our various applications. For example, we waited more than a year for review of an application by the Park Service to simply conduct a survey. We are still unsure of what caused such a long review time. In other cases, we are awaiting decisions on permits but have not been given feedback about when we might expect decisions or if our application provides all the information that will be required for a decision.

Dominion would be pleased to work with you as the Committee examines these matters in greater details, but there are three areas that based on our experience could benefit from improved clarity:

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold**

- Concurrent NEPA analysis and review of permits by FERC and other permitting agencies. Other agencies should work within the FERC outlined schedule to provide greater predictability to different milestones within the process.
- Require permitting agencies to determine when an application is complete within the context of the FERC schedule. Understanding whether a permit application is complete and undergoing review or if additional information is required (and if so precisely what information is needed) would help both the applicant and the permitting agency to stay on schedule.
- Strengthen coordination of FERC's NEPA reviews with cooperating agencies. In the absence of additional clarity on responsibilities of "lead agency" and "cooperating agency," we are too frequently seeing scenarios in which federal agencies decline to participate in the process as a cooperating agency only to later decide to conduct their own NEPA analysis. Ensuring that all federal agencies work together from the beginning of the process to ensure that everyone is on the same page will provide additional certainty to the schedule and to the scope of information required. Providing additional clarity to the definition of a lead agency, giving FERC some authority or requiring cooperating agencies to act in accordance with FERC's schedule would improve the process.

Questions from Ranking Member Maria Cantwell

As the electric generation sector grows more dependent on access to natural gas, it is increasingly important that natural gas pipelines are secure and reliable.

Unlike the bulk power system, natural gas pipelines are not subject to mandatory cybersecurity standards. In fact, I understand the Transportation Security Administration (TSA), not the Department of Energy or FERC, is responsible for pipeline cybersecurity.

The TSA performs a very important role every day in protecting our security. But I don't believe they are the right organization to protect against cyber-attacks against pipelines.

Question 1: Don't you agree that the Department of Energy, not the TSA, should have authority over pipeline cybersecurity? If you don't agree, please explain why.

Answer: As the Sector Specific Agency for Energy, it is natural to want to align the Oil and Natural Gas (ONG) subsector and its associated risks with the Department of Energy and FERC. However, TSA has operated a security partnership with pipelines for over a dozen years and developed a thorough understanding of pipeline security operations that other federal agencies, including DOE and FERC, do not possess. This partnership includes onsite facility audits conducted by TSA, both cyber and physical, as well as the development and implementation of consensus pipeline security guidelines, which all pipelines are directed to follow. In addition, TSA and the pipeline sector collaborate on regular security conferences and information

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold**

exchange programs where industry and TSA discuss and develop smart security practices and share problems and solutions.

Pipelines are subject to pipeline safety regulations, implemented by the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), which are intended to address the resilience and reliability of the pipeline infrastructure. Pipeline operators have business continuity plans to address service disruptions, regardless of cause. TSA and PHMSA have a Memo of Understanding (MOU) to coordinate pipeline safety and pipeline security. Losing this integrative approach would be counterproductive and would not improve security or pipeline safety. In addition, pipeline companies that fall under the CFATS regulations, which has cyber security requirements, will still have to deal with TSA. Additional cybersecurity programs that pipelines participate in include, but are not limited to, membership in the Downstream Natural Gas Information Sharing and Analysis Center (DNG-ISAC), piloting real-time information sharing programs, utilizing the incident response and network protection capabilities of ICS-CERT, conducting peer reviews with the ONG Cybersecurity and Capability Maturity Model (C2M2) and applying elements from the NIST Cybersecurity Framework to better design, build and update our cybersecurity systems. Given the uncertainty and complexity of transferring cyber security responsibilities to DOE and FERC, Dominion believes it is better to keep authority for pipelines with TSA.

Question 2: What is Dominion Energy doing to prevent successful cyber-attacks against your pipeline assets?

Answer: Dominion takes security very seriously. As part of the nation's critical infrastructure, we are conscious of the growing threats to national security, the U.S. economy and the health and safety of our employees and the general public.

Dominion uses an integrated set of cyber and physical security defenses to protect assets; preserve the confidentiality of data; and ensure continuity of operations. Dominion's systems comply with applicable regulatory requirements and industry standards/guidelines including the TSA Pipeline Security Guidelines and the DOT Pipeline Safety Regulations and have undergone and passed multiple audits.

Cognizant of the need to be diligent in an effort to combat adversaries that are constantly altering their tactics and techniques, Dominion's cyber and physical security personnel are in regular communication with government agencies, the law enforcement and intelligence communities, and industry peers to proactively assess the threat environment. The Company continually assesses and improves its security posture to align with new threats and evolving digital technologies. This includes both internal and third-party vulnerability assessments and penetration tests.

Pipelines under construction and our LNG facility are protected based on assessment, conducted by security professionals, of a wide range of relevant security risks. Security plans for existing pipeline facilities and pipeline construction projects are developed using a defense-in-depth

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold**

approach that provides for effective prevention, detection, assessment and response. Security posture is adjusted whenever warranted by the intelligence obtained. In addition, Dominion has volunteered to have the Federal Energy Regulatory Commission (FERC) evaluate our natural gas cyber and physical security controls as part of their outreach program. This will help test our ability to protect our infrastructure as well as insure our responsibility to provide a reliable source of fuel to our customers which includes electric generation.

Questions from Senator Joe Manchin III

Question 1: As a company operating in West Virginia, I know you are familiar with the economic challenges of our state. West Virginia is hurting. The decline of the coal industry has been devastating. We are losing businesses and population. So, in addition to doing everything we can to stop the bleeding and help our people in the near-term, we are also looking for ways to revitalize our home state economy. One of the ideas that I am intrigued by and increasingly optimistic about is the opportunities that the Marcellus and Utica shales present. We are working with the Mid-Atlantic Technology Research and Innovation Center (MATRIC) to help realize the potential of an Appalachian Storage Hub which could bring jobs to West Virginia. It would ensure we are maximizing the opportunities associated with our vast reserves of natural gas liquids (NGLs) such as ethane. According to MATRIC, about 20% of the value in the Marcellus Shale alone is ethane, propane and butane natural gas liquids. So, ideally, the cultivation of such a hub would attract manufacturing companies that need reliable affordable access to these feedstocks that are necessary for many of their processes. As you know, I am supportive of the expansion of energy infrastructure as long as it is done in an environmentally sound and responsible manner with public input. So, I'm encouraged by your investment in West Virginia. But, I'd also like for you to elaborate on what Dominion looks at to determine whether to get engaged in a more local way.

In other words, what would it take for you to start looking at a project like the Appalachian Storage Hub and building out your system to support the addition of manufacturing capacity in the region? How do we keep some of this gas in West Virginia?

Answer: We certainly recognize the local economic benefit that accompanies the responsible development of natural gas infrastructure and that dynamic is true in West Virginia as well. With regard to this specific project, Dominion is strongly supporting the Appalachian Supply Hub feasibility study being headed up by West Virginia University. Specifically, we have attended the kickoff meeting as an inaugural industry sponsor, contributed funding in support of the ongoing geologic studies and have actively participated in the meetings held to date, including our Director of Gas Storage and Land Services participating in the kick off meeting and recent status update meeting. We intend to contribute our geologists' expertise in assessing upcoming recommendations from the study team when those recommendations are made this summer.

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold

Question 2: Today, our reliability organizations and electric utilities are tasked with maintaining our electric grid in an increasingly challenging environment. A perfect storm of factors has put baseload units at risk, particularly in deregulated markets, and states are more frequently using out-of-market solutions to rescue these units and ensure their citizens and businesses have reliable affordable electricity. In the meantime, aging infrastructure, extreme weather events, the threat of cyberattacks, a rapidly changing fuel mix, and overregulation are increasingly testing our nation's electric grid. Several times throughout the month of January 2014, the upper Midwest and Mid-Atlantic experienced temperatures below zero. The Eastern portion of the PJM grid flirted with rolling blackouts. On January 7, a winter record was set when 141,132 megawatts of electricity was used. PJM, the nation's largest grid operator oversees 180,000 megawatts. That's cutting it pretty close in my book. Interestingly, following the winter of 2014, AEP reported that nearly 90% of its coal plants scheduled for retirement ran during the Polar Vortex. Coal helped keep the lights on. While near-term assessments do not cite major challenges in PJM, I remain very concerned that the additional baseload coal units scheduled to retire or shutdown will jeopardize the delivery of electricity.

In the event of another extreme cold weather event, particularly one that coincides with increased demand like we saw during the Polar Vortex of 2014? What about 3 to 4 years from now? What do regulators need to do to help move natural gas into a position where it can serve as baseload and provide the 24/7 reliability attributes that coal and nuclear power offer?

Answer: I agree that the nation needs to ensure that natural gas is available to meet customer demand. As one example to highlight the need your question appropriately raises, the Atlantic Coast Pipeline project has signed 20-year, binding transportation agreements with multiple end-use customers and over 94 percent of the gas capacity is under contract for domestic use. Over 76 percent of the 1.5 billion cubic feet per day of capacity is dedicated for use by utilities for power generation as the industry modernizes its fleet. One local gas distribution company, Southern's Virginia Natural Gas subsidiary, has advised FERC that its Hampton Roads Crossing pipeline is operating at design limits on peak demand days. Further, during frigid days Virginia Natural Gas has had to curtail service to large industrial customers to prevent residential and other customers from being left in the cold.

Some of the permitting modernization methods mentioned in my testimony – greater certainty with regard to scope and timeline of the permit process – would be tremendously helpful in ensuring that our nation's abundant natural gas potential is fully reached. Having in place a more certain schedule for projects that will deliver natural gas to consumers is critical for ensuring we continue to meet our demand.

Question 3: The development of oil and gas pipelines in the United States has become increasingly politicized in recent years. I understand the importance of expanding and modernizing our energy infrastructure. But, as a former Governor and a Senator, I also believe it is important that landowners and the public are treated fairly and given the opportunity to be heard. That said, I understand that permitting can be duplicative, uncertain and the cause of

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold

major delays – all potential killers for a multi-billion dollar project. Last year, this Committee took steps to streamline pipeline permitting processes. Unfortunately, the energy bill did not make it across the finish line. In your written testimony you write, “all we are asking for is fair and common-sense standards, and a reasonable schedule that is upheld.”

For the committee, please discuss in detail what you believe is a “reasonable schedule.”

Answer: I would agree with you that it is important that landowners and the public are treated fairly and given the opportunity to be heard during the permitting process. We think that robust public engagement from the beginning of a project is extremely important, and we take our obligation for transparency very seriously. With each of our projects, we engage in a tremendous amount of public outreach. To use the ACP as an example, we have communicated directly with dozens of organizations along the route, held 33 open houses in three states and participated in 12 public scoping meetings held by FERC. FERC has also held ten public meetings on the draft EIS. We have a responsibility to communicate with communities and landowners to make sure they understand the process and to accommodate their concerns as much as possible. We have made thousands of small and large route adjustments as the result of this stakeholder involvement. The public deserves to understand the process – that is key to gaining trust that we will meet or exceed requirements to ensure the project is built safely and with as minimal environmental impact as possible.

That public outreach can be accomplished while still having a certain and non-duplicative permitting process. With regard to what constitutes a reasonable schedule, that could vary depending on the type or complexity of a project; however, FERC sets what we believe to be a reasonable schedule for our pipeline permitting projects, and we would like for other entities with responsibilities to work within that established timeline. FERC, in coordination with other Federal agencies who have agreed to be cooperating agencies under NEPA, jointly develop a project schedule. It is imperative that agencies make every concerted effort to meet the schedule by providing timely comments during the NEPA review and completing their individual permit requirements. While we would not want a process that dragged on unnecessarily, it is the certainty of the schedule rather than the timeline itself that is of utmost importance.

Question from Senator Luther Strange

Question: Much of our energy infrastructure is privately financed. What burden does an uncertain permitting process mean for the economics of a transmission or pipeline project?

Answer: As with any capital investment, uncertainty in the process is not helpful. In addition to cost impacts, delays in the process also mean delays in the economic benefits associated with the projects. To provide two examples of local economic benefit from our projects: Construction of the Cove Point project will generate \$22 billion in new government royalty and other revenues to federal state and local governments during the project period 2018-2040 and will allow Calvert County, MD to receive an additional \$40 million annually in increased property tax revenue. The

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Ms. Diane Leopold

Atlantic Coast Pipeline will generate more than \$2.7 billion in economic activity during construction along with an average of \$4.2 million in annual local tax revenue. The ACP will save consumers in the region an estimated \$377 million annually in lower energy costs. Also, localities hosting the pipeline will receive an additional \$28 million annually in local tax revenue.

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler

Questions from Chairman Lisa Murkowski

Question 1: At the hearing, you stated that there are 250,000 to 300,000 people employed in the solar industry and 90,000 to 100,000 people employed in the wind industry. Could you please provide citations for these employment numbers? Are these all direct jobs? Also, how many people are employed in the hydropower industry?

As I mentioned during my testimony, Bloomberg New Energy Finance itself typically does not count jobs as part of our research. The figures I referred to during my testimony have been produced by the Solar Foundation and the Department of Energy. I invite the committee to review their figures here:

<http://www.thesolarfoundation.org/national/>

And here:

<http://www.aweablog.org/u-s-wind-jobs-continue-booming-top-100000/>

My understanding is that these are direct jobs, but I would advise the committee to review the reports and methodology that went into producing them directly.

As for the hydropower industry, the US Department of Energy in January 2017 released its U.S. Energy and Employment report

(https://energy.gov/sites/prod/files/2017/01/f34/us_energy_jobs_2017_final.pdf).

Please see Table 1 on page 29, which lists 56,259 “traditional hydropower” jobs in the U.S.

Question 2: In your testimony, you mention that policymakers should facilitate the development of transmission and distribution lines.

a) Can you detail the challenges associated with siting and permitting new transmission and distribution lines?

The most difficult challenges facing the building of new transmission often involve cost recovery and siting.

New transmission remains largely a utility-controlled monopoly. Thus traditional cost-recovery methods (ie, passing costs along to the rate base, or to individual generators) are designed for a single-utility, single-state projects. Larger, multi-state projects find it difficult to recover costs within the existing system as a result.

One of the higher profile projects currently under development across state lines is being developed by Clean Line Energy Partners. In a 2012 [letter](#) to the US Department of Energy, Clean Line articulated some of the challenges it has faced. These included the fact that the project must secure permits from each state in which it plans to operate. This can be further complicated if the project itself will not be delivering power to consumers living within that particular state.

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler

Such long-range transmission projects also face typical permitting hurdles associated with other large-scale infrastructure projects. This can include securing permits that comply with local, state, and federal regulations.

b) What impact does uncertainty of the federal permitting process have on the cost of a project?

Bloomberg New Energy Finance has not calculated exact costs and doing so is particularly difficult given the heterogeneity of these types of projects. As each of these projects is so large and faces unique challenges, it is very difficult to extrapolate a single, definitive average federal permitting cost.

More easy to estimate is the cost to consumers that transmission represents. The Edison Electric Institute, which represents large U.S. utilities, said that transmission accounted for about 9% of the average price of electricity in 2014.

(http://www.eei.org/issuesandpolicy/transmission/Documents/Trans_Project_lowres_bookmarked.pdf)

EEI cited the Energy Information Administration's Annual Energy Outlook 2015. EEI also said that generation accounts for 65% of the final price while distribution accounts for 25%.

c) What concrete actions can Congress take to facilitate the development of transmission and distribution infrastructure?

As a market analysis research group, it is not Bloomberg New Energy Finance's place to make specific policy recommendations, per se. However, we can volunteer ideas that might potentially accelerate market activity.

Firstly, it is important to find ways to cut the time spent overall by developers on permitting and siting. The longer projects take to get developed, the greater the risk to the developer and the more capital required. Convolved and complex permit application processes can be quite costly in terms of both time and money.

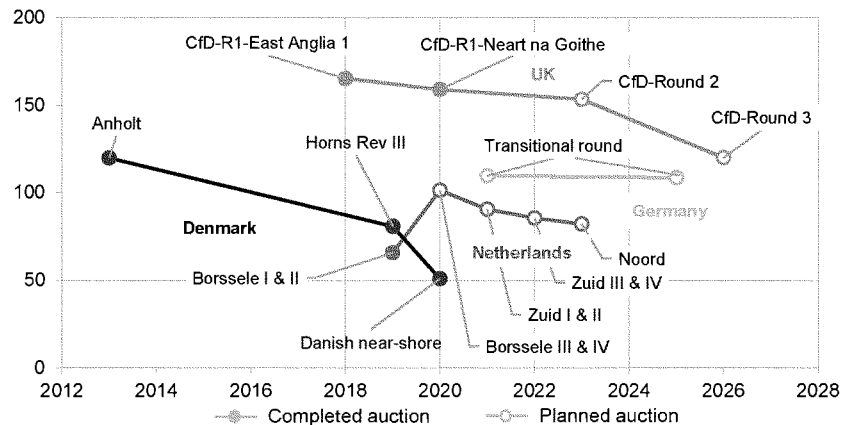
One potential way to address this would be to unify environmental assessment analyses into a more streamlined process. For developers dealing with multiple federal, state, and local agencies, a single application process with a single, unified set of time lines would no doubt be quite welcome.

We at Bloomberg New Energy Finance have seen examples of governments elsewhere essentially "multi-tasking" to perform multiple environmental assessments concurrently. In such cases, we have seen development times substantially accelerated.

One example of this has been in Denmark and the Netherlands, which have expedited permitting for new offshore wind projects. This, in turn, has reduced the "levelized costs" of these projects and allowed developers to bid for contracts to sell power at ever lower prices.

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler

The chart below tracks the prices at which various European offshore wind projects have pledged to build since 2012 (the left hand axis is dollars per megawatt hour).



Questions from Senator Ron Wyden

Question 1: Mr. Zindler, in your testimony you discuss the plummeting costs of renewable energy technologies like wind and solar, which account for an increasingly large portion of American energy infrastructure. Is it your impression that federal research, development and demonstration (RD&D) programs, like those at the Department of Energy, play an important role in driving down the costs of new energy technologies? As we plan for the future, would you agree that we should continue to make federal investments in energy technology RD&D as a component of investing in US energy infrastructure? If so, what recommendations would you have for federal energy RD&D programs?

It is rarely possible to draw a straight line from a single research program or dollar directly to an energy technology that has ultimately and successfully been deployed at scale. Inevitably, it is a confluence of factors and an array of players who combine to create success.

Nonetheless, we would argue that the support the federal government has lent to the development of new technologies has surely paid dividends to date. Specifically, research conducted at National Renewable Energy Laboratory and others has contributed to the recent scale-up in solar power deployment we have seen and the decline in solar costs. Certainly, other

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler

factors have also contributed such as sheer economies of scale, but the labs' contributions – over decades – should not be under-estimated.

The recent, rather extraordinary declines we have seen in the prices of solar and wind power, along with that for power storage could be misconstrued as a sign that further investment in RD&D is not required. In fact, much work and considerable progress must be done in order for the costs of these technologies to continue to decline. As I mentioned in my original testimony, wind and solar power is being cost competitive in many markets but the “intermittency issue” remains. Thus the need for cost-competitive battery technologies is all the more important.

In 2010, Bloomberg New Energy Finance wrote a report entitled Crossing the Valley of Death: solution to the Next Generation Clean Energy Project Financing Gap. The issues identified in that report regarding the challenges confronting the deployment of clean energy technologies remain largely the same today. The suggested options in that report also remain relevant, in our view.

Question 2: Mr. Zindler, in your testimony you commented on the improving price of energy storage--particularly lithium battery storage. Would you agree that the time is ripe for the federal government to be investing in energy storage? If so, what would you recommend Congress and the federal government do to help advance energy storage? And, would you agree that energy storage should be considered as a key part of “energy infrastructure” -- and, if so, that investments in energy storage should be included in a federal infrastructure package? Finally, what are some ways the federal government could de-risk storage innovations, including grid-scale storage?

As I discussed during my testimony before the committee, energy storage technologies are critical to any renewable energy scale-up as both wind and solar are “intermittent” sources of generation (no wind, no wind power; no solar, no solar power). We have seen precipitous battery price declines in recent years and we anticipate further drops in coming years. However, it should be noted that our forecasted drops assume that demand for lithium-ion batteries will spike, allowing for economies of scale to kick in. And this, in turn, is primarily contingent on a growth in demand for electric vehicles from consumers.

Regardless of those dynamics, there is little doubt that further work will be required to improve the longevity of batteries and their costs. This is where further research and development will be required.

In terms of deployment of existing and future technologies, a major barrier to adoption is that regulations that today often get applied to power storage projects were often been crafted with power-generating plants in mind. However, energy storage has now reached a level of maturity that it should instead be considered alongside other established technologies in providing various grid-scale services. For instance, rules pertaining to how energy storage projects can participate in utility auctions could be clarified to make sure they are not unnecessarily discriminatory

U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler

against new technologies. Provisions that require an asset provide certain services indefinitely ensure that energy storage projects cannot to compete.

While the federal tax code includes key provisions to support the deployment of wind and solar power-generating assets, it contains comparatively weak support for power storage assets on a standalone basis. There is currently no investment tax credit (ITC) for energy storage projects on their own, for instance. Today, energy storage can only receive the ITC when it is part of a solar or wind project with certain technical restrictions. Legislation to address this would be a major incentive for energy storage. Storage subsidies exist in markets such as Germany and Italy and this has spurred adoption.

Away from the federal government, we have seen some interesting developments in recent months to support power storage deployment. Specifically, regulators in several states and one country have introduced financial mechanisms that reward utilities for contracting distributed energy resources or third-party services (including energy storage) in place of capital investments. The UK, New York and California are leaders here, and this marks a radical departure from traditional utility regulation in which profits are derived only from capital investments. If successful, these models should be encouraged more broadly. This would make energy storage a key part of the “energy infrastructure”.

Question 3: Mr. Zindler, energy efficiency plays an essential part in our energy system, with projected savings of \$1 trillion to Americans by 2020. Would you agree that energy efficiency should be part of an energy infrastructure package? If so, where would you recommend focusing energy efficiency investments in the next five years?

In our recent [Sustainable Energy in America Factbook](#) (co-produced with the Business Council for Sustainable Energy) we highlighted how energy efficiency resource standard (EERS) policies at the state level have coincided with higher levels of private investment in energy efficiency. However these EERS exist in only about half of US states for electricity, and less than that for gas. Our data suggests that regions where a high proportion of states have EERS policies in place are gradually decreasing their share of overall consumption in the US, suggesting a material impact.

EERS provide utilities with incentives to find the most cost-effective means of hitting their efficiency targets. Down the value chain, providers of energy efficient products and services are incentivized to innovate to provide the least-cost options. Currently, EERS are typically funded by ratepayers prompting some resistance to their adoption in states where they do not currently exist. Moreover, where they do exist, utilities are not necessarily incentivized to run the schemes effectively if there is not a lost revenue adjustment mechanism (e.g. decoupling) in the regulatory framework.

Thus to a large degree, supporting energy efficiency is best done by government at the local or state level. The federal government can potentially provide incentives or challenges to states to adopt EERS or other policies, however.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler**

Separately, smart meters have demonstrated to date that they can cut utilities' operating costs by reducing the need for in-person meter reading, lowering general administrative costs, and cutting the risk of power theft. Additionally the technology has led to service improvements such as more accurate billing, outage detection and faster connections.

The 2009 American Recovery and Reinvestment Act provided substantial federal support for the roll-out of smart meters. This helped drive the deployment of no less than 12.6m smart electricity meters in 2011. By 2016, however, that had fallen to 5.8m such meters.

Today, over half of US electricity customers lack smart meters. Given the successes the ARRA achieved in spurring deployment of the devices, Congress could consider further such support in new infrastructure legislation.

Questions from Senator Debbie Stabenow

Question 1: Enhanced investment in innovation and domestic advanced manufacturing is helping power a recovery in the US auto sector. Keeping that progress going depends on continuing to lead globally in all kinds of automotive and energy innovation – including electric vehicles, battery storage, charging and vehicle to grid technologies. Competitors like China are investing heavily in these advancements. What kinds of infrastructure should the U.S. be investing in to ensure we can compete in electric transportation and related industries?

In Bloomberg New Energy Finance's view, electric vehicles (EVs) represent a critical part of the future of mobility. And capital expenditures in public EV charging infrastructure is the potential linchpin of large-scale, long-term deployment. In the US, there are currently just under 20,000 public charging stations for a total fleet of 500,000 EVs. Bloomberg New Energy Finance estimates that at least \$1bn per year will need to be deployed by 2020 to continue supporting the US EV market.

To date, EV charging businesses have struggled to show profitability and new investment into them have fallen as a result. From almost \$400m of publicly disclosed investments in 2010, just \$26m was raised in 2015 by such firms. The bankruptcies of start-ups Better Place and Ecotality in 2013 highlighted the growing pains of the industry, even as EV sales in the US reached a cumulative 400,000 at the end of 2015.

Both capital expenditure and operating costs are high for EV charging infrastructure, especially so-called "fast charging", which can cost an operating up to ten times more on a dollar per kilowatt-hour basis than the retail cost of electricity. As such, both state and federal level regulatory could support infrastructure rollout if the EV market is to continue to grow.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Ethan Zindler**

To date, we have seen limited examples of utilities successfully “rate-basing” the costs of adding EV charging stations in their service areas. More such efforts could be required to expand charging infrastructure. The federal government could also consider supporting deployment through grants or other means.

Question 2: Our electricity system is rapidly becoming both cleaner and more diverse. Whether that is renewable energy providing a significant amount of new power, generation, or carbon capture and storage, what investments must be made to our energy infrastructure to support this trend?

There are a wide variety of different types of investment that will be required in coming years to facilitate the continued clean energy build-out. I articulated quite a number of examples of these in my oral testimony before the committee. Others are discussed in response to other questions in this document.

Question from Senator Catherine Cortez Masto

Question: Nevada’s Governor Sandoval has supported an infrastructure initiative that supports vehicle electrification, which will reduce our dependence on oil, increase clean energy jobs, and cut down on greenhouse gas emissions. Do you have recommendations as to how the federal government can best support state led initiatives to increase the amount of electric vehicles in use?

Please see my response above to a question from Senator Stabenow.

In addition, in July 2016, the White House announced that EV supply equipment investments would become eligible to receive loan guarantees under Title XVII of the Renewable Energy and Efficient Energy Projects Solicitation (REEE). This pool of money has been available in some measure since 2007 and currently stands at \$4.5bn.

However, such loans guarantees would be subject to regulations set out under the 1703 guarantee program. Specifically problematic is the requirement that applicants must themselves cover the cost of “credit subsidies”. This requirement, in effect, can require that loan guarantee applicants put up 10% or more of the capital they are seeking to borrow. This is too high a hurdle for many companies.

In addition, borrowers can only use funds to invest in “pre-commercial” technologies which are defined as having been implemented no more than three times and active in the market for less than five years. This provision has the potential to exclude all Level 2 charging projects as well as direct-current fast charging EV supply equipment. However, projects that support the deployment of over 150kW charging could conceivably be eligible for the loan guarantees given that this technology is not deployed in any significant scale in the US.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

Questions from Chairman Lisa Murkowski

Question 1: Our rural and islanded communities have needs that often differ from those of high-population centers, and these differences are even more obvious in rural Alaska. What specific lessons and technologies can be leveraged from the efforts of the national labs in grid modernization so that our rural communities are not left behind? How would you meet the challenges of our rural communities in terms of increasing energy reliability and efficiency?

Answer: The ongoing Alaska Microgrid Partnership project within the Department of Energy's (DOE) Grid Modernization Initiative is an excellent approach to addressing the needs of rural and islanded communities in Alaska and elsewhere. Staff from four DOE national labs are working in multiple Alaskan communities to baseline their energy supply and efficiency needs and to define a path toward reducing the diesel fuel requirements by 50 percent in these communities. The labs have Alaskan partners and have completed initial assessments that will illuminate approaches for the integrated use of clean generation, energy storage, energy efficiency, and advanced microgrid controls to improve the reliability and affordability of electricity to rural communities. I am including background information on this project along with these Questions for the Record.

Question 2: The University of Alaska Fairbanks hosts the Alaska Center for Energy and Power, which has unique expertise and testing capabilities for grid technologies, including harsh environment testing. In what ways can the national labs better work with our university researchers, like those at ACEP, to conduct the research, development, and demonstration of energy infrastructure technologies of the future?

Answer: I recommend that Alaskan stakeholders interested in research and development (R&D) actively engage with the advisory groups supporting the Department's grid modernization efforts to provide first-hand knowledge of research progress and needs, and to help learn of opportunities for involvement. For instance, the Alaska Center for Energy and Power and the Renewable Energy Alaska Project are current participants in the microgrid project mentioned above.

A second approach is for Alaskan R&D stakeholders to partner with national labs in pursuit of university Funding Opportunity Announcements that flow from the Grid Modernization Initiative as well.

I suggest that Alaska R&D stakeholders engage with the Grid Modernization Lab Consortium (GMLC) leadership team to accelerate the rate at which these connections can be identified. As a co-chair of GMLC, I would be pleased to work with your staff to facilitate such a conversation.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

Question from Ranking Member Maria Cantwell

Workforce development has a particularly critical role in ensuring that our country is prepared to respond to the ever-evolving cyber threat. According to the Department of Homeland Security, in 2013 56 percent of all cyber incidents against critical infrastructure were directed at energy infrastructure, mostly the electric grid. This figure has declined as cyber-attacks against other critical infrastructure have grown, but the threat to our energy infrastructure remains high.

The Quadrennial review highlights workforce development as one of the things we need to focus on in order to protect the grid from cyber-attacks.

Question: What do you think we should do to ensure that we have a sufficient cybersecurity workforce to keep the grid secure?

Answer: Our electric grid, like the rest of the nation, is becoming increasingly affected by technology – from smart grid to distributed energy resources to supply and demand. As such, it is increasingly important that our nation has an adequate, viable cybersecurity workforce to ensure the security of the grid, but also to address the myriad of national security and domestic issues. A public/private partnership model should be considered to ensure the sustainability of training efforts.

There are many ways to develop a sufficient cybersecurity workforce, including:

- Worker cross training programs that allow workers with grid experience, such as linemen and operators, to transition from other jobs in the energy industries, including electric, oil and gas into cybersecurity.
- Consistent, high-quality cybersecurity curricula is needed at all levels in the university system; the race to respond to cyber workforce needs has led to inconsistency in program quality. This curricula should be integrated with science and engineering programs as well, which will help address stove piping of expertise.
- Continual education is necessary in a fast-moving domain such as cybersecurity; training exercises and continuing educational units for staff, particularly those in energy industries, are needed. As part of continuing education efforts, consider professional exchanges between government agencies, industry and national laboratories, among others.
- Internships that allow students to spend time with government agencies and industry to gain real-world, on-the-job training.
- Engaging in STEM K-12 outreach efforts to build interest of students and expand awareness and enthusiasm for computing and security topics. Many national laboratories, including the Pacific Northwest National Laboratory (PNNL), have incorporated cyber

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

into STEM outreach efforts.

- Outside-the-classroom activities that build practical skill, such as cyber defense contests, red team contests, etc. Examples include the National Collegiate Cyber Defense Competition, which provides curricula to assess students' depth of understanding in cybersecurity defense, and Pink Elephant Unicorn, a free cybersecurity "capture the flag" competition organized by PNNL and in collaboration with regional universities such as Washington State University – Tri-Cities, Columbia Basin College, and Northeastern University.

PNNL has recognized the need to develop a strong cybersecurity workforce not only for the electric grid, but to address additional pressing national challenges. As such, PNNL has increased partnering with universities and joint faculty appointments in cybersecurity to ensure training is aligned with national needs, and regularly brings faculty and student teams to the lab to embed with its researchers, resulting in exposure to real-world, contemporary cyber challenges. PNNL has also partnered with community colleges to develop applied programs that ensure a workforce that is ready and able to work at utilities and other industries.

Finally, PNNL and its operator, Battelle, have long been major supporters of STEM education in the local community and across Washington State, and have included cybersecurity in STEM outreach in as part of efforts to ensure a pipeline for the workforce of tomorrow.

Questions from Senator Ron Wyden

Question 1: Mr. Imhoff, I appreciated the discussion in your testimony of flexibility as a key grid attribute in which America should be investing. I agree that enhanced "grid flexibility" will improve our ability to manage renewable energy in a cost-effective way and provide new opportunities for consumers to efficiently use distributed energy resources like electric vehicles, all while boosting grid reliability and resilience. My home state of Oregon, for example, has a new goal of producing 50 percent of its electricity from renewable sources by the year 2040. We have also been making investments in energy storage and demand response systems. And, as you know, in the Northwest, we need to take a proactive approach to concerns about earthquake and tsunami risks—risks which could cause major impacts to vital grid infrastructure, impeding our ability to respond to a crisis. These issues present new challenges and call for tools that bolster grid flexibility while keeping electricity rates affordable. Could you elaborate on your vision for grid flexibility, and provide thoughts on how the federal government can help develop a more flexible grid, including mention of how the Grid Modernization Lab Consortium is addressing this issue?

Answer: I believe that future investments in the electric power system must reflect the need for operational flexibility across all generation, energy storage, and responsive demand-side resources to accommodate the future electric energy system that consumers choose, and be robust across multiple potential energy futures of the next 50 to 100 years. This would require:

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

- Generation, energy storage, and distributed energy resources that can respond to growing variable generation resource complexities in ways that are economical and supportive of grid reliability and resilience.
- Grid architectures and control approaches that enable reliable controls of increased distributed generation and consumer-control loads, while still being compatible with the legacy central control systems of the grid.
- System planning that accounts for uncertainty in in terms of fuel supply.
- New mechanisms to communicate value and priority across the distribution and transmission systems to deliver the flexibility at time scales needed for reliable operation of the grid.

Innovation and investment that reflect these flexibility concepts would provide an efficient, reliable, and resilient grid system at the state, regional, and interconnection levels that would support our economic vitality and be robust across multiple energy futures for many decades.

Question 2: Mr. Imhoff, you mentioned in your testimony the pioneering work done by the Pacific Northwest Smart Grid Demonstration Project (PNW-SGDP) on transactive controls. Transactive energy have the potential to save consumers money, while making more efficient use of our electricity generation, transmission, and distribution assets. What steps do you recommend to build on the findings of the PNW-SGDP to advance transactive controls in the Northwest and nationwide in a way that is good for consumers and businesses?

Answer: Transactive grid systems have great potential to improve the economic efficiency and reliability of our power grids, and aid in the integration of renewable generation, by providing an adaptive coordination mechanism engaging all kinds of distributed resources to provide grid services. These distributed resources include flexible loads in buildings, energy storage, electric vehicles, and smart photovoltaic solar inverters. Two groundbreaking demonstration projects of transactive coordination have been conducted in the last six years, including the Pacific Northwest Smart Grid Demonstration Project (PNW-SGDP) and American Electric Power's gridSMART demonstration project.

The next steps in the development of transactive systems are to:

- Develop and validate new control and economic approaches to transactive concepts: At the national level, DOE's Office of Electricity (DOE-OE) has launched a Transactive Systems Program that is delivering control and economic theory, a simulation testbed for testing transactive designs, and a standard basis for evaluating the performance of such designs in providing these values. This program promises to develop the foundation this technology requires for eventual commercialization.

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

- Validate transactive concepts at scale with commercial and government campuses. DOE-OE has engaged in a partnership with the DOE Building Technologies Office to develop the critical “behind-the-meter” aspects of this technology, including energy efficiency benefits, and to bring it to campuses and large commercial buildings as a near-term opportunity to demonstrate it at scale in a way that is immediately cost effective.
- Ensure access to new analytic tools and results from the Grid Modernization Laboratory Consortium (GMLC) to support regional policy efforts linked to distributed energy resources and demand response in the Pacific Northwest: At the regional level, there is a new policy initiative by the Northwest Power and Conservation Council to apply flexible building loads to displace a looming need for more generation capacity. There is a strong need to provide the Council with the tools and analytic capabilities to value this new resource. There is significant synergy between this Pacific Northwest work and the DOE efforts in platforms and tools to advance such regional initiatives.
- Further, the region could explore options for a regional value signal for these flexible loads, energy storage, and distributed generation to deliver flexibility to local and regional power systems. A means for doing so was pioneered by the PNW-SGDP, and the region can consider something analogous to it. One example is the emergence of an Energy Imbalance Market option being explored in the western system. The GMLC program is delivering tools such as grid modernization metrics (e.g., flexibility), tools for valuation of responsive resources, and grid services concepts that can be used in this effort.

Questions from Senator Debbie Stabenow

Questions: In the last week, Michigan has experienced the largest power outage in its history, with an estimated 900,000 customers losing power. Scientists project that the intensity and frequency of damaging storms will increase in the coming century. What investments are needed to make our electric systems more resilient to storms of increasing frequency and magnitude? Can you also talk about the different energy infrastructure needs facing rural areas versus larger population centers?

Answer: There are many investment options to increase the robustness and resilience of the electric power system to weather extremes. Dramatic improvements in reduced frequency and duration of weather outages for distribution customers have been demonstrated in recent smart grid demonstrations of distribution automation concepts. As I discussed in my testimony, Avista Corporation in Washington state has demonstrated impressive improved reliability, as has the Electric Power Board in Chattanooga, Tennessee. A second target would be use of the emerging DOE tools that link earth systems models to grid planning tools to enable grid planners to better reflect emerging weather extremes (storm, drought, etc.) in their planning for new, resilient infrastructure. A third option is to consider new concepts of microgrids that are designed for operation under extreme weather to provide critical electricity supply to food, water, fuel, and

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Carl Imhoff**

emergency response resources during major weather events. DOE efforts in Alaska, New Orleans, Hawaii, and the Southeast will offer new insights in this area.

Rural areas do have unique challenges. First, the customer density is lower, often making the financial aspects of infrastructure modernization more difficult to justify. Many rural customers are served by small and mid-sized public utilities that have less technical capacity to design and operate new grid infrastructure. DOE has strong relationships with the American Public Power Association and the National Rural Electric Cooperative Association, who represent these rural public utilities and can be a resource to accelerate the transfer of new planning tools, microgrid concepts, and distribution automation lessons learned to benefit rural utility customers.

Question from Senator Catherine Cortez Masto

Question: In Nevada, there is support for a shift to a de-regulated electricity market. I believe an open market will allow for more renewable energy proliferation and innovation, which in turn will need a more advanced smart grid and storage capacity. What are the best ways for the federal government to modernize the grid?

Answer: Grid modernization is implemented by the consumer and investor-owned utilities and states. DOE's Grid Modernization Initiative (GMI) is delivering new knowledge (e.g., fundamental control theory and high-performance computational science), new tools, and data that are intended to support utilities and states in developing their grid modernization policies and delivering on their investments.

Example resources in the GMI include:

- Foundational projects delivering new grid modernization metrics and valuation tools to assess policy objectives and progress.
- New control theory and software concepts for the tools operators to operate a more complex grid with millions of consumer digital devices at the grid edge.
- New planning tools that reflect the complexity of the modern grid with variable generation, enabling states and utilities to plan with higher precision.
- New standards for interoperability and grid services so that vendors can more effectively deliver new products that meet the reliability and resilience needs of utilities.
- New tools to ensure cyber resilience of the increasingly digital grid of the future.

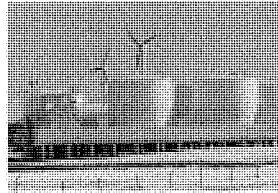
Continued commitment to these innovations, combined with public/private partnership to accelerate national progress on best practices for the modern grid, will provide important support to the efforts by utilities and regulators.



Alaska Microgrid Partnership

CHALLENGE

Alaska—perhaps more than any other region in the country—faces unprecedented challenges in modernizing its rural energy infrastructure. Across the state there are approximately 200 isolated microgrid systems that are not connected to larger grids, with most of these systems relying almost exclusively on imported fuel (primarily diesel) to meet electrical, space/water heating, and transportation requirements.



Two of three wind turbines can be seen over the bulk fuel tanks of the Kasigluk Power Station, a vision of what could be possible in the future.

These communities have populations ranging from 50 to 6,000 people, are comprised primarily of native Alaskans, and have some of the highest energy costs in the nation (up to ~10 times the national average). Rural Alaska likely has the lowest reliability and least resilient power systems in the country. Despite extensive renewable energy resources, advanced diesel and load control technologies commercially available, and great opportunities to improve building and electrical infrastructure efficiency, few projects are being implemented and most of those are largely grant funded.

APPROACH

This project involves creating a lead-by-example development pathway for islanded microgrids, testing the pathway using two pilot projects, and making the pathway data and other useful information available for other communities to follow. Key project activities include:

- Developing a consistent assessment pathway to reduce total imported energy usage in a holistic way, working to address electrical, heating, and transportation energy needs
- Pulling together largely existing analytical tools to coordinate technical and financial methods that support full development assessments, allowing expanded public and private sector engagement
- Implementing the pathway with two pilot communities, providing a workable example for other, non-pilot communities
- Developing new data sources and sharing information with project developers—via the Alaska Energy Data Gateway—that details the human, financial, and technical capacity of communities across Alaska to undertake new energy infrastructure projects.

At-A-Glance

PROJECT LEADS

- Ian Fleming, Director
University of Alaska Fairbanks Energy Laboratory
- Dr. David Greenblatt, Director
Energy Laboratory
- Peter Lammert
University of Alaska Fairbanks Energy Laboratory
- Elizabeth Smith
University of Alaska Fairbanks Energy Laboratory

PARTNERS

- Alaska Energy Data Gateway
- University of Alaska Fairbanks Energy Laboratory
- University of Alaska Fairbanks Energy Laboratory
- University of Alaska Fairbanks Energy Laboratory
- University of Alaska Fairbanks Energy Laboratory

BUDGET

\$1.5 million

DURATION

March 2016 – September 2017

TECHNICAL AREA

- Design and Planning
- Load and Energy
- Technical Assessment/Modeling
- Policy/Regulatory

The over-arching goal of the Alaska Microgrid Partnership is to significantly reduce the use of imported energy sources in Alaska's remote microgrids without increasing system lifecycle costs, while improving overall system reliability, security, and resilience. Expected outcomes from this project include:

- Creating an implementation methodology for other communities to follow by documenting and publicizing the community assessment, data collection, project analysis and development process
- Implementing the methodology in two pilot communities to act as models to position the communities to seek private and public funding to implement project recommendations.

The potential worldwide market and impact are huge: 400 diesel microgrids in Canada, 70 in Greenland, and more than 1,000 in Indonesia. The International Energy Agency estimates that more than 700 million people currently without electricity access could be most cost-effectively served by mini-grids or microgrids.

BERKELEY LAB
A Division of the U.S. Department of Energy



Abstract: November 2014 issue of the *U.S. Department of Energy's* *Site Remediation Bulletin*. The bulletin is a clearinghouse of information between DOE headquarters and the regional offices, designed to foster better working relationships, information on regional and management goals. The bulletin was also focused on six technical areas priority to management efforts.

Keywords: *workplace spirituality, organizational commitment, organizational citizenship behaviors, organizational trust, organizational identification, organizational justice, organizational citizenship behaviors, organizational trust, organizational identification, organizational justice, organizational citizenship behaviors, organizational trust, organizational identification, organizational justice*

**U.S. Senate Committee on Energy and Natural Resources
March 14, 2017 Hearing: Opportunities to Improve American Energy Infrastructure
Questions for the Record Submitted to Mr. Terry O'Sullivan**

Question from Chairman Lisa Murkowski

Question: Please detail the types of jobs that responsible development in the 1002 area of ANWR or the Outer Continental Shelf would create? What sort of salary range and benefits would these sorts of jobs provide?

Answer: While LIUNA represents workers throughout the state in the oil industry from the North Slope to the Valdez Terminal (the terminal of the Trans Alaska Pipeline), the most recognizable work our members perform is the construction and maintenance of the pipeline infrastructure that moves energy resources from extraction into the market place. Laborers proudly helped build the Trans-Alaska Pipeline and we hope that responsible development of Alaska's energy reserves can provide jobs and economic opportunity throughout the State. The energy industry in Alaska, like in much of the country, helps support other work that LIUNA members perform, including associated infrastructure upgrades and environmental adaptation.

While salary ranges differ depending on the type of work, a construction Laborer in Alaska who is helping to build a pipeline can expect to make an hourly wage of \$25 to \$35 an hour plus benefits including health insurance, a defined benefit pension plan, and access to world class training. However, it is important to note that many of these work opportunities fluctuate with the season and are dependent on the permitting of the project.

Questions from Senator Ron Wyden

Question 1: Mr. O'Sullivan, thank you for your testimony and for appearing before the Committee. You may have seen that the Democratic infrastructure blueprint includes \$100 billion for energy infrastructure upgrades. Would you agree that any federal infrastructure package should include resources for investing in energy infrastructure? Furthermore, do you think that such a package should include investments in the infrastructure of our nation's electricity system?

Answer: Absolutely. LIUNA supports a broad \$1 trillion infrastructure package that invests in the nation's physical infrastructure, including transportation, water, and energy infrastructure. However, it is important to note that many energy infrastructure projects do not suffer from lack of funding, largely because much of the industry has the financial resources to make private investments into needed projects. Instead, they need permitting and regulatory stability that help bring these important projects online.

Question 2: Mr. O'Sullivan, I appreciated the mention in your testimony of renewable energy as an important part of our domestic energy resource mix. The number of people employed by the U.S. wind and solar industries currently comes to around 400,000, according to the American Wind Energy Association and Solar Energy Industries Association. And, the Environmental

Defense Fund says that solar and wind are creating jobs at a rate that is 12 times faster than that of the rest of the U.S. economy. Do you think the United States should continue investing in clean energy infrastructure projects that create jobs like these?

Answer: LIUNA is an “all-of-the-above” energy union and we support continued investment in clean energy infrastructure. However, we sometimes find resistance from the developers of these projects to using the highly trained, highly skilled workers that we represent. If the Federal Government is going to make public investments into projects that benefit for-profit enterprises, Congress should insist that these projects return value to their communities by providing compensation packages that are in line with the standards of living in the communities where they are located.

Questions from Senator Joe Manchin III

Questions: As you know, my home state of West Virginia is suffering from persistently high unemployment rates – higher than the national average. In our southern counties – traditionally our largest coal-producing region – we are consistently posting unemployment numbers in the double digits and, from July 2014 through July 2015 alone, the state lost over 19,000 jobs. As you all know, West Virginia is an energy exporter. West Virginia’s workers have kept the lights on in this country for decades. So, I believe it is important that our policies ensure these energy workers have access to job opportunities in the natural gas sector. And when I say “job opportunities”, I mean high-paying quality opportunities that offer West Virginians a means of obtaining the skills and knowledge required to cultivate a viable long-term career path.

Please elaborate for me on how your organization engages local workforces when a pipeline project is announced. Specifically, how do you leverage these opportunities for veterans and out-of-work miners?

Answer: LIUNA and our signatory contractors have developed a national network of training centers that provide world class training and skills development programs for workers who wish to join our union and enter into a career in the construction industry.

The West Virginia Laborers’ Training Trust Fund in Mineral Wells, West Virginia, is a nonprofit, jointly administered, labor/management trust fund. The Training Center is equipped with an administration/classroom building, dormitory with dining facilities, a one acre mock hazardous waste site and an 8,750 sq. foot training bay allowing continued year round classroom instruction and hands-on training.

In order to seek eligible workers from within local communities for the proposed Atlantic Coast Pipeline, applications have been made available at all Workforce West Virginia Centers, and the West Virginia Laborers’ Training Fund has conducted a series of outreach events and jobs fairs. The Training Fund works with local groups and organizations in order to help veterans, women and dislocated/disadvantaged individuals such as miners, enter into the workforce as a union construction laborer. Additionally, participants who complete the training program are eligible

to receive college credits towards an Associate's Degree in Applied Science in Occupational Development.

Question from Senator Luther Strange

Question: With many pipeline manufacturers having substantial available production capacity, regulations affecting new infrastructure projects have hurt our workforce. From your perspective, what can Congress do to eliminate the barriers affecting new infrastructure projects and job creation within the energy sector?

Answer: Creating certainty in the permitting process would go a long way to eliminating unnecessary and unreasonable delays that keep important infrastructure project from being built.

LIUNA believes that the responsible regulations and permitting can lead to better projects which protect workers, communities and the environment. Unfortunately, opponents of infrastructure projects have used the process to slow down or kill projects that they don't like. LIUNA supports regulatory reform that streamlines the review processes, allows review by separate agencies and entities to proceed concurrently, and provides for more definitive permitting processes that enable projects to move forward without delay once all regulatory concerns have been addressed.

Additionally, assuring that the permitting offices have the personnel resources to consider permit applications in a timely manner is essential. That is why LIUNA has called for the filling of vacant spots on the Federal Energy Regulatory Commission (FERC), so that the Commission has the quorum necessary to complete regulatory reviews and approvals.

Also, Congress should explore ways to overturn some of the last minute actions by the Obama Administration to wall-off resources from exploration and development.

Testimony of
The American Gas Association
Submitted to the

Senate Energy and Natural Resources Committee
In response to the

Hearing to Receive Testimony on Opportunities to Improve American Energy Infrastructure

Which took place on March 14, 2017

Chairman Murkowski and Ranking Member Cantwell, the American Gas Association (AGA) thanks you for the opportunity to submit written testimony on the critically important issue of enhancing our nation's energy infrastructure. We commend you and your colleagues on the Committee for focusing attention on this matter and for seeking valuable input from stakeholders on how to improve the efficiency, resiliency and safety of our nation's energy infrastructure.

Founded in 1918, AGA represents more than 200 state regulated or municipal natural gas distribution companies. Today, more than 177 million people in the United States rely on the safe, affordable and clean natural gas delivered to their home or business as a basic life necessity.

As you are aware, technology breakthroughs in the production of oil and natural gas have revolutionized our domestic energy outlook. In a brief time span, we have transitioned from predictions of an era of energy scarcity to an indisputable era of energy abundance. Thanks to these revolutionary technological advances, energy resources that were previously uneconomic to produce, are now being produced at costs competitive with conventional production.

Today, the U.S. estimated natural gas reserves and total resource base exceed 2,800 trillion cubic feet, according to estimates from the Colorado School of Mines. In practical terms, this is enough natural gas supply to meet America's energy needs for at least the next century. This robust natural gas supply ensures a long-term, stable pricing outlook that is already having a profound impact on the U.S. economy. Expanded use of natural gas is spurring economic development and job creation in regions throughout the country. Domestic, low cost natural gas is delivering lower energy bills for consumers, enabling the deployment of new technologies in the residential, commercial, and transportation sectors, providing the necessary back-up for intermittent renewables, and producing substantial environmental and health benefits for society.

We believe even more can, and should, be done. In some areas of the country, the lack of pipeline infrastructure denies homeowners and businesses the option of using natural gas, leaving them

dependent on higher priced and often less reliable forms of energy. In other parts of the country, supply constraints and growing demand have elevated natural gas prices. Additional pipeline infrastructure could alleviate the upward price pressure.

It is unfortunate that in recent years over-politicized opposition to interstate energy infrastructure projects has delayed, and in some instances prevented, a preferred energy resource from serving areas in need. Large-scale natural gas infrastructure projects play a critical role in realizing the full economic value of our domestic energy resources. Expanding natural gas pipeline infrastructure facilitates the ability to safely expedite natural gas shipments from areas of burgeoning supply to areas of rising demand.

Federal agencies should modernize and streamline permitting processes so that natural gas infrastructure can be expanded to meet the needs of all citizens, as well as to enhance reliability and help meet our nation's energy security goals. Natural gas infrastructure companies face serious challenges in managing multiple overlapping, inconsistent, and often duplicative federal, state and local permitting processes. All too often, an inefficient permitting process delays considerably, or worse, halts needed projects.

We urge the Committee, in its oversight capacity, to consider the following recommendations for Administrative action:

- Withdraw CEQ Final Guidance on Consideration of GHG Emissions and Effects of Climate Change in National Environmental Policy Act Reviews.
- Revise Waters of the United States Rule.
- Streamline the FERC review process to ensure a timely review and decision on infrastructure certificate applications.
- Increase the number of staff in regional offices of the Army Corps of Engineers and the U.S. Fish and Wildlife Service to ensure the timely processing of permits for natural gas and other energy infrastructure projects.

In its legislative capacity, we encourage the Committee to consider legislation that would deem as approved any related state or local agency authorization associated with a project that has received a FERC certificate approval, unless the state or local agency acts to approve or deny their authorization within a specified period of time.

While we recognize that discussions regarding “natural gas infrastructure” are largely focused on interstate transmission pipelines that transport natural gas from areas of production to markets

throughout the country, we encourage the Committee to consider the critical role of the distribution network and the interconnectedness of the entire pipeline system overall.

Although gas distribution companies are not responsible for the construction of large transmission pipeline projects, natural gas utility companies are often the distribution partner for the natural gas flowing through those pipelines – serving your constituents who use natural gas in their homes, businesses or industrial facilities. In fact, natural gas utilities often serve as “anchor customers” that contractually agree to purchase natural gas from new and expanded interstate pipeline infrastructure, thus playing a significant role in making those projects meritorious from both a consumer-benefits standpoint, as well as from an economic viability standpoint.

Natural gas utilities play a vital role in local economic development efforts, since natural gas service is often a prerequisite to attracting manufacturing and commercial investments. These enterprises contribute to local economies regarding jobs and tax revenues. By connecting large “anchor” customers such as industrial parks or manufacturing facilities, the utility helps to optimize the natural gas distribution system by spreading costs across a broader customer base, which in turn lowers the cost of natural gas service for all customers. Pipelines make all of this happen.

Natural gas local distribution companies own and operate a significant majority of the nation’s natural gas pipeline infrastructure and are an integral part of the energy infrastructure equation. In total, they own and operate 2.2 million miles of pipelines, safely and reliably delivering clean natural gas to residential, commercial and industrial customers or “end users” throughout the country. Customers see their utility’s name on their bills, our trucks in the streets and our company sponsorship of many civic initiatives. Utility employees live in the communities they serve and interact daily with their customers and with the state regulators who oversee pipeline safety.

The highest priority of every natural gas utility is delivering natural gas to their customers safely, reliably, responsibly and affordably. Natural gas utilities are committed to continually upgrading infrastructure based on risk-based integrity management programs. That is why we are committed to proactively collaborating with Congress, federal and state regulators, public officials, emergency responders, excavators, consumers, safety advocates and the public to continue improving the industry’s longstanding record of providing natural gas service safely, reliably and efficiently to the 177 million Americans we serve.

A comprehensive and growing effort is underway to accelerate the replacement of distribution pipelines that may no longer be fit for service. And although this work is being facilitated by specific state regulatory and state legislative policies that establish innovative rate structures and allow for accelerated replacement and modernization of natural gas pipelines, it is important to note because Congress has legislative authority over pipeline safety. These replacement programs are intended to enhance service for your constituents.

In 2011, 18 states had a specific rate mechanism facilitating accelerated replacement of pipelines, and today 40 states and the District of Columbia now have such mechanisms and programs in place. And of the states without a specific accelerated replacement rate mechanism, Alaska, Arkansas, Idaho, North Dakota, Vermont, and Wisconsin have all finished replacing their cast iron and bare steel distribution pipelines with modern, superior performing plastics. In fact, as of today, overall cast iron makes up less than two percent of the total distribution pipeline mileage -- and that number is continuing to decline. This replacement work has been heralded by Congress, federal and state regulators and citizens around the country. But just as importantly, it has led to a broader discussion about "smart modernization" of distribution infrastructure -- which centers on not only replacement but also "expansion" of pipelines, to extend service to underserved and unserved areas.

The Residential Sector

Today, local distribution companies deliver natural gas to 177 million Americans who use the fuel to heat their homes, warm their water and cook their food. But many more Americans want natural gas and the comfort and savings it brings. Affordable prices are encouraging more homes and businesses to switch to gas, but the country needs to invest in new pipeline capacity to make sure that the gas can get to customers -- especially when they need it most.

Households that use natural gas for heating, cooking and clothes drying save an average of \$874 per year compared to homes using electricity for those applications, and savings from low domestic natural gas prices have led to almost \$50 billion total in savings for consumers nationwide.

The Commercial Sector

Commercial businesses are also taking advantage of low natural gas prices. The average real retail price commercial customers paid for natural gas in 2016 dropped to its lowest level since 1975. Last year, commercial customers' utility bills averaged just \$405 per month, the lowest since AGA began collecting data in 2003. In sum, low natural gas prices have generated \$76 billion in savings for American businesses since the shale gas revolution began in 2009. Since these small and medium sized businesses are the core of the U.S. economy and fundamental to our daily lives, sustained lower energy prices help generate job growth, benefiting families and supporting American prosperity.

Today, there are more than 5.4 million commercial sector customers in the United States. These include buildings such as schools, hospitals, police and fire stations, offices, restaurants, grocery stores, retail outlets and public halls. Most of these facilities use natural gas for space and water heating. Commercial buildings account for nearly one-fifth of all energy use in the United States, and natural gas serves 18 percent of that energy use. Given that commercial square footage

is projected to grow, it represents a tremendous growth opportunity for natural gas fuel to serve the sector. Meeting this need however, will require the necessary pipeline infrastructure to transport increased volumes of natural gas fuel.

The Power and Industrial Sectors

Natural gas demand is growing rapidly in other sectors as well. Volumes for gas-fired power generation have surged in recent years, driving down emissions and electricity costs for consumers.

The industrial sector is also realizing the benefits of clean and affordable natural gas, which can be used as both a fuel and a feedstock. Natural gas use in the industrial sector is accelerating as companies are moving back to the US and expanding operations to take advantage of low-cost natural gas. Billions of dollars are now being spent to revive mothballed industrial facilities, on-shore facilities from overseas, and open new capacity.

Many local gas companies are examining the application of Combined Heat and Power technologies to help their largescale users capitalize on very competitive natural gas fuel costs. By generating heat and electricity onsite using natural gas fuel, these industrial customers can significantly improve environmental benefits, lower energy costs and reduce their carbon footprint.

In closing, we urge the committee to recognize that encouraging these positive trends to continue will require more pipelines to be approved and constructed (both large transmission and local distribution infrastructure). As an energy rich nation, it is incumbent upon us to maximize access and availability of our energy resources through distribution systems that encourage domestic growth and economic vitality. The natural gas pipeline system represents just one component of the country's energy infrastructure. Our members, the natural gas distribution companies, play an integral role in this vast and complex pipeline system. We are committed to facilitating the expansion of our nation's energy infrastructure, particularly natural gas pipelines, to afford all Americans access to reliable, affordable energy.

Again, we commend the Committee for holding this hearing and studying important energy infrastructure issues. We stand ready to assist with the discussion and to help identify comprehensive solutions. We thank the committee for providing us the opportunity to submit testimony.

**Statement for the Record by the
AMERICAN PUBLIC POWER ASSOCIATION (APPA)**

**Submitted to the
SENATE ENERGY AND NATURAL RESOURCES COMMITTEE**

For the March 14, 2017, Hearing on

OPPORTUNITIES TO IMPROVE AMERICAN ENERGY INFRASTRUCTURE

The American Public Power Association (APPA) appreciates the opportunity to submit a statement for the record for the Senate Energy & Natural Resources Committee hearing on “Opportunities to Improve American Energy Infrastructure.” APPA supports and agrees with the testimony of Mr. Jeff Leahy of the National Hydropower Association.

The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. We represent public power before the federal government to protect the interests of the more than 49 million people that public power utilities serve, and the 93,000 people they employ. Our association advocates and advises on electricity policy, technology, trends, training, and operations. Our members strengthen their communities by providing superior service, engaging citizens and instilling pride in community-owned power.

This statement will focus on three categories of energy infrastructure that are ripe for regulatory reform and improvement: hydropower, natural gas pipeline permitting, and vegetation management.

Hydropower

Public power utilities have led in hydropower development in recent years. Today, one hundred public power utilities have Federal Energy Regulatory Commission (FERC or Commission)-licensed hydropower facilities. Making full use of the nation’s hydropower resource is key to ensuring that the nation’s grid remains reliable and resilient, and that utilities can meet emission reduction goals. Hydropower is a source of emissions-free, base-load power, which unlike variable renewable resources, is available 24/7. Moreover, hydropower’s “black start” capability makes it highly valuable through the lens of concerns about cyber and physical security; in instances of outages or disruptions to the grid, hydropower units can cycle back on quickly and become a backbone of full power restoration.

There is a significant potential for new hydropower to be generated at non-powered dams throughout the country, as well as for hydropower output to be dramatically increased in existing hydropower facilities and at water distribution conduits/canals. But there are excessive barriers to tapping this potential.

FERC is the primary federal agency responsible for the licensing and relicensing of such non-federal hydroelectric projects, but given the involvement of multiple resource agencies, the licensing process can be lengthy, difficult, costly, and uncertain for applicants. Under the Federal Power Act (“FPA”), FERC must establish requirements in conjunction with the license (“conditions”) that give “equal consideration” to not only power needs, but also Endangered Species Act requirements, water quality issues, marine navigation, and other public interest concerns. FERC must carefully evaluate many aspects of a hydropower project, but at the same time, state and federal agencies can impose “mandatory conditions” that FERC cannot balance or modify in the public interest. While it is appropriate to consider a broad array of factors, this process must be streamlined and reformed. Critical new additions to existing

hydropower facilities are languishing under bureaucratic and often contradictory processes that can span a decade or more or which simply become too costly. FERC must be given more clear-cut authority to establish deadlines and fulfill its role under the FPA. APPA also supports the concept of establishing a more manageable mandatory conditioning process, such as requiring resource agencies to more clearly define the objective of each mandatory condition and demonstrating they have appropriately balanced associated “power and non-power” values.

Natural Gas Pipeline Permitting

The low cost of natural gas due to increased production, along with environmental regulations, have driven utilities to retire coal-fired power plants and replace them with natural gas in recent years. Electric utilities are spending hundreds of millions of dollars to convert existing coal-fired facilities, where possible, to natural gas or to construct new natural gas plants. They are also using natural gas generation to back up variable wind and solar power. As such, there is a critical need to build new interstate natural gas pipelines and to improve upon existing infrastructure across the country to ensure this greater use of natural gas can be accommodated.

FERC is the federal agency tasked with approving routes for proposed natural gas interstate pipelines. The Commission works with a variety of federal, state, and local agencies in the development of environmental reviews of these projects under the National Environmental Policy Act (NEPA). Unfortunately, the Commission lacks the ability to ensure that other federal agencies abide by deadlines related to natural gas pipeline applications. APPA supports legislation to reinforce FERC’s role as the lead agency for siting interstate pipelines and provide it with the authority to set and enforce natural gas pipeline permitting deadlines. The requirements for all agencies to conduct concurrent reviews and identify issues of concern that could delay compliance with FERC timelines will help expedite the review and approval processes, speeding up the construction of much needed new, interstate natural gas pipelines. In addition, the requirement for FERC to post information on its website on the status of applications requiring multiple federal authorizations will provide much-needed transparency to stakeholders, public power utilities include.

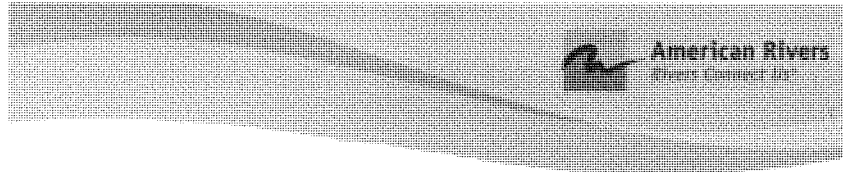
Vegetation Management

The proper management of vegetation near electric infrastructure located on federal lands is important to ensure electric reliability and prevent wildfires. Vegetation that has made contact with electric infrastructure could result in power outages and forest fires. These serious and sometimes devastating outcomes can be prevented with proper management of vegetation. Properly maintained rights-of-way (ROWs) not only prevent vegetation from encroaching on power lines on federal lands, they also increase operational efficiency, public safety and environmental benefits. Ultimately, the costs of operating, maintaining, and repairing these lines and facilities on federal lands are borne by utilities and their customers.

Legislation to enable proper vegetation management was approved by the House Natural Resources Committee and included in comprehensive energy legislation approved by the House of Representatives in December 2015. The Association supported these efforts by Congress to facilitate vegetation management on federal lands, including hazardous and high-risk vegetation located outside of ROWs, and would appreciate Congress supporting these efforts again in the 115th Congress.

Conclusion

We are pleased that the Committee is taking a fresh look at opportunities to improve energy infrastructure and look forward to working with you to develop and refine legislation. Thank you for the opportunity to comment.



Hearing before the U.S. House of Representatives, Committee on Energy and Commerce,
Subcommittee on Energy: *Modernizing Energy Infrastructure: Challenges and Opportunities to
Expanding Hydropower Generation*

Testimony of American Rivers

March 15, 2017

Thank you for the opportunity to submit testimony regarding hydropower generation and operation in the United States. American Rivers is one of the leading national conservation organizations involved in hydropower. Our staff has been involved in hundreds of licensings since our founding, and we have seen the best and worst that the federal licensing process has to offer. Since 1973, American Rivers has protected and restored more than 150,000 miles of rivers through advocacy efforts, on-the-ground projects, and an annual America's Most Endangered Rivers ® campaign. Headquartered in Washington, DC, American Rivers has offices across the country and more than 250,000 members, supporters, and volunteers.

Before delving into a discussion on how hydropower works in America today, we would like to identify for you five things that could improve the highly collaborative licensing process laid out in the Federal Power Act and attendant statutes:

- The Federal Energy Regulatory Commission (FERC) should presumptively grant study requests submitted by federal, state, and tribal agencies;
- FERC should promote the adoption of memoranda of understanding (MOUs) between the Commission, tribes, and states to improve coordination and prevent unnecessary delay;
- Congress should increase appropriations to the federal resource management agencies to fund the staff positions that allow them to efficiently and thoroughly evaluate applications for hydroelectric licenses; and
- Congress should extend its recognition of the right of Native American tribes and Alaska Native Corporations and Villages to manage water quality standards on tribal lands to include their rights to manage land use and fish and wildlife populations as well.
- Congress should consider whether FERC should relinquish jurisdiction over permitting projects on non-powered dams owned by the U.S. Army Corps of Engineers (Corps).

American Rivers is heartened that the Committee is examining the challenges and opportunities of hydropower in the United States. In the twelve years since the Energy Policy Act of 2005 was passed, there have been no hearings on how that act altered the licensing process. This includes the most recent Congress, when several changes to the Federal Power Act and the licensing

process were voted upon without the benefit of an oversight hearing into the current process, and without the benefit of informed stakeholders (industry, states, tribes, NGOs, and federal agencies) discussing what in their respective opinions works an

d what needs improvement. We are grateful that the Committee is taking the time to conduct an oversight hearing, although we are disappointed that no states, tribes, or federal agency witnesses were invited to testify, and we hope that the Committee will avail itself of their expertise before drafting legislation. Ideally, any legislation would be drafted pursuant to a stakeholder process that takes into account the perspectives, needs, and rights and responsibilities of all relevant parties to a hydropower license proceeding.

Hydropower provides approximately 7 percent of the overall energy production in the country, and comprises 50 percent of all non-fossil fuel energy consumed in the U.S. Over the course of what we expect will be a thorough and informed evaluation of how hydropower functions in the United States, we are confident that the Committee will arrive at the same conclusion that the U.S. Department of Energy did in the Hydropower Vision Report released last year: building new dams will cost more in both investment dollars and negative impacts to clean water, wildlife, and rural economies than it is worth. Efforts to expand hydropower production should instead focus on promoting efficiency, retrofitting suitable non-powered dams, and upgrading century-old technology present in far too many currently operating hydroelectric projects.

The licensing of hydroelectric dams is overseen by the Federal Energy Regulatory Commission (FERC), with the critical involvement of the federal Departments of Agriculture, Commerce, and the Interior, as well as state and tribal water quality agencies. FERC may grant a license for a term of 30 to 50 years, with the average life of a license being 45 years. For perspective, a dam coming up for relicensing in 2017 could have been last licensed during the Summer of Love in the administration of President Lyndon B. Johnson. That would be before the Apollo 11 moon landing, before Watergate, before Chernobyl, and before the fall of the Soviet Union. There is no member of this 100-seat chamber who served in Congress at that time. No current Senator could have voted on the National Environmental Policy Act of 1969 (NEPA), or the Federal Water Pollution Control Act Amendments of 1972 (the Clean Water Act or CWA), and only five could have voted on the Energy Consumers' Protection Act of 1986 (ECPA). None of the dams licensed in 1967 considered any of those federal laws—because they did not yet exist. The depth of scientific knowledge gained in the past 50 years cannot be addressed in this testimony, but must be considered by this Committee prior to altering hydroelectric licensing.

The Federal Power Act (FPA), passed by Congress and signed by President Woodrow Wilson in 1920, delineates the responsibilities for licensing at the federal level. FERC is responsible for regulating the wholesale energy market, including by granting licenses to individuals seeking to place a hydroelectric dam in a navigable waterway. FERC's expertise was and has remained in energy markets and the safety of non-nuclear energy facilities. FERC is not, and has never been, responsible for maintaining fish, wildlife, or federal lands.

Since the passage of the FPA, the Secretaries of Commerce (through the National Marine Fisheries Service) and the Interior (through the U.S Fish and Wildlife Service) have been responsible for fish and wildlife and the Secretaries of Agriculture (through the U.S. Forest Service) and the Interior (through the Bureau of Indian Affairs, the Bureau of Land Management, the U.S. Fish and Wildlife Service, and the National Park Service) have been responsible for managing lands held by the federal government (“federal reservations”). The expertise and experience these public servants, and their staffs, have accrued in the almost-100 years since the enactment of the Federal Power Act cannot be matched at FERC, and FERC has acknowledged before this Subcommittee that it does not seek to absorb their responsibilities.

The Federal Water Pollution Control Act Amendments of 1972, commonly known as the Clean Water Act (CWA), made an essential update to the hydroelectric licensing process by recognizing the right of states and tribes to regulate water quality within their boundaries. While the FPA itself only dictated evaluation of impacts to federal reservations and the ability of fish species to move through the river system, §401 of the CWA empowers states and tribes to preserve healthy waters and requires dam owners to assist in the repair of diminished water quality in systems impacted by projects. FERC also lacks the staff resources and expertise to enforce water quality standards, or to administer state water rights, which have been confirmed as a matter of state law with the passage of the McCarran Amendment of 1952.

Provided all participants in a licensing are upfront and committed to work together, the hydroelectric licensing process provides a range of stakeholders the opportunity to shape the shared use of our nation’s rivers. The rivers do not belong to environmentalists or to electricity producers; they belong to all Americans, and they must be maintained to promote multiple uses. American Rivers supports the collaborative process currently in place, as well as the hard work done by all parties to produce electricity that does not destroy critical environment or clean water for humans and wildlife. It is true, however, that improvements could be made to the process. We highlight five of those improvements here.

Study Requests

It is essential that the impact of a given hydropower project be thoroughly examined for its impacts to water quality, federal reservations, and the health of the ecosystem. Because a hydroelectric license may be evaluated only once during a human lifetime, many licenses in effect today have only been updated once in the past fifty years. Moreover, many dams in operation today not only precede the bedrock environmental and health statutes previously mentioned; they were constructed between the Harding and Franklin Roosevelt Administrations. Although impacts to the river were considered in the decades when these projects were built, the federal government was more concerned with impressive structures than environmental interconnectedness. The devastation of the Atlantic salmon population due to damming New England rivers from 1620 on unfortunately did not inform consideration on how Pacific salmon and steelhead would fare once the rivers of the West were dammed. The impact to federal

reservations too often focused on where the project was sited, and not how the project's construction and operation impacted the reservation.

As a result of insufficient care and maintenance in the middle part of the 20th Century, many licensees submitted applications to FERC that were not thoroughly vetted for their impacts to fish, wildlife, and federal lands. Failure to recognize the prolonged harm possible to the environment, rural communities, and the federal estate only began to be corrected in the 1970's and 1980's. While there had long been cries from tribal communities, conservationists, and rural advocates, it took a long time—too long in many cases—for the federal resource management agencies to fulfill the responsibilities Congress charged them with in 1920.

In order to evaluate the impact a project has had within their respective jurisdictions, FERC, the Secretaries of Agriculture, Commerce, and the Interior, as well as water quality agencies of the states and tribes where the project is sited, submit requests for information (studies). The standard length of a study is only two years, although if the licensee presents insufficient information, the studies may go on longer. Under the traditional licensing process (TLP), the study requests from the states, tribes, and federal agencies are only rendered to the applicant once FERC has evaluated its portion of the application. It is then that the application is referred from FERC to the agencies and they submit their study requests to the applicant.

The sequential nature of these study requests has proven frustrating to both applicants and to the resource agencies. Applicants sometimes accuse the agencies of springing unexpected requests for information on them, and argue that since FERC didn't request the information, it should not be relevant in considering the license. Recall, however, that FERC's mission is one of energy, and not one of environment. FERC often does not request information on the impact to fish, wildlife, federal reservations, and water quality because Congress specifically vested the responsibility to manage those resources in the federal and state and tribal agencies, respectively. FERC, understandably but not productively, has on occasion refused to exercise its statutory authority when the U.S. Code provides the state, tribal, and federal agencies their own authority to obtain information. The result is more backlog and more bureaucracy. It was these issues related to the implementation of the TLP that led Congress to enact the ILP as part of the Energy Policy Act of 2005 which we discuss in more detail, below.

Because FERC's mandate is one of energy and not one of environment, and because the role that the resource agencies play in the licensing process must not be removed or otherwise exercised, American Rivers believes the most efficient way to obtain the information the agencies require is to have FERC presumptively include their study requests at the front-end of the review process. By FERC passing along the requests for information from the cabinet Secretaries, states, and tribes as soon as possible, it will eliminate the aspects of surprise and uncertainty that bedevil the process now. This change would not necessarily require action by Congress or the resource agencies; it could be enacted by FERC directly, although Congressional directive would clear up

any confusion about the matter. American Rivers notes that this type of action is anticipated by the Integrated Licensing Process (ILP), discussed below.

Memoranda of Understanding

Congress understood when it passed the FPA that collaboration is essential and so that law wisely charges the relevant federal entities with responsibilities matched to their expertise. The hydroelectric licensing process is one where the interplay between environmental stewardship, water quality and state water law, trust and treaty obligations, and preserving the use of public lands and waters is essential. While it is unfortunate that many projects were not evaluated appropriately in the past, or that there are often challenges in improving projects so they conform to the bedrock environmental statutes enacted almost half a century ago, it is imperative that the licensing process not simply be collaborative, but cooperative.

Stakeholders on all sides agree that disagreements and intransigence lead to litigation. Litigation is expensive and it is time-consuming. The extensive costs of time and money on the government, conservationists, tribes, outdoor economies, utilities, and ratepayers should be avoided whenever possible. The costs of licensing, monetary and otherwise, are ultimately borne by the people of the United States, and all parties should be interested in minimizing cost whenever possible and appropriate. That is why we believe FERC should promote the adoption of memoranda of understanding (MOUs) between itself, tribes, and states to incentivize collaboration rather than litigation. FERC and the California State Water Resources Control Board have recently signed just such an MOU to allow the ILP process and the §401 process to happen in parallel, rather than sequentially, which should substantially reduce the time to license California projects that are pending §401 certification.

Congress attempted to improve licensing when, in the Energy Policy Act of 2005, it created an alternative to the aforementioned TLP. This new process, the Integrated Licensing Process (ILP), brings all the resource agencies into the room with the licensee to facilitate information sharing and to encourage collaboration as early as possible. Projects whereby an applicant has chosen the ILP, and whereby the applicant has chosen to engage in a cooperative manner with relevant stakeholders and conditioning agencies, tend to be completed in a much shorter timeframe than projects following the TLP. As the ILP is not always selected by the licensee and because even in an ILP, cooperating across the state and federal divide can occasionally be difficult, FERC should initiate MOUs between itself, tribes, and states to expedite licensing and fulfill the promise of the ILP.

Increase Appropriations to Resource Agencies

As stated, it is a chief frustration of all participants in licensings that the process can drag on for far too long. While each stakeholder can provide a bevy of reasons why licensings may be unnecessarily prolonged, none can deny that when it comes to the federal resource agencies, the tightening of the monetary spigot has forced them to do much more with much less. While it is

possible for these agencies to process applications and fulfill their statutory duties at their current level of funding, it takes more time. This is time that injures water quality, wildlife, and prevents licensees and their ratepayers from receiving the certainty they deserve.

The experience housed within the resource agencies cannot survive in a funding vacuum. These employees are individuals whose expertise is borne of years of education and working on licensings. The value of sitting down with an applicant, of getting on the river and examining the wildlife, of cataloguing flows and releases over years and watersheds is immeasurable in the licensing process. In order for any of the Secretaries to fulfill their statutory obligations and place a scientifically informed and legally defensible condition on a license, there must be funding available to pay for the personnel necessarily for the agencies to fulfill their responsibilities under the Federal Power Act, Endangered Species Act, Magnuson-Stevens Act, Coastal Zone Management Act, and other attendant and relevant federal statutes.

Failure to appropriate sufficient funds starves not only the managers of our public resources, but denies the agencies the information they need to make decisions in the public interest. A key function of the resource management agencies—and one of the reasons that the independent Commission, located in Washington, D.C. is not responsible for evaluating the potential or actual environmental impacts of a hydroelectric project—is to collect information from the project site. The Fish and Wildlife Service, the National Marine Fisheries Service, and the Forest Service, among others, are literally down in the reeds (or aboard scows) in every state of the nation. Failure to support them and their work only results in missed opportunities, wasted time, and money lost on the back end.

The United States is in the final stretch of licenses issued before the Ford Administration. This is not the time to forego carrying the lessons learned over difficult relicensings and decades of tremendous strides made by committed and unwavering public servants, licensees, and citizen participants. Congress should increase appropriations to the federal resource management agencies to fund the staff positions that allow them to efficiently and thoroughly evaluate applications for hydroelectric licenses. It may be beneficial for Congress to consider statutorily required mandatory cost recovery for these agencies. If there is no one at the agency who knows how licensings work and what Congress has charged the Cabinet Secretaries to do, no one, including the applicants, can be served.

Recognize the Rights of Tribes and Native Corporations/Villages

Among those communities that have been most injured by the insufficient evaluation and inconsiderate operation of hydroelectric projects have been the Native American tribes of the United States. When the federal government failed to fulfill its statutory obligations under the FPA to ensure fish passage and preserve federal reservations, nowhere were the injuries more serious than on Indian reservations. While federally owned and partially federally maintained, these reservations are not public lands. Injuries to them are borne wholly by the tribes and their

members. The Department of the Interior, through litigation, Presidential and Congressional direction, and the too-long realization that the fulfillment of trust and treaty obligations of the United States require dedicated action, has significantly improved in its evaluation of hydroelectric projects' impacts on Indian lands. The time has come to recognize tribes' right to determine the impact of actual and proposed projects on their lands and their reserved rights to fish and wildlife.

The trend since the end of the Termination Era (1970) has been to assist tribes, when possible, reclaim their capacity to develop and execute policy at the local level. This is the foundation of what, in Indian Country, is described as "sovereignty." This legal epoch, the Self-Determination Era, has seen Congress devolve unto tribes greater authority in health care, education, and public safety. The resilience of tribes as they recover from decades of government-sponsored devastation cannot be questioned. Many federal and state natural resource managers who have partnered with tribes have discovered that many tribes (unsurprisingly) possess the academic and technical talent required. Furthermore, generational knowledge and the cultural connection to the land, water, and wildlife (commonly referred to as "traditional ecological knowledge" or "TEK") provide an edge to tribal resource managers. Federal and state managers are coming to learn what they previously dismissed as folklore or superstition is a highly nuanced understanding of how humans interact with the natural environment.

The Clean Water Act identifies tribes that are judged to possess sufficient technical capability the designation of "treatment as state" (TAS), meaning that they have the same rights and responsibilities as states do in evaluating water quality and the impact of hydroelectric projects thereon. Just as there is a crucial benefit to having state and federal regulators within proximity of the project site, there is a tremendous benefit to having regulators who live on or adjacent to the project site involved in the process. While in 2017, a Bureau of Indian Affairs (BIA) Superintendent may have close communication with the tribal department of environmental quality, it would serve both efficiency and self-determination to recognize the tribe's right to be at the licensing table for those situations in which the Departments of Commerce and the Interior currently represent them.

American Rivers urges the Committee to consider, in full consultation with the appropriate tribal representatives, whether it would be advisable to devolve the authority to protect tribal resources from the Departments of Commerce and the Interior to the tribes themselves. Amending the FPA to recognize tribes' rights to manage their lands and fisheries—just as federal law recognizes their rights to manage their waters—could eliminate needless bureaucracy and ensure the proper stewardship of those resources. Furthermore, doing so would be a continuation of prevailing policy trends, not a departure therefrom.

Corps vs. FERC Permitting Process at Non-Powered Dams

Section 408 of the Rivers and Harbors Act authorizes the Corps to permit modifications and alterations to existing Army Corps constructed public works projects. The Corps requires the permit applicant to meet their standards and to ensure there no injury to the public interest or any effect on the Corp's projects' ability to meet its intended purpose. The Corps will evaluate the projects impact on any alteration to flood conveyance, structural integrity, operation and maintenance, NEPA requirements, and flood absorption or blocking capabilities. The Corps oversight in allowing an outside party to use their infrastructure is necessary to ensure the integrity of the Corps infrastructure as well as to ensure the outside party does not adversely impact the waterway or wetland where the project is located.

Recently there has been discussion about the Corps' 408 process being duplicative of FERC's ILP in the permitting and licensing of hydropower projects to be added to currently non-powered Corps infrastructure. American Rivers agrees with the statement of then-Director of FERC's Office of Energy Policy Ann Miles, who testified before this Subcommittee that it might be preferable for FERC to relinquish jurisdiction over hydropower projects to be added at Corps facilities, but it is inappropriate to transfer such authority from the Corps to FERC. American Rivers believes that the Committee should seriously consider simplifying the process of adding power to non-powered dams by exempting them from the FERC licensing process.

While some utilities may prefer the ILP to the 408 process, American Rivers agrees with FERC and the Corps that alterations to structures owned by the United States and operated and maintained by the Corps for purposes authorized by Congress should remain within the jurisdiction of the Corps of Engineers in order to best protect the interests of the taxpayers and the multiple users of the waterway.

Conclusion

It can be too easy to fall into the us vs. them trap, and to believe that the only way to achieve our objectives is by preventing another party from achieving hers. That is not the position of American Rivers. We believe affordable energy can exist alongside robust fisheries, that flourishing outdoor economies can benefit from longstanding dams and impoundments, and that the lands held in trust pursuant to treaties between sovereign nations may not be compromised for the sake of convenience. It's not a matter of the environmentalists versus industry. Everyone wants electricity, everyone wants clean water. In hydroelectric licensing, as in all things, we must seek consensus and compromise when possible.

As currently organized, the hydroelectric licensing process requires the involvement of federal, state, and tribal officials. It is collaborative, with shared responsibilities, and should remain that way. There are minor changes that could be made by FERC (presumptively including study requests from the federal, state, and tribal resource managers and pursuing MOUs when able) and by Congress (providing sustainable funding, recognizing tribal rights to manage land and wildlife, and possibly exempting non-powered Corps dams from the FERC licensing process).

We urge the Committee to thoroughly examine the impacts of the Energy Policy Act of 2005 and to solicit the input of all stakeholders in the hydroelectric realm before altering the licensing process.

On behalf of our members and supporters, we again thank the Committee for its attention to this important topic. We are happy to answer questions and provide further information as necessary. Please direct inquiries to Brendan Mysliwiec at bmysliwiec@americanrivers.org or at 202-243-7077.

TESTIMONY OF KEVIN COLBURN ON BEHALF OF AMERICAN WHITEWATER

UNITED STATES SENATE
ENERGY AND NATURAL RESOURCES COMMITTEE

HEARING TO RECEIVE TESTIMONY ON OPPORTUNITIES TO IMPROVE AMERICAN
ENERGY INFRASTRUCTURE

MARCH 14, 2017

SENATOR LISA MURKOWSKI, CHAIRMAN
SENATOR MARIA CANTWELL, RANKING MEMBER

Chairman Murkowski, Ranking Member Cantwell, and Members of the Committee,

Thank you for the opportunity to submit written testimony regarding opportunities to improve American Energy Infrastructure and specifically hydropower generation and operation in the United States.

American Whitewater is a national 501(c)(3) non-profit organization with a mission "to conserve and restore America's whitewater resources and to enhance opportunities to enjoy them safely." With approximately 6,000 members and 100 affiliate clubs, we represent the conservation interests of tens of thousands of whitewater enthusiasts across the country. Since the early 1990's, we have actively participated in the FERC hydropower licensing and relicensing process on well over 100 dams. Through the Federal Power Act, our efforts have brought life back to rivers that had been severely impacted by hydropower for decades. In our work, we strive to balance society's need for power with what flowing rivers also do for fish, wildlife and our communities. As these rivers have been restored, so have local economies that depend on outdoor recreation, including paddlesports, fishing, and other river-dependent recreation.

The Hydropower Relicensing Process Offers Opportunities For Rural Communities to Reclaim Rivers.

Hydropower dams have dried up rivers that provide fishing and boating opportunities for local residents and visitors, inundated towns and farmlands under reservoirs, and blocked the migration of fish—including many species that provide economic and cultural value for local and regional communities. Many rural communities still suffer from these enduring losses today. Through the federal hydropower relicensing process of the Federal Energy Regulatory Commission (FERC), American Whitewater has worked as a public interest advocate to restore water and economic opportunities to communities across the country. We highlight several of our success stories below.

The Santeetlah Dam dewatered the Cheoah River for 77 years before it roared back to life in 2005. We successfully advocated for 20 annual high flows and year-round base flows that, together, mimic key components of a natural river while continuing to allow

for ample power generation. These releases have become a recreational treasure in Graham County, which is one of the poorest counties in North Carolina. Anglers are reporting high quality smallmouth bass fishing, and last month an estimated 600 paddlers descended the river during a single scheduled release. Graham County recently passed a resolution in favor of additional recreational dam releases on the Cheoah, an outcome that is possible and envisioned in the FERC license. These transformative benefits for the communities around the river were apparently not overly burdensome on the Licensee, who sold the newly licensed project (the Tapoco Project, which includes four dams) in 2012, reportedly for \$600 million dollars.¹

Nearby, power generation releases on North Carolina's Nantahala and Tuckasegee rivers are scheduled in advance to allow for profitable power generation as well as predictable rafting, canoeing, and kayaking. These releases support a large number of tourism related jobs in this rural Appalachian region, and are the result of collaboratively developed licenses that American Whitewater helped craft. A 2009 study found that the largest of one of many rafting outfitters in the area, the Nantahala Outdoor Center, created and maintains 579 jobs and contributed a total of \$48,073,691 to the local economy in 2008.²

In the early part of the 20th century, the Feather River in California was known as a world-class trout fishery until a series of dams either inundated or dewatered the river for much of its length. American Whitewater engaged in the relicensing process and was successful at securing new flows in several reaches that restore vital ecological functions to the river. The result has been a 30% increase in flows, better fishing, and popular kayaking and rafting opportunities, with only a modest 6% reduction in power production.

These examples illustrate that the modern FERC hydropower relicensing process is capable of producing outcomes that allow for power generation while restoring ecological, recreational, and economic values with direct benefit to local communities. It would be an overstatement, however, to say that these rivers are flourishing. They remain severely impacted by the enormous footprint of the projects and their ongoing operations. They are working rivers with chronic problems, but the relicensing process has required the power companies to share the rivers with their neighboring communities, with many species that call these rivers home, and with the public who owns the river. That well-reasoned reallocation of a fraction of the river's water, which the relicensing process has facilitated, has indeed had profound benefits on rural and natural communities alike with corresponding positive economic benefits.

¹http://www.thedailytimes.com/news/alcoa-closes-dam-sale-tapoco-now-brookfield-smoky-mountain-hydropower/article_90c65b1b-17f2-53cc-846f-03a2a541a6a1.html

²<http://datalibrary.nemac.org/swnc/sites/default/files/2009%20Nantahala%20Gorge%20Economic%20Impact%20Study.pdf>

Hydropower is a Mature, Built-Out Energy Source, and is Appropriately Challenged By Free Market Competition From Young Energy Sources That Have Ample Room To Grow.

Hydropower is a more than century-old technology that has already been employed widely and is operational at an enormous scale; the vast majority of potential sites have already been developed. As the Committee considers “Opportunities to Improve American Energy Infrastructure,” we believe it is important to understand the reality of where hydropower fits into the context of other new energy development. In 2016 alone, more than 14 GW of new solar power and 8 GW of wind power were brought online in the United States.³ In contrast, in its 2016 *Hydropower Vision* Report, the Department of Energy estimates new hydropower potential over *the next 34 years* totals between 5.2 GW under a “business as usual scenario,” and 12.8 GW with advances in technology and low cost financing.⁴ (Note that these figures do not include pumped storage that can be used for energy storage and is sometimes included in estimates of future hydropower potential.) Simply put, it will take creative action and 34 years for additional hydropower generation to compete with what wind or solar added to the grid last year alone.

Hydropower already plays a significant role in our energy system and we anticipate that it will continue to do so for many years to come. As the *Hydropower Vision* Report outlines, it is unlikely that hydropower will grow significantly, especially relative to wind, solar, and associated battery storage systems. Instead of providing baseload generation, hydropower’s value in the future will be one of helping to regulate the grid as these renewables continue to grow. In fact, it is reasonable to assume that these changes will leave some hydropower projects unprofitable and lead to removal. The future may well involve fewer hydropower projects, with those that remain being more efficient and effective at meeting the needs of the grid.

The Only Appropriate Opportunity For Expanding Hydropower Generation is at Existing Dams.

The Department of Energy’s *Hydropower Vision* Report specifies that there is no potential for additional generation from new stream development under current circumstances, and potential for just 1.7 GW between now and 2050 if technological advances are realized and low-cost financing is in place. Instead of developing new projects, the future of expanding hydropower generation lies within upgrading existing projects and retrofitting non-powered dams. We support this effort if it is done in a responsible manner that protects public trust resources.

³ Solar Energy Industries Association. (n.d.) *Solar Market Insight Report 2016 Year in Review*. <http://www.seia.org/research-resources/solar-market-insight-report-2016-year-review> (last visited March 12, 2017); and American Wind Energy Association. (n.d.) *U.S. Wind Industry Fourth Quarter 2016 Market Update*. Available at: <http://awea.files.cms-plus.com/FileDownloads/pdfs/4Q2016%20Fact%20Sheet.pdf> (last visited March 12, 2017).

⁴ U.S. Department of Energy, Wind and Water Power Technologies Office. *Hydropower Vision Report*. July 2016. P. 18. Available at: <http://energy.gov/eere/water/articles/hydropower-vision-new-chapter-america-s-1st-renewable-electricity-source> (last visited March 12, 2017).

As mentioned above, the Department of Energy estimates that 5.2 GW of new hydropower capacity can be added through such upgrades and installations over the next 34 years.⁵ While by no means a game-changing figure, this capacity is low hanging fruit. We have supported projects that fit this category, including the major capacity increase at Holtwood Dam on the Susquehanna River in Pennsylvania and numerous smaller projects.

While the *Hydropower Vision Report* estimates that potential exists to add hydropower to over 50,000 non-powered dams in the U.S., it is not practical to do so at the majority of these projects. The Report wisely places a filter on this number for projects that have a minimum capacity of 500 kW, reducing the number of non-powered dams where it is practical to add hydropower capabilities to just 671 dams.⁶

Constructing new dams does not make sense in this era of rapid market changes. It also does not make sense when our dam infrastructure is aging and in need of maintenance and repair. Recent events at the Oroville Dam on the Feather River in California demonstrate a greater need for the hydropower industry to invest in maintaining existing projects.

We support improving efficiencies at existing hydropower projects and adding hydropower capabilities to non-powered dams in large part because of the profound cumulative impacts that over a century of rampant private hydropower development have had on our public rivers. Our dammed, working rivers are already severely impaired, and our remaining free-flowing rivers are rare and more important than ever as biological strongholds and recreational destinations.

The Importance of Collaboration Among Stakeholders and State and Federal Resource Agencies.

FERC's Integrated Licensing Process appropriately contains involvement from tribal, state and federal agencies with expertise in energy, fish and wildlife, water quality, recreation and cultural values. In our experience, good outcomes like those described above happen when the licensee works collaboratively with all stakeholders throughout the entire process. This includes ensuring that there is robust, scientifically sound data early in the process about the project and the river, and a willingness to mitigate the Project's impacts. When collaboration does not happen disagreements and intransigence lead to delays, administrative challenges, and occasionally litigation, which is expensive and time consuming. We reference the testimony of the Hydropower Reform Coalition submitted to this Committee for suggestions to ensure that the process is a collaborative one.

Legislators proposed hydropower legislation in the last session of Congress (H.R. 8) that would have shifted responsibility for all of these areas to FERC. This is not an

⁵ *Hydropower Vision Report* at 18. See also "business as usual" alternative, Table ES-2.

⁶ *Id.* at 252.

action that we support. Aside from licensing hydropower projects, FERC is an independent agency responsible for regulating the interstate transmission of electricity, natural gas and oil. By design, it does not have sufficient expertise relevant to rivers. This is the mandate given to other agencies, including the U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and state and tribal water quality agencies.

When stakeholders cooperate, the Integrated Licensing Process takes approximately six years. While some compare this timeframe to the process for permitting a natural gas plant, we believe this is an unfair comparison. The impact of the two technologies is completely different. Hydropower dams automatically change the function and use and enjoyment of a publicly owned river by blocking it, significantly altering its flow, and preventing species from accessing critical parts of their habitat. Additionally, hydropower license terms last for 30-50 years.

Further, hydropower licenses cover projects that can involve multiple dams, reservoirs and powerhouses, and more than one river. Some of the projects we've worked on in California involve dozens of dams and the footprint of one is the size of the state of Rhode Island. Additionally, the hydropower facilities that are up for relicensing now were first constructed before virtually all modern environmental laws were in place. It is during relicensing proceedings that the public gets the opportunity to ensure that dam owners make the necessary changes to comply with modern laws. The opportunity to mitigate for the damage to the environment, while still providing reliable electricity, only arises once in a generation or two. For all of these reasons, it makes sense to take the time to get it right.

Hydropower Emits Greenhouse Gasses.

The idea that hydropower is a "clean, green, and renewable" source of power is a myth. In addition to the impacts to water quality, riparian habitat, and natural life cycles of aquatic fish and wildlife, the technology contributes to greenhouse gas emissions. Reservoirs behind dams are not carbon-neutral, but instead are responsible for approximately 1.3% of anthropogenic CO₂ equivalent emissions worldwide over a 100-year timespan.⁷ In addition to carbon, reservoirs emit methane that has 34 times the warming potential as carbon.⁸ We recognize that these reservoirs emit less carbon than a coal-fired power plant, but to say that they are carbon-free is incorrect.

Conclusion

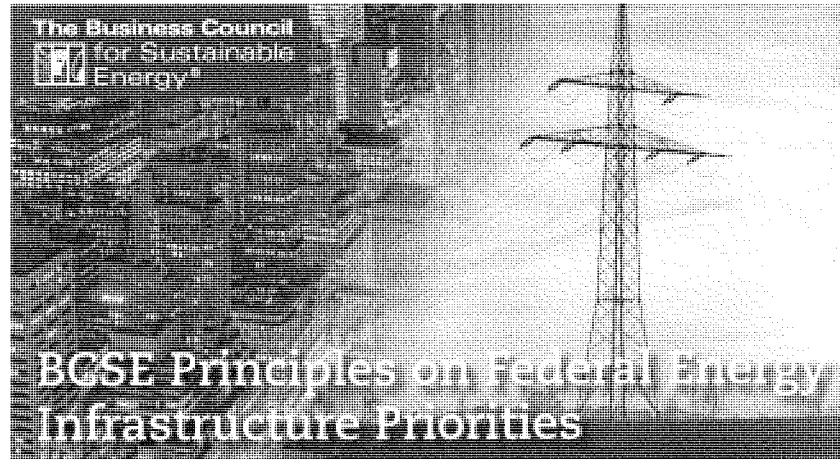
We thank the Committee for this opportunity to provide testimony on hydropower's future, which will affect rivers and recreation-based rural economies nationwide. We have significant experience with relicensing hydropower dams and feel that

⁷ Deemer B, Harrison J, Li S, Beaulieu J, DelSontro T, Barros N, Bezerra-Neto J, Powers S, Dos Santos M, Vonk J. 2016. Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis. *BioScience* 66: 949-964.

⁸ *Id.*

implementation of the Integrated Licensing Process has encouraged enhanced collaboration among all stakeholders. Placing more authority with FERC, an agency with DC-based decision makers, and less with local stakeholders and resource agencies that have on-the-ground expertise, will only serve to discourage this collaborative approach and local decision-making.

We support opportunities to increase capacity at existing dams through efficiency improvements and retrofitting existing non-powered dams to add generation capacity. To the extent modest regulatory reforms will encourage this type of development, we welcome any opportunity to work with the members of the Committee, tribes, resource agencies, and utilities on comprehensive solutions that create these new opportunities, provided they are fully protective of our aquatic resources. We do not support or see potential for the construction of new hydropower dams.



This document outlines the Business Council for Sustainable Energy's (BCSE) principles for federal energy infrastructure proposals and initial recommendations for consideration by the Trump Administration and 115th Congress.

The Challenge and the Opportunity

Energy powers our lives and is at the heart of the U.S. economy.

The extensive power grid and natural gas system in the U.S. have fueled the nation's economic growth and ensured its global competitiveness.¹ However, the country's energy infrastructure lacks the required attributes necessary to meet the demands of the 21st century. As the U.S. economy becomes more digitally driven, energy infrastructure that is reliable, affordable, smart, and resilient becomes even more critical.

It is estimated that the U.S. has a \$5 trillion gap in funding for infrastructure investment between now and 2040. This includes a gap of over \$560 billion needed in additional energy infrastructure spending alone.²

Even with electric and natural gas utilities spending hundreds of billions of dollars annually on infrastructure, a large funding gap still exists.³

The United States is one of the most attractive markets in the world for companies whose operations entail significant energy-related costs.

To address this gap, the public and private sectors must work together to update market rules and to establish modern policy frameworks. This must include competitive market structures that facilitate long-term planning and infrastructure investment and maintaining support for energy efficiency.

This collaboration is essential for the delivery of affordable, reliable, and clean energy products and services to businesses and households. It is also vital to the operation of other critical infrastructure systems, including security, water and waste management, transportation, communications, the built environment, and industrial sectors.

BCSE Principles for Federal Energy Infrastructure Proposals

- **Upgrades and Investment in U.S. Infrastructure Have Broad Bipartisan Support:**

Investment in U.S. infrastructure will improve U.S. economic competitiveness, will increase our national security and resiliency, and has the potential to create tens of thousands of jobs.

- **The Energy System Is Critical Infrastructure:** Reliable and secure energy systems power the U.S. economy and sustain other critical infrastructure systems. Transportation, water, lighting, and security systems will see dramatically increased electrification in the decades ahead, putting more demand on the U.S. energy system while simultaneously creating an opportunity to incorporate more secure, resilient, smart, and efficient energy infrastructure additions.

- **Municipal Facilities Are a Significant Part of the Infrastructure Fleet:** Municipal facilities are generally long-term investments and include assets in the transportation, lighting, water, waste, and energy sectors and provide vital services to their communities.

- **Criteria for Infrastructure Investments Should Consider Multiple Objectives:** Investment decisions should reflect overarching objectives including resource efficiency, consumer savings, environmental performance, resiliency, and sustainability. Projects also should optimize design, construction, and operation for resilience, and incorporate—to the extent possible—the use of third parties to ensure that projects meet their performance objectives.

- **Energy Infrastructure Includes Pipelines, the Electric Grid, Buildings, Lighting Systems, and the Technologies That Connect and Optimize the Energy System:** The next-generation energy system will be bi-directional and much more integrated with the built environment, which will increasingly enable customers to interact with it.

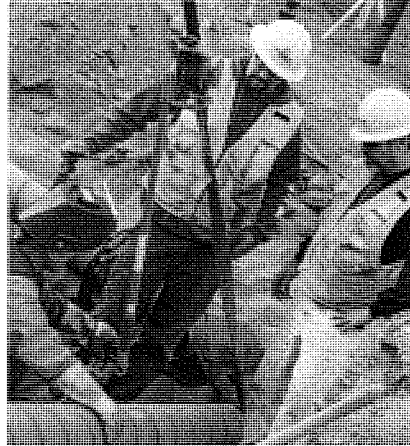
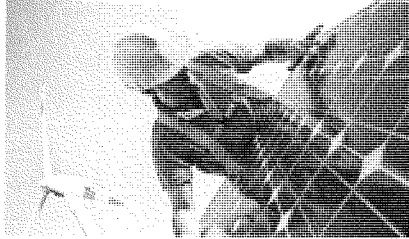


PHOTO COURTESY OF AVISTA UTILITIES

This will require smart infrastructure solutions—backed by improved cybersecurity protocols—that facilitate the collection of data via sensors along distribution networks, advanced analytics, and the incorporation of communications technologies to optimize performance, preempt problems, and allow for rapid response. The next-generation energy system will also need to integrate demand-response protocols for increased electric grid efficiency, as well as utility-scale and distributed renewable and clean energy technologies, which will require upgrades and expansion to the grid system. Energy storage will also play a larger role in the power, buildings, and transportation sectors. Lighting systems represent 20 percent of U.S. energy use, and upgrading outdoor lighting systems can result in significant cost savings while providing other security, connectivity, and efficiency services. Through more strategic and systemic approaches to modernization, the U.S. can integrate complementary assets, advance new market structures, and accelerate deployment of clean energy technologies.

Energy infrastructure is critical infrastructure. It includes natural gas pipelines, the electric grid, buildings, lighting systems, and the technologies that connect and optimize the energy system.



To ensure the responsible use of taxpayer dollars, federal funding for the construction and renovation of schools, hospitals, state and local buildings, and other projects should require energy efficient and resilient building construction practices, as well as performance metrics.

• **New and Renovated Buildings Should Avoid Locking In Long-Term Energy Waste:** To ensure the responsible use of taxpayer dollars, federal funding for the construction and renovation of schools, hospitals, state and local buildings, and other projects should require energy-efficient and resilient building construction practices, as well as performance metrics. These measures will ensure that wasteful energy systems are phased out and replaced with cost-effective technologies and practices. As examples, smart capability should be added when renovating HVAC systems to only heat and cool when needed, lighting systems should be upgraded to include LEDs that can control the amount of light needed (using the connected lighting infrastructure to collect data to improve the worker productivity and overall energy efficiency of buildings) and measures such as electric vehicle charging stations and energy storage should be considered.

• **Integration of Energy Technologies Is a Market Trend:** In buildings, campuses, micro grids, and cities, multiple energy technologies are being used to enable more efficient production, distribution, and use of energy. Information and communications technology (ICT) is a key bridge to the integration of technology and energy management.

• **Cross-sector Interactions Permeate the Energy Infrastructure Discussion:** Energy infrastructure is closely integrated with sectors other than energy. In particular, transportation, water, waste, and the built

environment overlap significantly with energy. The water sector is a large energy consumer⁴ and, due to aging infrastructure, could see significant energy savings through the use of leak detection, pressure monitoring technologies, and electricity generation onsite. Transportation is becoming more diversified; fueling stations will be needed for alternative-fueled vehicles, hydrogen for fuel cell electric vehicles, and propane and biogas for natural gas vehicles. Related infrastructure also will be needed for battery electric vehicles, which will need to be integrated with the power grid. Buildings also are increasingly becoming grid-integrated. Further, a thriving economy relies on the country managing its waste in a cost-effective and efficient manner. To assist with that objective, there is a significant opportunity to generate renewable energy at waste management facilities.

• **Information and Communications Technology and Cybersecurity Should Be Approached Proactively:** The ICT component of the energy system of the future cannot be ignored. A smarter energy system will be one that facilitates two-way communication in real time through the use of advanced sensors, communications networks, and data management platforms. This will enhance overall performance and decrease costs for generators, distributors, operators, and consumers. This also means that there is an increasing need to emphasize cybersecurity and secure communications networks as connectivity and remote management of key energy assets grow.

What Is Needed

The BCSE asks that the Trump Administration and Congress consider the following recommendations when looking at infrastructure decisions.

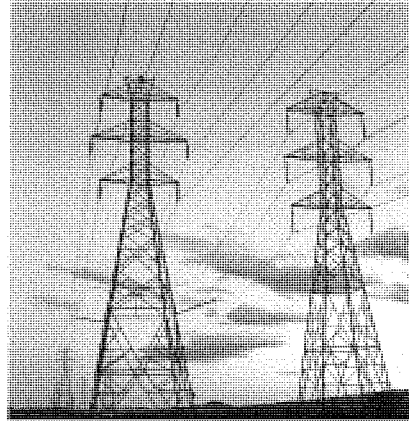
- **Siting, Permitting, and Regulatory Reforms Should Be Key Components of Federal Action on Infrastructure:**

Streamlining of siting and permitting processes for electric grid, electric transmission, natural gas pipelines, power generation, hydropower projects, energy storage, and materials management are critical for infrastructure investment.⁵ Further, federal government leadership is needed to promote and adopt policies that foster effective transmission and infrastructure planning. This includes ensuring that clean energy projects can be developed by implementing workable regulations for federal land management, wildlife, military, and aviation interactions. Despite well-intentioned efforts to achieve balance between conservation and energy goals, development is being severely hindered by unworkable rules that do not sufficiently contain legal risk for investors or provide sufficient clarity. Investors require clear rules with manageable risks. BCSE encourages devoting significant attention to the hard work of addressing both environmental and development goals through policies and personnel decisions.

- **Targeted Federal Funding, Including Tax Policy, Should Be Used to Significantly Leverage Private Sector Investment:** Establishing mechanisms and instruments that unlock and leverage private capital for infrastructure investments is an appropriate role for the federal government. Solutions that spur lower-cost financing such as loan guarantees or bonding authority for projects are needed. This can be achieved through the tax code, infrastructure banks, or other means. For some sectors, research, development, and deployment funding will be needed. The Administration and Congress should look at past and current initiatives and focus on what has been efficient and effective. As mentioned above, federal funding also can be leveraged by targeting the vast array of municipal infrastructure projects that contribute to the resiliency of our communities.

- **Proposals to lift the budget sequestration on federal tax incentives for private investment in America's public buildings should be considered.**

Currently, tax incentive programs—Build America Bonds, Qualified School Construction Bonds, Qualified Zone Academy Bonds, New Clean



Establishing mechanisms and instruments that unlock and leverage private capital for infrastructure investments is an appropriate role for the federal government. Solutions that spur lower-cost financing such as loan guarantees or bonding authority for projects are needed. This can be achieved through the tax code, infrastructure banks, or other means.

Renewable Energy Bonds, and Qualified Energy Conservation Bonds—are subject to sequestration (6.8 percent for FY 2016) through fiscal year 2024. The sequester effect on these bonds unduly affects state and local government issuers, and it should be lifted. Further, existing tax incentive programs should be modified to support a new federal tax credit bond for resiliency infrastructure to harden critical public facilities from the effects of natural disasters and cyberattacks.

- **There is significant growth potential that can be gained by a reinvestment in the federal hydropower fleet.** The federal hydropower system makes up approximately 50 percent of total U.S. hydropower capacity.⁶ Funding should be directed

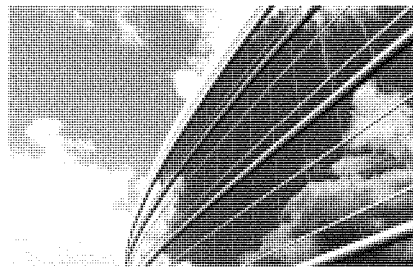
to support the Army Corps of Engineers Civil Works and the Bureau of Reclamation efforts to operate, maintain, and upgrade their existing hydropower projects, as well as to build on their existing non-powered infrastructure.

- **Municipal facilities make up a significant portion of infrastructure assets, and proposals should consider investment and support in municipal infrastructure projects.** Long-term investments in transportation, lighting, water, waste, and energy infrastructure are crucial to maintaining the viability and service in the communities that municipal facilities serve.
- **Facilitating Regional and Local Planning and Action Is Crucial:** Much of the decision making on infrastructure is dependent on regional planning and local action. Cities (particularly those that own or manage infrastructure assets) are uniquely positioned to evaluate new practices and technologies, and federal infrastructure approaches should include support for such activities at the city scale. The federal government should provide resources to state, local, and regional decision makers to identify the needs and facilitate long-term planning and funding strategies. For example, some states are not as far advanced in their grid modernization efforts as others. Technical assistance and sharing of best practices can help decrease this gap and allow for realization of the benefits of a fully modernized and more efficient grid. Of note, public-private partnerships and challenge grants can assist with planning for conventional and emerging technologies alike.
- **Federal Support for Building Energy Efficiency Should Remain a High Priority:** With buildings accounting for over 70 percent of U.S. electricity demand, over 30 percent of U.S. natural gas demand, and about 40 percent of U.S. energy consumption, the energy infrastructure spending gap is also addressed through improved building energy efficiency.

 - **Building energy codes and appliance standards are key federal policies, which have enjoyed bipartisan support for decades.** By ensuring minimum standards in new construction and appliances and equipment installations, codes and standards effectively build energy efficiency into structures. In the case of building energy codes, these cost-effective efficiency measures

will generate savings for the life of the structure. Building energy codes also contribute positively to resilience efforts by improving the habitability and productivity of residential and commercial structures, respectively, following outages. For existing buildings, energy efficiency retrofits, backed by an investment-grade audit and evaluation, can significantly reduce utility costs.

- **Financing is often cited as a key barrier when retrofits are being considered by building owners and managers, but market-based alternatives now exist to attract and leverage private capital.** Energy Savings Performance Contracts (ESPC) are an established and widely accepted private financing mechanism that is widely used to alleviate capital costs especially in the federal, state, municipal, education, and healthcare sectors. Between 2011 and mid-2016, the federal government entered into ESPCs worth \$3 billion.⁷ State and local government Property-Assessed Clean Energy programs have leveraged over \$300 million in recent years for commercial building retrofits and over \$3 billion for residential projects, and have cumulatively led to over 32,000 new jobs.⁸
- **Initiate a National Lab Program for Developing Resilient Building Policies:** It is important to develop effective best practices and policies that will address our increasingly vulnerable building infrastructure. The National Labs play a crucial role in research and development of technology and standards that are critical for building infrastructure. Congress and the Administration should direct the National Labs to focus on developing and testing the materials and installation practices necessary to withstand dangerous weather events and other resiliency challenges. There is also



a leadership role for the National Labs in researching and assessing cybersecurity threats. As buildings and other energy sector assets become more connected, the potential for domestic and foreign interference and system breaches causing widespread disruptions and outages rises at an alarming rate. The National Labs are uniquely qualified to work with federal and private sector stakeholders to better understand the threats and trends in cybersecurity.

- **Appoint a High-Profile Infrastructure Post to Ensure That Federal Agencies Follow the Direction from Congress.** The effectiveness of changes to federal energy infrastructure requires the authority and follow-through at the highest levels of the Administration. Creating a high-level infrastructure post sends the message that energy infrastructure, and infrastructure more generally, is a high



The Trump Administration and Congress have an unprecedented opportunity to help improve our nation's aging infrastructure. Through public-private partnerships, siting, permitting, and regulatory reforms; targeted research, development, and deployment investments; and financing tools that leverage private capital, the federal government can upgrade and expand U.S. infrastructure and create well-paying jobs for Americans.

Endnotes

1. At 7.1 cents per kilowatt-hour and less than \$4 per million btus respectively, the retail prices of electricity and natural gas for the industrial sector in the U.S. are lower than those in other major economies, such as Germany, China, and India. The public and private sector are capturing the benefits of these lower energy prices while the comparative advantage in energy pricing is boosting investment and creating jobs.
2. See American Society of Civil Engineers figures from infrastructure report card 2016. <http://www.infrastructurereportcard.org/wp-content/uploads/2016/05/ASCE-Failure-to-Act-Report-for-Web-5.23.16.pdf%20-%20page=7>.
3. On average, the electric power industry invests \$100 billion per year to build smarter energy infrastructure and to transition to even cleaner generation sources. A record \$117.8 billion in investments is estimated in 2016 (see Edison Electric Institute, *Electric Perspectives Magazine*, July/August 2016, p. 15, at <http://cdn.coverand.com/6643/319499/6e7508f48fa566dcb062f55e54ba2b6b4ca094c4.1.pdf>). Further, natural gas utilities spend \$22 billion annually to help enhance the safety of natural gas distribution and transmission systems. The industrial sector is expected to invest more than \$100 billion over the next half decade in response to natural gas supply growth. (See the Natural Gas Supply Association Winter Outlook 2016–2017, at http://www.ngsa.org/download/analysis_studies/FINAL-Winter-Outlook-2016-17-Presentation.pdf).
4. According to the U.S. Environmental Protection Agency, drinking water and wastewater systems use 75 billion kilowatt-hours per year, enough electricity to power 6.75 million homes (see <http://www.epa.gov/region9/waterinfrastructure/training/energy-workshop/docs/2009/energystar-benchmark.pdf>). Energy is the second highest budget item for municipal drinking water and wastewater facilities and can comprise 30 to 40 percent of a municipality's total energy bill (see <https://www.epa.gov/sustainable-water-infrastructure/energy-efficiency-water-utilities>).
5. Models for consideration include the bipartisan Public Land Renewable Energy Development Act S.1407 and eliminating the infrastructure development uncertainty caused by the Council on Environmental Quality's greenhouse gas guidelines.
6. Bureau of Reclamation (14,112 megawatts, 18% of U.S. capacity), Army Corps of Engineers (20,959 MW, 26%), and Tennessee Valley Authority (3,619 MW, 5%).
7. See http://naesco.org/data/industryreports/esco_recent_market_trends_30sep2016.pdf, p. 11.
8. See <http://pacenation.us/pace-market-data/>.
9. The FAST Act permitting dashboard has been created and could be a tool to draw high-level attention to the permitting process. See <https://www.permits.performance.gov>.

**STATEMENT OF
HEATHER REAMS,
MANAGING DIRECTOR OF CITIZENS FOR RESPONSIBLE ENERGY SOLUTIONS
To the
SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES
For the
ENERGY INFRASTRUCTURE OVERSIGHT HEARING
March 14, 2017**

My name is Heather Reams, and I am the Managing Director of Citizens for Responsible Energy Solutions (CRES). CRES appreciates the strong interest of the Senate Energy and Natural Resources Committee in energy infrastructure, which is so important to our future and our nation's economic revitalization. We want to thank the Committee for the opportunity to submit testimony on this issue.

CRES is a non-profit organization that advocates for comprehensive, responsible and free-market solutions to our nation's clean energy challenges. In that role, we support federal policies and legislation that facilitate market development and deployment of clean energy generation and related infrastructure. CRES supports the inclusion of clean energy provisions as a significant component of the infrastructure package that is being developed by the Congress.

Reliable, affordable energy is vital to our economy, and to the economic growth targets of the new Administration. Just as important, Americans want their energy to be clean and not contribute to climate change.

CRES polling shows that, regardless of party affiliation, Americans want clean energy. A full 82 percent of Americans believe it's time for our country to update our energy infrastructure to allow for safer, more efficient delivery of traditional energy sources, while ensuring clean energy technologies have open access to the energy market. Further, 68 percent of Americans favor the federal government taking steps to reduce emissions of gases like carbon dioxide that cause global

CRES Testimony
Senate Committee on Energy and Natural Resources
March 14, 2017

climate change.

The electricity sector, driven by technological innovations and many state renewable mandates, has already begun to transform the way that we generate, store and deliver power. Innovations are also enabling us to gain efficiencies and utilize renewable resources in ways that simply weren't possible in the past, but we have a long way to go. Federal policies can either facilitate or impede this progress.

According to the National Conference of State Legislatures, as of 2016, there were 29 states with some form of a renewable portfolio standard (RPS). Utilities and other power providers, such as independent power producers, are making significant investments to meet these RPSs. Increases in renewable generation and in generation from natural gas facilities have also reduced our nation's reliance on coal-fired generation. While coal generation accounted for over 48 percent of electricity generation as recently as 2008, it was only about 33 percent of total generation in 2015, according to the Energy Information Agency. During the same time, the total share of generation from non-hydropower renewables increased from 3.1 percent in 2008 to 7 percent by 2015.

CRES recognizes that the leadership of the Committee on Energy and Natural Resources sought to facilitate many of the policy changes needed to assist utilities in their transition to cleaner generation resources through provisions contained in S. 2012, the Senate-passed version of the North American Energy Security and Infrastructure Act of 2016. It is our hope that similar legislation will eventually be considered by the 115th Congress.

The federal government also has had an important role in the research and development of new technologies, and that role should continue. In recent years, the Department of Energy sought to shift the focus of the national labs to research that was more applicable to the needs of energy

CRES Testimony
Senate Committee on Energy and Natural Resources
March 14, 2017

providers. CRES supports continuing such an emphasis for the labs under this Congress and the new Administration.

Federal incentives and tax policy can also play a crucial role in enabling innovation by the private sector, while maintaining rate stability for ratepayers. An infrastructure package that includes investments in clean energy and smart grid technology is one way to provide such incentives. In fact, CRES polling shows that 83 percent of Americans believe the government and private sector should partner to help innovators conduct research, support the development of clean energy technologies, and make it easier for consumers and businesses to gain access to cutting-edge energy technology.

Further, as the Congress considers tax reform, it must consider how changes to, or the elimination of, clean energy tax credits and credits for research and development may affect new clean energy investments, as well as innovative start-up companies. In the early years, these energy innovators are often conducting research and pre-commercialization activities, yet might not be profitable. Again, CRES polling indicates that 85 percent of Americans believe clean energy companies should be allowed access to the same financing options that help traditional energy companies attract investment in new technologies. This would include giving investors a tax benefit for using private funds instead of taxpayer funds to support new clean energy innovations. Tax policy should encourage research and development by U.S. companies. America must retain its leadership and competitive edge role in energy innovation.

As one of the largest consumers of electricity in the nation, the federal government can also lead by example. We know that there is an effort by many members of Congress to ensure that the Administration continues to achieve energy and water savings at federal facilities through the use of Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs).

CRES Testimony
Senate Committee on Energy and Natural Resources
March 14, 2017

It is our understanding that the use of these contracts by past Administrations has saved over \$12 billion for the taxpayers, and has made federal facilities more energy and water efficient. The contracts entered into under these programs result in public-private partnerships that reduce federal outlays and provide the type of market-oriented solutions that the federal government should be pursuing. CRES supports efforts to continue such contracting, and our polling supports this position: 86 percent of Americans support government policies that would encourage energy efficiency in buildings and homes to stimulate job creation, generate energy savings for ratepayers, as well as benefit the environment and public health. Further, federal, state and local governments could utilize energy efficiency technologies in their buildings to save taxpayer dollars.

We appreciate the ongoing efforts of the Committee to ensure that renewable energy development, and the transmission to support such generation, can occur in a cost-effective, environmentally sound manner on federal lands. Such federal land management policies should also seek to facilitate siting of renewable generation near existing transmission facilities. As older coal plants close, transmission capacity will become available, and renewable power developers can hopefully take advantage of this capacity. We recognize that the siting, permitting and construction of new transmission lines can be controversial, and it is therefore important to utilize existing transmission resources as efficiently as possible.

The potential to add hydroelectric generation to existing dams and conduits, including federal dams, as well as the development of pump-back hydropower facilities, can add significant clean generation to our nation's energy mix. Currently, only about three percent of the nation's existing dams generate electricity. More importantly, much of this new generation could potentially be managed in a way that helps integrate other renewable resources onto the transmission grid.

CRES Testimony
Senate Committee on Energy and Natural Resources
March 14, 2017

Distributed generation and energy storage, as well as demand response programs, can also help reduce the need for new transmission and displace older fossil fuel generation. These resources are an important part of our clean energy future. To date, only three states have requirements for utilities to acquire energy storage, but CRES urges the Committee to support incentives, or public-private partnerships, for energy storage as part of the infrastructure package.

CRES is supportive of new nuclear power generation as well. Existing nuclear plants currently provide nearly 20 percent of our nation's electricity. Nuclear power is a key non-emitting baseload resource, but almost all of our nation's existing plants are reaching the end of their design life. That is why CRES supports S. 512, the Nuclear Energy Innovation and Modernization Act, which is currently pending in the Senate Environment and Public Works Committee.

This bipartisan bill, which aims to facilitate the licensing of advanced nuclear reactors, underscores the critical role that nuclear energy continues to play in producing clean, safe and reliable power for American households, businesses and infrastructure. The Nuclear Regulatory Commission's regulatory environment is broken, and in urgent need of reform. Its structure is outdated, drowning innovators in burdensome red tape, and is therefore too rigid to allow for new technologies and innovations to be brought to market. If our nation wants advanced energy solutions that contribute to a cleaner environment, we need a new approach to government regulations that embraces innovation.

With respect to the transportation sector, the infrastructure package should help facilitate vehicle electrification. Rapid chargers along key interstate highway systems will help eliminate "range anxiety" for the owners of electric vehicles (EVs), as well as those considering owning or leasing EVs. Electrification of public transit systems, if done in a thoughtful manner that includes both the transit agency and the local utility, can have multiple benefits, potentially including

CRES Testimony
Senate Committee on Energy and Natural Resources
March 14, 2017

energy storage from the batteries of bus fleets, demand response capacity for the utility, and health benefits for those living near transit corridors as diesel buses are replaced with clean electric buses.

Finally, the cleanest kilowatt is still the one we don't use. CRES applauds the last Congress for enacting S. 535, the Energy Efficiency Improvement Act of 2015. We appreciate Senator Portman's leadership on energy efficiency issues, and hope that this Congress will enact the additional energy efficiency measures that were embedded in Title I of S. 2012 from the last Congress. Investments in energy efficiency and smart grid technology, as well as energy conservation, should all be considered in an energy infrastructure package and promoted for new construction, which will provide cost-savings for taxpayers over the life of the infrastructure investment.

Again, CRES thanks the Chair and Ranking Member for their ongoing commitment on these issues, and we appreciate the opportunity to submit this statement.

LINDA DAHLMEIER
MAYOR FOR THE CITY OF OROVILLE

United States Senate
Energy and Natural Resources Committee Hearing to Receive Testimony on
Opportunities to Improve American Energy Infrastructure
March 14, 2017
Senator Lisa Murkowski, Chairman
Senator Maria Cantwell, Ranking Member

Dear Chair Murkowski, Ranking Member Cantwell, and Members of the
Subcommittee:

I am writing to share my perspective as Mayor for the City of Oroville on the topic
of Opportunities to Improve American Energy Infrastructure.

My small rural town of 19,000 people sits at the base of the Sierra foothills along
the banks of the Feather River. While I have always felt blessed to live in Oroville,
we are not a wealthy community. The median income for my community is
\$36,000 and almost 24% of our residents are below the poverty line. Our town is
also home to the tallest dam in America. Until this past month, having the tallest
dam bear the name of our town has always been a point of pride. That all
changed on February 9th of this year.

The collapse of the main spillway at the Oroville Dam and the near failure of the
emergency spillway led to the evacuation of 180,000 people, including virtually all
of the residents of my city. People spent hours trying to flee just a few miles, not
knowing if the spillway would fail, taking them and their loved ones away. Had the
spillway failed, 180,000 people would have died; 28,000,000 would be without a
source of water and life as we know it in the state of California would forever be
changed. This disaster is one of the worst nightmares any elected official could
imagine for their community.

While the dam did not fail, the cost of this event continues, and it goes far beyond
the repairs to the dam. The thousands of truck trips to bring materials have
degraded many of our roads. Real Estate transactions have declined and escrows
have been cancelled. And recreation, which we depend on in our small

community, has come to a standstill with very little options in place for alternatives or recovery.

The Feather River fishery is one of the important elements of our recreation economy. We do not know the long-term impacts the damage has caused to the hatchery. We do know that the mud and silt from the collapsed spillway has killed many of the fish that live in the river and certainly destroyed much of the habitat. We also know that many fish were stranded as the flows ramped down from 50,000 cfs (cubic feet per second) to zero in just a few hours.

River Bend Park, which was built as part of the Settlement Agreement with DWR for the FERC hydropower license for Oroville Dam, was inundated and sustained serious damage. 800 families will be displaced for soccer while the park remains closed and tournaments will be held in other cities. For the past several years we have been working on a river plan that would reconnect the City with the river, and many now wonder if the river is something to embrace or if it should be feared.

Biking and running trails gone. Fishing tournaments gone. Boat ramps closed. Roads closed. Docks closed until further notice. The cost for just the road repair is in the millions. The cost to our community is overwhelming. How can we move forward from here? We need your help.

First, the residents of Oroville and the surrounding areas deserve to know how this happened. Several public interest organizations brought up the inadequacy of the emergency spillway during the FERC relicensing process in 2005. FERC and the California Department of Water Resources assured us that the dam was safe and could handle any foreseeable flood event. We in Oroville believed this to be true. The fact the emergency spillway was supposedly rated to 350,000 cfs and yet it nearly failed with a flow of just 12,000 cfs tells us that the dam safety regulators at FERC did not take the safety of the citizens of my town seriously.

While some testifying before your committee recommended a 50% expansion in our nation's hydropower, we believe the safety and integrity of the nation's existing hydropower infrastructure needs to be addressed before you consider legislation to promote new hydropower.

With this concern in mind, we request an oversight hearing on FERC's Division of Dam Safety to determine how this regulatory failure occurred. Second, we need to have a full analysis of the impacts of this event to Oroville and the surrounding areas. This should include the direct and indirect impacts to services, infrastructure, and local economies. We also need to have a full analysis of the impacts to the Feather River and how that will impact current and future recreation.

Lastly, we need to have a process to discuss with FERC, DWR, and the water beneficiaries of this project about how these impacts will be mitigated. The fact is that the benefits from the Oroville project are immense. California does not exist in its current form without the water from this project. But it is the people from my community that were in harms way when parts of this project failed. We need to be made whole before any discussion moves forward regarding expanding the role of dams and hydropower.

I sincerely hope that this committee would want to know more about the regulatory failure that occurred at the Oroville Dam before any consideration is given to expanding FERC's regulatory authority on promoting development of new hydropower infrastructure in this country.

Respectfully,

Mayor Linda L. Dahlmeier

TESTIMONY OF THE HYDROPOWER REFORM COALITION

UNITED STATES SENATE
ENERGY AND NATURAL RESOURCES COMMITTEE

HEARING TO RECEIVE TESTIMONY ON OPPORTUNITIES TO IMPROVE AMERICAN
ENERGY INFRASTRUCTURE

MARCH 14, 2017

SENATOR LISA MURKOWSKI, CHAIRMAN
SENATOR MARIA CANTWELL, RANKING MEMBER

Thank you for the opportunity to submit testimony regarding opportunities to improve American Energy Infrastructure and specifically hydropower generation and operation in the United States.

The Hydropower Reform Coalition (HRC) is a diverse consortium of more than 160 national, regional and local organizations with a combined membership of more than one million people. We represent stakeholders, from canoeists to conservationists to lake homeowners, with an interest in restoring rivers that are impacted by hydropower dams. Together, our efforts have protected or restored thousands of river miles and countless opportunities for boating, fishing and other forms of recreation across the country that provide direct economic benefits to communities impacted by hydropower development.

Hydropower Licensing

Hydropower provides approximately 7% of the overall energy production in the country, and comprises 50% of all non-fossil fuel energy consumed in the U.S. The Federal Energy Regulatory Commission (FERC) oversees licensing hydroelectric dams, with the critical involvement of the federal Departments of Agriculture, Commerce, and the Interior, as well as state and tribal water quality agencies. Public interest organizations and individuals likewise participate and add significant value to the process. FERC may grant a license for a term of 30 to 50 years, with the average life of a license being 45 years. Licenses dictate river flows, reservoir levels, public access, and power generation, and thus profoundly affect fish, wildlife, communities, and recreation-based economies for several decades.

The Federal Power Act grants FERC the authority to license non-federal hydropower projects, and FERC is thus the convener and decision maker on many components of the license. The Federal Power Act ensures that power companies have rights and protections as recognized by FERC in the relicensing process. The Clean Water Act grants states, and some tribes, the right to prescribe instream flows for fish, water quality, and water-based recreation in order to protect the interests of their citizens. Federal agencies that are responsible for the management of public land and water and

imperiled and/or migratory fish species also have the ability to protect those public interests in relicensing through issuing mandatory conditions in the license. The National Environmental Policy Act ensures that the relicensing process is science-based, transparent, and open to local citizens, municipalities and counties, and organizations that are most directly affected by the hydropower projects.

These regulatory authorities are designed to ensure that hydropower development balances power and non-power interests and that adverse impacts to underlying resources—such as fish, wildlife, and recreation values—are avoided or mitigated. Without these dovetailed legal authorities, local communities, fish and wildlife, and recreation-based economies would be left, as they historically have been, at risk of irresponsible hydropower development.

Opportunities to Encourage Collaboration and Local Solutions

The current legal and regulatory framework that guides hydropower licensing recognizes the importance of collaboration. The Integrated Licensing Process (ILP) adopted by FERC in 2003, encourages the type of collaboration our member organizations have experienced in successfully developing license proposals that restore flows to rivers at hydropower projects across the country. It brings all the resource agency staff with local knowledge and expertise into the room with the licensee to facilitate information sharing and encourage collaboration as early as possible. The ILP process was developed by FERC through consultation with licensees and other stakeholders, including the HRC. However, despite the process improvements it offers, opportunity remains to further improve coordination and efficiency among the agencies, applicants and stakeholders. One way to accomplish this is for FERC to take actions to further expedite the licensing process by initiating Memorandums of Understanding (MOU) between itself, tribes, and states. An example of this is the MOU our members assisted in crafting between the FERC and the California State Water Resources Control Board to allow the ILP process and the Water Quality Certification process under §401 of the Clean Water Act to happen in parallel, rather than sequentially.

When collaboration does not happen disagreements and intransigence lead to litigation, which is expensive and time consuming. The costs of licensing, monetary and otherwise, are ultimately borne by the people of the United States, and all parties should be interested in minimizing cost whenever possible and appropriate. For these reasons, we believe FERC should promote the adoption of MOUs between itself, tribes, and states to incentivize collaboration.

Another potential avenue to increase collaboration and reduce time consuming consultations is for the Committee to consider delegating to Native American tribes the authority to protect their lands. Currently, §4(e) of the Federal Power Act grants the Secretary of the Interior, working through the Bureau of Indian Affairs, the authority to condition a license to protect tribal resources. If tribes were granted that authority directly, it would expedite the licensing process by eliminating the middleman. There is

precedent for such delegated authority: many tribes have been delegated Clean Water Act authority to set and enforce water quality standards, including in hydropower license proceedings. The HRC urges the Committee to consider, in full consultation with the appropriate tribal representatives, whether it would be advisable to devolve the authority to protect tribal resources from the Department of the Interior to the tribes themselves.

Ensure Critical Information is Available at the Beginning of the Process

It is imperative to start the licensing process by collaboratively developing and carrying out studies about the river, how the project operates, and the impact that it has had on the ecosystem and surrounding communities. This information informs the entire licensing process, and is important to get right because licenses last for 30-50 years. Additionally, many of the projects that are due for relicensing were originally licensed before bedrock environmental laws and health statutes were implemented, and before impacts to water quality, fish, wildlife, recreation and federal lands and waters were adequately considered.

FERC, federal resource agencies, and state and tribal water quality agencies submit requests that studies be done in order to evaluate the impact that a hydropower project has had on their respective jurisdictions. These studies are necessary in order for agencies to fulfill their statutory obligations in relationship to hydropower relicensing. The standard length of a study is only two years, although if the licensee presents insufficient information, the studies may go on longer.

Once agencies, tribes, and other stakeholders submit their study requests, FERC issues a decision (i.e. a "study plan determination") on what studies it determines are necessary. FERC may reject some study requests, including those that are designed to provide critical information for resource agencies to exercise their authority. When this happens, most federal resource agencies undergo a dispute process to ensure that they will have access to the information they need. Agencies with §401 authority under the Clean Water Act have the authority to require their studies later. In both instances, it unnecessarily delays the process. In some cases, decade-long delays have ensued in part because the §401 agency has been denied, by FERC and/or the licensee, access to the information necessary for it to complete the process in a legally defensible manner.

The HRC recommends that at the beginning of the licensing process, FERC either grant these study requests or allow other agencies to require them under their own regulatory authority. We also recommend that FERC and other agencies develop a memorandum of understanding to improve coordination throughout the process, as discussed above. While these recommendations do not necessarily require a change to the Federal Power Act, a statement by Congress would have the salutary effect of encouraging FERC to adopt them.

Some stakeholders are doing a poor job of learning from decades of relicensing proceedings and integrating that knowledge into future study plan development. In our

experience, some licensees argue that studies that were proposed by other stakeholders are unnecessary, when in actuality, they have become standard practice in other relicensing proceedings. The relicensing process could go much more efficiently if FERC works with experienced relicensing stakeholders to develop and implement a Best Practices Guide to relicensing studies.

Meeting the Challenge of Adequately Funding Resource Agencies

Federal resource agencies play a vital role in the hydropower licensing and relicensing process, ensuring that fish, wildlife, recreation and public lands and waterways are granted equal consideration to power generation as stakeholders develop hydropower license conditions. Federal agency staff provide invaluable first-hand, on-the-ground expertise and experiences with the project because they live and work in the region where the project is located. While FERC staff often live in Washington, D.C., and are only able to visit a project once or twice in the course of a relicensing proceeding, federal resource agency staff attend relicensing meetings regularly and have experience from other projects that informs the process. They also have the ability to sit down with the licensee, can get out on the river to observe real-time conditions, and understand the river and its hydrology because they have monitored it. The information that they gather is pivotal to the licensing process, allowing stakeholders to make challenging decisions in the public interest about trade-offs between resource protection and power generation.

Where FERC's mandate relates to energy regulation, Congress directed federal resource agencies (the U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Bureau of Indian Affairs, and the National Marine Fisheries Service) to fulfill certain obligations and make scientifically informed and legally defensible conditions on hydropower licenses. Their ability to carry out their regulatory obligations in a timely fashion has become increasingly constrained in the face of funding restrictions.

In order to carry out their duties in an efficient and effective manner federal resource agencies must be adequately funded in order to support their employees and their work. The HRC recommends that Congress increase appropriations to the federal resource management agencies in order to fund the staff positions that allow them to efficiently and thoroughly evaluate applications for hydroelectric licenses. Additionally, we request that Congress evaluate allowing licensees to pay to the land managing agencies a portion of the fees that they now pay to FERC for the direct cost of implementing their license conditions.

Improving the Process of Adding Hydropower to Existing Army Corps Dams

We have heard concerns from some in the hydropower industry that the FERC licensing process is duplicative of the process required by the U.S. Army Corps of Engineers (Corps) when installing hydropower at existing non-powered dams. However, given that Corps dams are taxpayer owned, authorized by Congress for specific purposes, and are

generally considered critical infrastructure, it is essential that the Corps retain its authority to carefully consider the implications of alterations to their facilities when adding hydropower to their structures. Therefore, we agree with then-Director of the Office of Energy Projects at FERC, Ann Miles, when she testified before the House Energy and Commerce Subcommittee on Energy and Power in May 2015 that it might be advisable for Congress to give the Corps the exclusive authority to regulate non-federal hydropower development at Corps infrastructure.¹ To simplify the process of adding hydropower to non-powered federal dams, the Committee should consider amending the Federal Power Act to remove these dams from FERC's jurisdiction.

Opportunities to Expand the Value of Hydropower

The title of this hearing is "Opportunities to Improve American Energy Infrastructure." It is important to understand the reality of where hydropower fits in the context of other new energy development. In 2016 alone, more than 14 GW of new solar power and 8 GW of wind power were brought online in the United States.² Solar installations were led by California, North Carolina, Nevada, Massachusetts and New York, while the biggest increase in wind production occurred in Texas, Oklahoma, Iowa, North Dakota, Kansas and Nebraska.³ These states span the entire geographic and political spectrum of the United States. For context, the July 2016 U.S. Department of Energy Hydropower Vision Report evaluated the potential for increasing hydropower production in the U.S.⁴ The Report stated that there is potential to add 1.7 GW of new hydropower capacity by 2050⁵ through constructing new dams.⁶ This is just 7% of the wind and solar installed last year alone. In addition, the report stated that the United States could add 11.1 GW of new hydropower capacity by upgrading existing projects and retrofitting non-powered dams with hydropower capabilities by 2050, but even this optimistic projection assumes new advanced technology.⁷ As evidence that there is great potential for growing hydropower capacity in the U.S., some point to the fact that of the 80,000 dams in the United States only 3% currently have hydropower. However, the reality is that the total amount of power that this would generate is small relative to growth potential for other forms of renewable energy. Additionally, while there is certainly potential to retrofit

¹ United States. Cong. House. Committee on Energy and Commerce, Subcommittee on Energy and Power. *Hearing on Discussion Drafts Addressing Hydropower Regulatory Modernization and FERC Process Coordination under the Natural Gas Act*. May 13, 2015. 114th Cong. 1st sess. (Testimony of Ann Miles, Director, Office of Energy Projects, Federal Energy Regulatory Commission at p. 15). Available at: <http://docs.house.gov/meetings/IF/IF03/20150513/103443/HHRG-114-IF03-Wstate-MilesA-20150513.pdf> (last visited March 12, 2017).

² Solar Energy Industries Association. (n.d.) *Solar Market Insight Report 2016 Year in Review*. <http://www.seia.org/research-resources/solar-market-insight-report-2016-year-review> (last visited March 12, 2017); and American Wind Energy Association. (n.d.) *U.S. Wind Industry Fourth Quarter 2016 Market Update*. Available at: <http://awea.files.cms-plus.com/FileDownloads/pdfs/4Q2016%20Fact%20Sheet.pdf> (last visited March 12, 2017).

³ *Id.*

⁴ U.S. Department of Energy, Wind and Water Power Technologies Office. *Hydropower Vision Report*. July 2016. Available at: <http://energy.gov/eere/water/articles/hydropower-vision-new-chapter-america-s-1st-renewable-electricity-source> (last visited March 12, 2017).

⁵ *Hydropower Vision Report* at p. 4.

⁶ See generally, *Hydropower Vision Report*.

⁷ *Id.* at 18.

existing dams, it is doubtful that these facilities will be able to compete in the emerging energy marketplace, unless they have grid-regulating capabilities.

In the past, many have focused on total energy production as the metric to consider when quantifying opportunities for expanding hydropower. However, simply calculating the gross number of electrons that a project can produce is no longer adequate. Instead, the future of hydropower should focus on the value it provides in the context of rapidly changing energy markets. As solar generation increases in California and other energy markets, there is an increasing risk of over-generating power in the middle of the day.⁸ This phenomenon, formally known as the “duck curve,” highlights the fact that bringing on more baseload generation in today’s marketplace is akin to bringing sand to the beach. Simply put, the projects that will have the most value in the immediate and foreseeable future are those that can provide complimentary grid regulation as renewables like wind and solar continue to rapidly come online. To this end, FERC can improve their analysis of license applications by including an assessment of whether projects are capable of regulating the grid while maintaining or improving the integrity of the aquatic environment and recreational values of the waterway. This is something that is already happening. Our members are engaged in the relicensing of a project in California where we can actually increase the grid regulating capabilities of the project while providing additional flows to the river. The future of hydropower lies in this type of smart operation combined with efficient environmental protection.

Lastly, a critically important finding of the Department of Energy’s 2016 Hydropower Vision Report is that building new dams will cost more in both investment dollars and negative impacts to clean water, wildlife, and rural economies than it is worth. The Report concluded that efforts to expand hydropower production should instead focus on promoting efficiency, retrofitting suitable non-powered dams, and upgrading the century-old technology that is present in far too many currently operating hydroelectric projects. We agree. As recent events associated with Oroville Dam on the Feather River demonstrate, the hydropower industry needs to be focused on maintaining their existing projects before considering any expansion. We oppose and strongly discourage any incentives or initiatives aimed at building new hydropower dams. The future of hydropower is in the smart and responsible operation of the existing system to better meet the needs of the grid, with modest additions to capacity at existing dams. The Committee should focus its attention there.

New Consideration for Preliminary Permits Where FERC is Likely to Deny a New Hydropower Project

When a hydropower developer applies for a preliminary permit, a number of factors make it immediately clear that some sites are unsuitable for development. These can include river protections recognized in Comprehensive Plans or significant impacts on other FERC projects, making it highly unlikely that FERC would ultimately issue a

⁸ Scottmadden Management Consultants, *Revisiting the California Duck Curve: An Exploration of Its Existence, Impact, and Migration Potential*, October 2016. Available at: http://www.scottmadden.com/wp-content/uploads/2016/10/Revisiting-the-Duck-Curve_Article.pdf (last visited March 12, 2017).

license for the project. Despite comments from the public highlighting these issues, FERC typically issues the preliminary permit⁹ stating that these issues are “premature at the preliminary permit stage because they address the potential effects of constructing and operating the proposed project.”¹⁰ Instead, FERC states that “should the permittee file a license application, these issues will be addressed in the licensing process”¹¹ to determine 1) the potential effects of constructing or operating the proposed projects and 2) whether the project is consistent with Comprehensive Plans.

In these situations, FERC, the permittee, state, federal and tribal agencies, and the public invest time and financial resources in engaging in the ILP prior to filing a license application over the course of three to five years. If the licensee files for an extension of a preliminary permit or files a license application, the time commitment is further extended before FERC begins any meaningful review. Commonly, either the permittee withdraws their permit or license when it realizes that it will be unable to construct and operate the project, or FERC denies the license. For example, on the Bear River in Idaho, FERC recently denied a license for Twin Lake Canal Company’s Bear River Narrows Hydropower Project (P-12486).¹² The project was located within an area protected from hydropower by the Northwest Power and Conservation Council and was inconsistent with at least eight wildlife and land management plans. It also would have inundated Bureau of Land Management lands designated as of special concern where inundation was prohibited. The project also would have compromised a settlement agreement on an existing upstream hydropower project. In June 2016, FERC denied the license because of the irreparable adverse effects on the Bear River and inconsistency with Comprehensive Plans.

In order to prevent these situations, the HRC recommends that the Committee examine ways to allow FERC to review these issues without having to take several years to go through the full licensing application process. This could involve a step either at the preliminary permit phase or immediately after, where if a project is inconsistent with Comprehensive Plans, FERC can deny the permit or otherwise terminate the licensing process shortly after the applicant files the Pre Application Document and Notice of Intent.

Conclusion

In the collective experience of our coalition, we have had several successful experiences negotiating license agreements that provide for continued profitable generation of hydropower in a manner that recognizes the non-power values our rivers provide for fishery resources, recreational experiences, cultural values, and general public use and enjoyment. We all want our lights to come on and we all value healthy

⁹ FERC has denied preliminary permits where the applicant is proposing to construct a project in the same location as a project that it previously denied a license for based on a finding that the site’s environmental values outweighed its power value. See FERC Project No. 11873.

¹⁰ *Black Canyon Hydro, LLC*, 137 FERC ¶ 62,049 at 62,051 (2011).

¹¹ *Ibid.*

¹² *Twin Lakes Canal Company*, 155 FERC ¶ 61,261 (2016).

rivers. In hydropower licensing, as in all things, we must seek consensus and compromise when possible.

There are many opportunities to improve the hydropower licensing process, the value of hydropower, and the health of our rivers. This includes ensuring that resource agencies have the funding and information they need to fulfill their statutory obligations and incentivizing collaboration through adopting MOUs. It also involves recognizing the role that hydropower plays in a rapidly changing energy market and ensuring it meets the needs of the grid while maintaining or improving the integrity of the aquatic environment and recreational values of the waterway. Finally, as we consider modernizing hydropower we need to focus on maintaining and upgrading existing infrastructure and in some cases, consider project removal.

On behalf of our members and supporters, we again thank the Committee for its attention to this important topic. We are happy to answer questions and provide further information as necessary. Please direct inquiries to Thomas O'Keefe, Chair, Hydropower Reform Coalition at okeefe@americanwhitewater.org or at 425-417-9012.



Northwest Public Power Association

9817 N.E. 54th Street Vancouver, Washington 98662-0576
 (360) 254-0109 FAX (360) 254-5731
 E-mail: nwppa@nwppa.org
 Web Site: www.nwppa.org

March 28, 2017

The Hon. Lisa Murkowski, Chairman
 Committee on Energy & Natural Resources
 United States Senate
 304 Dirksen Senate Office Building
 Washington, DC 20510

The Hon. Maria Cantwell, Ranking Member
 Committee on Energy & Natural Resources
 United States Senate
 304 Dirksen Senate Office Building
 Washington, DC 20510

Dear Chairman Murkowski and Ranking Member Cantwell:

On behalf of the Northwest Public Power Association, I would like to thank you for holding a hearing on improving our energy infrastructure. As an association representing 152 consumer-owned utilities in 9 western states and British Columbia, NWPPA has a direct interest in this topic. The central mission of consumer-owned utilities is to serve their communities with reliable and low cost power on a not-for-profit basis. Maintaining and improving the reliable operation of the electric facilities that our members utilize daily to provide service to their customers is of paramount interest.

Federal Agencies as Facilitators and Members of Project Development Teams

NWPPA supports the testimony of Clay Koplin, Chief Executive Officer of Cordova Electric Cooperative and the Mayor of Cordova, Alaska. Cordova Electric is one of NWPPA's 23 Alaskan members. Clay Koplin is also a member of NWPPA's Board of Trustees. NWPPA and its membership share Cordova Electric's belief that federal participation in energy infrastructure is needed. By focusing on federal collaboration beyond the mere regulator and permitter role to becoming a facilitator and member of agile project development teams, federal government involvement can more quickly build infrastructure projects and deliver the social, economic and environmental values envisioned by Congress.

Hydroelectric Power as a Carbon-free, Renewable Resource

Additionally, we support the need for federal recognition of all hydroelectric power – including existing, large-scale hydro – as a renewable resource. NWPPA supports legislation to improve hydropower licensing timeliness, efficiency, and affordability, and to include credit for early action investments. NWPPA supports the establishment of FERC as the coordinating agency for setting licensing schedules, studies, and resolving conflicting licensing requirements. NWPPA opposes policies that discourage or displace carbon-free hydro generation in favor of other renewable generation. Further, NWPPA supports a default license term of 50 years for all hydropower projects.

Rights of Way Maintenance and Fire Prevention

NWPPA urges the committee to support legislation that establishes a clear and efficient framework for electric utilities and federal agencies to address vegetation management in or near rights-of-way (ROW) on federal lands. Federal permitting for vegetation management is inconsistent among federal land management agencies, risking timely action to maintain safe ROW and prevent unnecessary fire damage. We urge the introduction of legislation that:

- Allows electric utilities to secure pre-approval for vegetation management for ROWs on federal lands;
- Improves timeliness for approval of management plans, ensuring predictability and consistency in the permitting and approval process; and
- Provides protection for utilities if federal agencies fail to respond in a timely manner to proposed vegetation management plans.

Grid Modernization

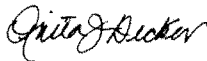
NWPPA supports the federal government's continued role in stimulating grid modernization technology development, by supporting research and development and grants for pilots and implementations of various grid modernization technologies. As an important part of grid infrastructure, modernization projects can come in the form of electric vehicle infrastructure, smart meter investments, new equipment and software, and other technologies. Modernization solutions can more effectively accommodate variable energy resources and optimize distributed energy resources. Grid modernization can also allow integration of connected, responsive, and controllable assets to the benefit of the overall grid system and end-use consumers.

Energy Efficiency

NWPPA supports Congressional efforts to bolster energy efficiency through investments, incentives, and standards. Energy efficiency investments should be considered infrastructure investments, as energy efficiency technologies, applications and building standards can create or impact physical assets and create jobs, which benefit local economies. New investments and incentives for energy efficiency help to raise awareness of the benefits of energy efficiency, increase consumer installations and energy savings, and create demand for and development of additional technologies that support energy independence.

NWPPA appreciated the opportunity to submit written testimony on the issue of improving our country's energy infrastructure. NWPPA looks forward to working with you and our Senate delegation on this issue.

Sincerely,



Anita J. Decker
Executive Director



Steve Moyer
Vice President of Government Affairs

April 11, 2017

The Honorable Lisa Murkowski, Chair
The Honorable Maria Cantwell, Ranking Member
Senate Committee on Energy and Natural Resources

Re: Statement of Trout Unlimited regarding Hydropower development and opportunities to improve American energy infrastructure.

On March 13th the Senate Committee on Energy and Natural Resources held a hearing on energy infrastructure, titled *Hearing to receive testimony on opportunities to improve American energy infrastructure*. The same week, the House Energy and Commerce Subcommittee on Energy held a hearing titled *Modernizing Energy Infrastructure Challenges and Opportunities to Expanding Hydropower Generation* (3/15/2017). Trout Unlimited appreciates the committees' interest in improving the hydropower regulatory framework. We offer the following statement in response to these hearings.

Trout Unlimited and our members have a huge stake in ensuring that hydropower development is done right. TU's mission is to protect, conserve and restore the Nation's trout and salmon fisheries and the watersheds on which they depend. Our 155,000 members live, recreate, hunt and fish along the waterways impacted by hydropower development. TU has a long history of engagement — both in project-specific licensing and in regulatory or policy-level processes — partnering with utilities and project developers to identify and implement collaborative solutions balancing the needs of fish and wildlife with power production goals. From working with Avista Corporation to restore bull trout in northwest Montana, to working with Portland General Electric (PGE) to restore salmon and steelhead on the Deschutes River in Oregon, to working with Pacific Power and Light (PPL) to restore Atlantic salmon on the Penobscot River, Maine, TU has a deep history with hydropower regulation. We have seen it work well, and we have seen it work poorly.

Based on our experience, we offer the following perspective on opportunities to invest infrastructure and improved regulatory processes to support expanding hydropower production while meeting the balanced goals described above. We urge Congress to carefully consider our views, as well as those of the hydropower industry, Tribes, state and federal resource agencies, and communities directly impacted by hydropower generation. We urge Congress to be far more inclusive and deliberate when it develops its legislation than it did in the prior Congress. We urge Congress to develop consensus within stakeholders on the legislation. It is tough work, but just as we have found lasting, durable agreements with stakeholders on individual licenses, we strongly believe that we can as well in Congress.

A mission to conserve, protect, & restore North America's coldwater fisheries and their watersheds.

National Office: 1777 N Kent St., Suite 100, Arlington, VA 22209
T: (703) 284-9406 F: (703) 284-9400 smoyer@tu.org www.tu.org

Trout Unlimited Recommendations

1. Support state, tribal and federal resource agency mandates

The Federal Power Act provides conditioning authority to the State and federal resource agencies to protect fish, wildlife and lands. These authorities include ensuring timely and effective fish passage and assurances of water quality above and below the project. TU relies on federal resource agencies to protect and restore our fisheries resources and to help ensure equal consideration of non-power values in FERC's licensing processes.

Because hydropower licenses can last as long as 50 years, natural resource agencies' roles in the licensing process provides a crucial opportunity to ensure that projects will be properly developed and operated to ensure our river resources are preserved for future generations. This opportunity is all the more crucial for re-licensing, as many of our nations' existing hydropower projects were developed before the existence of most major natural resource laws. The relicensing process provides our resource managers with the much needed opportunity to ensure that these projects are upgraded to meet modern day laws and standards for conservation performance. Support for these agencies is critical to ensuring a timely and balanced outcome.

The most efficient way to ensure a timely process is to ensure these resource agencies have the tools and resources that they need to effectively engage in the licensing process; the greater involvement by these regional local and regional staff, the better the outcomes.

Any legislative proposal should support state and federal conditioning authorities – including support for the resource evaluation and information needs of permitting agencies - and ensure that these agencies have the necessary resources to effectively engage in support of their resource protection obligation to the American public.

Not only does this include preserving the statutory conditioning authorities that allow agencies to protect fish and wildlife habitat and other public land resources, but also supporting funding to agency programs and staff to ensure the resources are available to fulfill these obligations in an efficient and effective manner.

TU recommends that any legislative approach to expanding hydropower infrastructure include the following principles to support state, tribal and federal resource agencies in the licensing and relicensing process:

Do no harm: Protect critical state, tribal and federal resource agency mandates and authorities

Previous legislative proposals proposed to centralize permitting authority at FERC, undercutting the individual conditioning authorities provided by the Federal Power Act sections 4(e), 18, and 10(j) and to the States and Tribes through the Clean Water Act section 401. Although the Commission has a skilled staff, the agency does not have the statutory mandate to protect the lands and resources that are currently within the jurisdiction of its sister agencies in the Departments of the Interior and Commerce, such as fish and wildlife, endangered species, and public lands. These federal resource agencies have

local and regional field staff with on the ground knowledge of the resources involved in any particular licensing process. Their level of familiarity and connection to the resources helps bring a deeper level of knowledge to the process, with is necessary to optimize a license for all users. ***No proposal should minimize or reduce Mandatory conditioning authorities for state and federal resource agencies***

Ensure complete and early record development

Agency authorizations can face delay where the agency is unable to obtain the necessary information as a part of the FERC study process. These studies are necessary in order for agencies to fulfill their statutory obligations in relationship to hydropower relicensing. The standard length of a study is only two years, although if the licensee presents insufficient information, the studies may go on longer.

Delay could be minimized by improving coordination at the study phase to ensure all agencies – not just FERC – are able to obtain the necessary information to complete review and processing of necessary permits and authorizations without additional delay for data collection. Congress could provide direction to FERC to either grant these study requests or allow other agencies to require them under their own regulatory authority. While these recommendations do not necessarily require a change to the Federal Power Act, a statement by Congress would have the salutary effect of encouraging FERC to adopt them.

Support strong funding to agency budgets to support early and consistent engagement

In order to carry out their duties in an efficient and effective manner federal resource agencies must be adequately funded in order to support their employees and their work. We urge the Congress to increase appropriations to the federal resource management agencies in order to fund the staff positions that allow them to efficiently and thoroughly evaluate applications for hydroelectric licenses. Additionally, we recommend that Congress evaluate allowing licensees to pay to the land managing agencies a portion of the fees that they now pay to FERC for the direct cost of implementing their license conditions.

2. Invest in existing infrastructure

TU believes that any effort to increase hydropower supplies should focus first on existing infrastructure, prioritizing power gains through improvement and modernization of existing resources and equipment (efficiency improvements) and adding or expanding production at existing, well-maintained infrastructure – including federal storage facilities and water delivery infrastructure.

Improve operations at existing facilities to increase production while reducing impacts (capacity additions or efficiency upgrades)

A critically important finding of the Department of Energy's 2016 Hydropower Vision Report is that building new dams will cost more in both investment dollars and negative impacts to clean water, fish and wildlife, and rural economies than it is worth. The Report concluded that efforts to expand hydropower production should instead focus on promoting efficiency, retrofitting suitable non-powered dams, and upgrading the century-old technology that is present in far too many currently operating hydroelectric projects. We agree

Adding power at appropriate non-powered dams and conduits (well-maintained and mitigated facilities)
—anywhere water is moving, there is opportunity for power generation.

Opportunity exists to expand hydropower development at existing infrastructure — such as federal dams and irrigation delivery systems where water is already in motion for another important use. Conduit development in particular has the potential to be beneficial for rural agricultural communities as in-conduit energy development creates opportunity for benefit to water users and ecosystem values by creating an additional source of revenue for investment in water saving efficiencies or infrastructure improvements, such as fish passage and screening or improved bypass flows. Conduit development can bring in rural, dispersed sources of power to irrigation districts and water users whose power needs are often far from the grid.

To encourage these types of developments, Congress can help by supporting multi-use authorizations at federal facilities. Such action would add power production and fish and wildlife as authorized purposes consistent with existing and primary project purposes. This would enable flexible management and allow for more creative solutions.

For example, in 2013, TU supported Representative Tipton's Bureau of Reclamation Small Conduit Hydropower and Rural Jobs Act, which became Public Law No: 113–24. The bill was aimed at improving the process for hydropower development at Bureau of Reclamation Facilities and was advanced without sacrificing the environmental review and protections that are essential to balanced outcomes.

Improvements could also be made to the regulatory process for licensing hydropower developments at US Army Corps of Engineers' (USACE) projects to minimize delay and process duplication between the FERC and USACE licensing processes for adding hydropower to non-powered Corps facilities.

3. Encourage Ongoing Investment during life of license

Look for opportunity to promote mid-term investments by utilities to support ongoing study and improvement during the license term. A current complaint with relicensing is that there is too much study and too much expense. Ongoing investment and study would arguably allow a utility to spread investment cost over time while also entering the next relicensing period with more data and understanding about project operations and impacts. One approach, outlined in previous legislative proposals, would allow the Commission to consider certain “project-related investments” made by the licensee over the term of the project license (where those investments did not already result in an extension of the license term by the Commission) as a factor in determining the length of a project license during relicensing. This approach would encourage project owners to make early or ongoing project investments that may be above and beyond what their underlying FERC license requires by clarifying that FERC will take these investments into account when evaluating a future relicensing proposal. This concept is worth further exploration.

4. Support Cooperative Processes and Collaborative Settlements that Consider Larger Picture - Local solutions, local successes

Whether adding capacity to an existing non-powered dam or conduit, or relicensing and updating operations at an existing facility – the best outcomes are achieved in the context of a multi-stakeholder, collaborative approach. TU has partnered with industry and other stakeholders in a number of licensing settlements and related processes.

Trout Unlimited staff and volunteers have worked on hundreds of licensing and relicensing processes around the country. Some of the best results came from those examples where utilities, agencies and stakeholders worked collaboratively to develop a plan to advance power and non-power needs. To name but a few among these processes, TU worked to restore valuable fisheries and relicense dams owned by Avista Corporation in northwest Montana; PGE on the Deschutes River in Oregon, and PPL on the Penobscot River, Maine.

We supported these efforts because they were focused on improving the regulatory process or promoting project development without sacrificing natural resource safeguards. We urge the Committee to apply this same basic principle to any future legislative proposal regarding hydropower licensing.

Additional Considerations

Changing Climate: Changes to timing and magnitude of streamflow will have an impact on hydro operations and in the cost-benefit calculation for new hydro resources. On the supply side, warming temperatures will likely reduce snowpack in the West, which is important for maintaining base flows in rivers and streams during the dry season (e.g., mid-summer-early fall) when there is little precipitation. This will likely cause a reduction in hydropower generation. Conversely, hydropower generation may increase in some areas during the winter because warmer temperatures will likely result in more precipitation falling as rain as opposed to snow increasing streamflow. On the demand side, warmer temperatures are predicted to reduce winter heating demands, while significantly increasing peak demands during summer periods. Consequently, it is likely that hydropower will be a less reliable energy source in the future because its availability during times of high demand will be diminished as the climate warms.

Aging Infrastructure: While we see promise for expanding hydropower at existing facilities, we caution that not all dams are suitable for hydropower operations. As noted in the hearing memo, many of America's dams have exceeded their design life and are in need of modernization. By 2025, 70 percent of the dams in the US will be over 50 years old. According to the American Society of Civil Engineers, 15,500 dams are classified as high hazard.

As the Congress undertakes evaluation of the interconnected topics of Infrastructure investments; expanding hydropower generation and water storage and delivery solutions for the drought-stricken west; we encourage lawmakers to include consideration of dam removals and infrastructure repair as part of the overall picture.

Lawmakers should also carefully weigh the relative energy benefits and natural resource impacts of multiple small dams. Dam impacts on fisheries do not necessarily scale up with size. An old 500 kilowatt

hydro plant with no fishway near the head of tide on a coastal river can have much larger impacts on recreationally and commercially important fish than a modern 50 MW plant that can afford good fish passage or appropriate mitigation. Resist calls to exempt older or small plants from fish passage requirements.

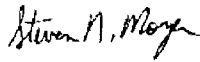
Conclusion

The most balanced and efficient way to bring new hydropower online, is to ensure that the development is well-sited and appropriately mitigated from the start and to support and encourage early and often investment in evaluating and improving operations over time.

We support a balanced and critical review of current processes for regulating, mitigating and integrating hydropower. We hope that such discussions will help to ensure that any legislative proposals are carefully tailored to address specific concerns or opportunities for improvement in a manner that balances power and non-power values. We were very concerned with legislation advanced during the last Congress, such as the hydropower provision of HR 8. Specifically, we urge Congress to support and defend resource agency authorities and mandates - including the Clean Water Act, Endangered Species Act and Federal Power Act.

We appreciate the opportunity to provide these comments to the committee of its consideration and we look forward to working with members of the committee to identify areas for improvement in the process that will not result in loss of protections for fish, wildlife and recreation values.

Sincerely,



Steve Moyer

Summary of Recommendations:

1. Support state, tribal and federal resource agency mandates;
 - Keep in place critical state, tribal and federal resource agency mandates and authorities
 - Ensure study requests are approved to ensure complete and early record development
 - Support strong funding to agency budgets to support early and consistent engagement
2. Invest in Existing infrastructure;
 - Improve operations at existing facilities to increase production while reducing impacts (capacity additions or efficiency upgrades)
 - Adding power at appropriate non-powered dams and conduits (well-maintained and mitigated facilities) –anywhere water is moving, there is opportunity for power generation.
3. Encourage Ongoing Investment during life of license;
4. Support Cooperative Processes and Collaborative Settlements.

