# A SMARTER INVESTMENT: PATHWAYS TO A CLEAN ENERGY FUTURE

## VIRTUAL HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

OF THE

## COMMITTEE ON ENERGY AND COMMERCE

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# C O N T E N T S



[1] Mr. Camp did not answer submitted questions for the record by the time of publication.

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[2] The report has been retained in committee files and is available at https://docs.house.gov/meetings/IF/IF03/20210218/111210/HHRG-117-IF03-20210218-SD014.pdf.

# A SMARTER INVESTMENT: PATHWAYS TO A CLEAN ENERGY FUTURE

**THURSDAY, FEBRUARY 18, 2021**

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY,
COMMITTEE ON ENERGY AND COMMERCE,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 11:30 a.m., via Cisco Webex online video conferencing, Hon. Bobby Rush (chairman of the subcommittee) presiding.

Members present: Representatives Rush, Peters, Doyle, McNerney, Tonko, Veasey, Schrier, DeGette, Butterfield, Matsui, Castor, Welch, Schrader, Kuster, Barragán, Blunt Rochester, O'Halleran, Pallone (ex officio), Burgess, Latta, McKinley, Kinzinger, Griffith, Johnson, Bucshon, Walberg, Duncan, Palmer, Lesko, Pence, Armstrong, and Rodgers (ex officio).

Staff present: Jeffrey C. Carroll, Staff Director; Waverly Gordon, General Counsel; Tiffany Guarascio, Deputy Staff Director; Perry Hamilton, Deputy Chief Clerk; Anne Marie Hirschberger, FERC Detailee; Zach Kahan, Deputy Director, Outreach and Member Services; Rick Kessler, Senior Advisor and Staff Director, Energy and Environment; Mackenzie Kuhl, Press Assistant; Jourdan Lewis, Policy Coordinator; Elysa Montfort, Press Secretary; Lino Pena-Martinez, Policy Analyst; Kaitlyn Peel, Digital Director; Nikki Roy, Policy Coordinator; Medha Surampudy, Professional Staff Member; Tuley Wright, Senior Energy and Environment Policy Advisor; Sarah Burke, Minority Deputy Staff Director; Jerry Couri, Minority Deputy Chief Counsel for Environment; William Clutterbuck, Minority Staff Assistant; Nate Hodson, Minority Staff Director; Peter Kielty, Minority General Counsel; Emily King, Minority Member Services Director; Mary Martin, Minority Chief Counsel, Energy and Environment; Brandon Mooney, Minority Deputy Chief Counsel for Energy; Brannon Rains, Minority Policy Analyst, Consumer Protection and Commerce, Energy, Environment; Peter Spencer, Minority Senior Professional Staff Member, Energy; and Michael Taggart, Minority Policy Director.

Mr. RUSH. I am going to symbolically gavel the meeting to order. The Subcommittee on Energy will now come to order.

I want to thank all of you all for your presence here. Today the subcommittee is holding a hearing entitled "A Smarter Investment: Pathways to a Clean Energy Future."

Due to COVID–19 and this pandemic that we are living in, the public health emergency, today's hearing is being held remotely.

Our Members and our witnesses will be participating via video conferencing.

As part of our hearing, microphones will be set on mute for the purposes of eliminating any and—any unnecessary—as part of our hearing, microphones will be set on mute for the purposes of eliminating inadvertent background noise. Members and witnesses, you will need to unmute your microphone each time you wish to speak.

Documents for the record can be sent to Lino Pena-Martinez in the email address that we provided through staff. All documents will be entered into the record at the conclusion of the hearing.

And now, today, in—the Subcommittee on Energy convenes for its first hearing in the 117th Congress. Before I proceed to beginning the opening statements, I would like to take a moment to welcome to the subcommittee's new majority and minority—new minority Members. I want to take a moment just to welcome our new majority Members, and they include Congresswoman Kim Schrier from Washington.

Welcome, Kim.

She is new to the Energy and Commerce Committee. And two veterans of the Energy and Commerce Committee, Congresswoman Doris Matsui of California—wave to us, Doris, that is right; she will be joining with us—and Congresswoman Kathy Castor. Is Kathy on the line? I don't see her on the line. They will both be joining us.

Ms. CASTOR. Thank you, Mr. Chairman.

Mr. RUSH. Thank you. I am pleased to have each of our new majority Members on the subcommittee for this Congress.

And we also have returning with us our esteemed ranking member, Fred Upton, of the great State of Michigan. And Fred, I am also pleased that you also are rejoining us as the leader of our minority colleagues.

And would you at this time like to introduce the minority's new Members?

Mrs. RODGERS. Thank you, Mr. Chairman, this is Cathy. Fred Upton is not able to be with us today, so we have Dr. Burgess that is sitting in to serve as the ranking member on the subcommittee. And, as far as our new Members, I can do a little wing action here.

Let's see here: Debbie Lesko from Arizona, new Member to the subcommittee; Greg Pence from Indiana, new Member to the subcommittee. And the rest of you may need to wave at me here.

Mr. RUSH. I think we have Gary Palmer.

Mrs. RODGERS. Gary Palmer.

Mr. RUSH. And Debbie Lesko.

Mrs. RODGERS. Yes.

Mr. RUSH. Greg Pence.

Mrs. RODGERS. Yes.

Mr. RUSH. And Kelly Armstrong.

Mrs. RODGERS. There we go, Kelly Armstrong. I did see him, too.

Mr. RUSH. Right.

Mrs. RODGERS. Thank you, Mr. Chairman.

Mr. RUSH. That is quite all right. Well, I want to thank you, Chairman—the ranking member of the full committee. And I will now—opening—5 minutes for an opening statement on my part. I recognize myself for 5 minutes for a brief opening statement.

**OPENING STATEMENT OF HON. BOBBY L. RUSH, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS**

In October 2018 the IPCC Panel on Climate Change released a special report on global warming. This report made several things apparent: global emissions are on the rise; changes are necessary before 2030; and, to avoid the harshest consequences of this climate change, we must reduce global emissions to net zero by 2050. Today the subcommittee meets to discuss the reinvigoration of our Nation's pathways to a clean energy future toward those very ends.

In the year 2018 the energy sector was the second-largest source of U.S. greenhouse gas emissions. This is according to the U.S. Energy Information Administration in 2019.

In the year 2019, approximately 26 percent of the U.S. energy-related $CO_2$ emissions came from mining petroleum fuels; 33 percent came from natural gas; and 21 percent came from burning coal. In the same year, 63 percent of U.S. electricity generation came from fossil fuels.

These past trends may seem daunting. However, reports show that a clean energy future is more than possible and that our progress toward this goal is well underway. For a case in point, renewables will account for most of the new electricity generating capacity for commercial operations in the year 2021. In addition, the cost of clean energy sources like solar power has increased by up to 82 percent since 2010, as a result of improved technology and expanding market participation.

This month the National Academies released a report on the U.S. energy system. The report emphasizes that achieving net-zero carbon emissions in our Nation by 2050 is not only feasible, but that it would also bolster the economy, increase the availability of quality jobs, and help address systemic and longstanding social injustices.

It also concludes that near-term emission reduction may be achieved by doubling generation from noncarbon-emitting sources, deploying renewables, scaling back coal and some gas, and preserving nuclear and hydroelectric plants.

Representatives of the subcommittee, I humbly submit to you that getting the U.S. back in the lead on clean energy is essential for all of us. Yet there are severe consequences to our inaction. Inaction is not an option.

Recent manifestation of this includes the disproportionate impact of the coronavirus on communities that shoulder the burden of energy generation and what is currently happening in the great State of Texas, where many of you reside, also where at least 4.3 million customers have endured frigid—I must say, Chicagolike—temperatures without electricity. This is a climate crisis in the State of Texas, and I do intend to have hearings in the future around the failure of our energy center to protect our American citizens in the State of Texas.

Members, through our jurisdiction and through our membership, you and I have the tools and we are the team to address these issues and other issues, as well. We demonstrated this same acumen during the 116th Congress by releasing the CLEAN Future Act, which was a framework to get the U.S. on a path to net zero by 2050.

This year we are in pursuit of complementary policies that would increase our overall transmission capacity to support energy security; advance electric vehicle charging; drive diversity and inclusion; and increase clean energy usage via strategies like a clean electricity standard.

It has been said that a journey of 1,000 miles begins with the first step. Today, my dear colleagues, I urge the reinvigoration of our march toward a clean center of gravity, and that is to—and that is we must march forward to a clean, reliable, and secure energy future.

[The prepared statement of Mr. Rush follows:]

## PREPARED STATEMENT OF HON. BOBBY L. RUSH

In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released a special report on global warming. This report made several things apparent: global emissions are on the rise, changes are necessary before 2030, and, to avoid the harshest consequences of climate change, we must reduce global emissions down to net zero by 2050. Today, the Subcommittee meets to discuss the reinvigoration of our Nation's pathway to a clean energy future toward those ends.

In 2018, the energy sector was the second-largest source of U.S. greenhouse gas emissions. According to the U.S. Energy Information Administration, in 2019, approximately 46 percent of U.S. energy-related $CO_2$ emissions came from burning petroleum fuels, 33 percent came from natural gas, and 21 percent came from burning coal. In the same year, 63 percent of U.S. electricity generation came from fossil fuels.

These past trends may seem daunting. However, reports show that a clean energy future is more than possible, and that our progress towards this goal is well underway. Case in point, renewables will account for most of the new U.S. electricity generating capacity for commercial operations in 2021. In addition, the cost of clean energy sources, like utility-scale solar power, has decreased by up to 82 percent since 2010 as a result of improved technologies and expanded market participation.

This month, the National Academies released a report on the decarbonization of the U.S. energy system. The report emphasizes that achieving net-zero carbon emissions in the U.S. by 2050 is not only feasible, but that it would also bolster the economy, increase the availability of quality jobs, and help address systemic and long-stemming social injustices. It also concludes that near-term emissions reductions may be achieved by doubling generation from non-carbon emitting sources, deploying renewables, scaling back coal and some gas, and preserving operating nuclear and hydroelectric plants.

Members of the subcommittee, I submit to you that getting the United States back in the lead on the clean energy game is essential. There are severe consequences to our inaction. Recent manifestations of this include the disproportionate impact of the coronavirus on communities that shoulder the burden of energy generation and what is currently happening in Texas, where 4.3 million customers have endured frigid, Chicago-like temperatures without electricity.

Through our jurisdiction and membership, we have the tools and the team to address these issues and other challenges. We demonstrated this during the 116th Congress by releasing the CLEAN Future Act, a framework to get the U.S. on a path to net zero. This year we are in pursuit of complementary policies that will increase our overall transmission capacity to support energy security, advance electric vehicle charging, drive diversity and inclusion, and increase clean energy usage via strategies, like a clean electricity standard.

It has been said that a journey of a thousand miles begins with a single step. Today, colleagues, I urge the reinvigoration of our march toward a new center of gravity—and that is forward to a clean, reliable, and secure energy future. And with that, I recognize my friend and colleague, the gentleman from Michigan, Ranking Member Upton.

Mr. RUSH. And with that, I recognize—now recognize my friend and colleague, the gentleman from Texas, who is the acting ranking member of the Energy Subcommittee.

I recognize you for 5 minutes for an opening statement, Representative Burgess.

## OPENING STATEMENT OF HON. MICHAEL C. BURGESS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. BURGESS. And I thank the Chair. And let me just say, starting out, I also want to thank the Denton Independent School District that has provided me one of their offices that has both heat and Internet. So I knew I needed a reliable source of Internet to be a participant in this hearing.

And Chairman Rush, it is good to be back with you. Of course, you and I served for 5 terms on the Energy Subcommittee going back to the 119th Congress. I took a brief hiatus, but with the retirement of Representatives Olson and Flores, is it important to have a Texan back on the subcommittee.

And your hearing today does occur at a critical time in the Nation's history: 5 million American households left without electricity across Oklahoma, Texas, Louisiana, and Arkansas. And we had dangerous, record-setting winter weather, which ravaged the entire central United States, blasting subfreezing Arctic air all the way well south of the Mexican border, and many types of power production across all fuel types were challenged and went offline. People were left stranded. Power outages have lasted for days. Other utility services, particularly water, has also been impacted. Tragically, people have lost their lives.

Americans are rightfully angry. Texans are rightfully angry and deserve answers. Given these recent events, it is important—and I welcome your observation to hold additional hearings, but part of today's hearing should focus on ways to increase the reliability and resilience of our electric grid. This is not a partisan issue. When the temperature drops below zero, no one cares which party the electricity comes from. They just want the heat to come on, the lights to go on when they flip the switch.

As we know, Texas leads the nation in renewable power. It has transitioned faster than any other State. Congress needs to gather facts and understand the root causes of this energy crisis before speeding ahead with new renewable mandates that shift away from more reliable components of the existing energy fleet.

In recent years the energy sector has done a rapid transformation and reduced our dependence on foreign energy. And that is so critically important, and people forget that. And it has helped rescue us from the 2008 economic recession and lowered our Nation's emissions. This revolution was not produced alone by Federal spending and mandates, but instead created by America's spirit of innovation and our Nation's dynamic free market economy. Transformation has brought many benefits to our Nation, including—but those benefits do not eclipse the importance of a stable supply of energy for all Americans.

Investments are made in new energy production and energy infrastructure, but the reliability of those systems must always be the priority. Unfortunately, some of the early actions of this administration canceling pipelines, prohibiting new energy production on Federal lands signaled the desire to go in the opposite direction.

And let me just remind my colleagues that America leads the world in reducing its carbon emissions. And some of us are still around who sat through the markup of the 2009 Waxman-Markey climate bill. But, in fact, we have reduced emissions through mar-

ket forces greater than what would have been reduced if Waxman and Markey's bill had been signed into law. So let's not forget the actions that have been produced by the free market, and they will reduce our Nation's—they—if we don't pay attention to that, we will reduce our Nation's energy resiliency and hurt our energy workers without any significant impact to global emissions.

Look, Chairman Rush, you are correct to say that America deserves a cleaner energy future, but pursuing a path toward that future while ignoring energy reliability may be the wrong approach. This subcommittee, this subcommittee should work together to prioritize the reliability of our power sector. We can pursue methods of expediting clean, American-made energy products, but we must remove barriers to slowing down innovation and creating jobs to provide affordable energy at home for Americans at home. Our energy sector stands ready to meet those challenges, but we can't let the heavy hand of government become an additional obstacle.

Look, we have got significant work ahead of this Congress. We can look to America's clean energy future, but we cannot afford to rapidly transition our energy system without assurance of its reliability. We cannot support policies that destroy entire industries or increase America's dependence on foreign sources of energy and critical minerals. I hope we can find a bipartisan consensus and keep those priorities in mind.

[The prepared statement of Mr. Burgess follows:]

## PREPARED STATEMENT OF HON. MICHAEL C. BURGESS

Thank you, Chair Rush, I look forward to serving on the Energy Subcommittee with you once again in the 117th Congress.

Today's hearing occurs at a critical time in our Nation's history. This week, almost 5 million American households were left without electricity across Oklahoma, Texas, and Louisiana as dangerous and record-setting winter weather ravaged the Central United States, blasting sub-freezing arctic air all the way south to the Mexican border. Many types of power production—across all fuel types—went offline.

People were left stranded, with power outages that lasted for days. Other utility services, like water and sewage were also impacted. Tragically, people lost their lives. Americans are rightfully angry and deserve answers.

Given these recent events, I intend to use today's hearing to focus on ways to increase the reliability and resilience of our electric grid. This is not a partisan issue. When the temperature drops below zero, nobody cares where the electricity comes from—they just need the heat to come on.

As we know, Texas leads the Nation in renewable power, and it transitioned faster than any other State. Congress needs to gather the facts and understand the root causes of this energy crisis before speeding ahead with new renewable energy mandates that shift away from a reliable existing fleet.

In recent years, the energy sector has undergone a rapid transformation that has reduced our dependence on foreign energy, helped rescue us from an economic recession, and lowered our Nation's emissions. This revolution was not produced by Federal spending or mandates, but instead created by America's spirit of innovation and our Nation's dynamic, free market economy.

This transformation has brought many benefits to our Nation, but those benefits do not eclipse the importance of a stable supply of energy for all Americans. As investments are made in new energy production and energy infrastructure, the reliability of those systems must always be the priority.

Unfortunately, President Biden's early actions, such as canceling the Keystone XL pipeline, rejoining the Paris Climate Agreement, and prohibiting new energy production on Federal lands, signal a desire to go in the opposite direction.

Let me remind my colleagues that America leads the world in reducing its carbon emissions and that the 2006 Waxman-Markey climate bill would have produced worse results for the environment than the results produced by the free market.

These actions will reduce our Nation's energy resiliency and hurt our energy workers without any significant impact to global emissions.

We all agree that America deserves a cleaner future, but pursuing a path towards that future while ignoring energy reliability is the wrong approach.

This subcommittee should work together to prioritize the reliability of our power sector. We can pursue methods of expediting clean, American-made energy products. We must remove barriers slowing innovation to create jobs and provide affordable energy at home. America's energy sector stands ready to meet these challenges, but we can't let the heavy hand of government become an obstacle.

Our subcommittee has significant work ahead this Congress. We can look to America's clean energy future, but we cannot afford to rapidly transition our energy system without assurance of its reliability. We cannot support policies that destroy entire industries or increase America's dependence on foreign sources of energy and critical minerals. I hope we can find bipartisan consensus with those priorities in mind.

Mr. BURGESS. And Mr. Rush, I would also ask unanimous consent—in my research for this hearing I came across a Scientific American article that talked about the 2003 northeast blackout 5 years later. And interesting in this look-back article, they referenced the Energy Policy Act of 2005, which many of us will remember, that created some additional resiliency because of the challenges to the northeast grid that happened during that summer. And, of course, we all recall that many lives were lost to the extreme heat conditions, and we can't forget that heat can be just as deadly as cold if Americans are unprepared.

But again, Mr. Chairman, I will get this—have my staff get this to your staff, but I would ask unanimous consent to include it as part of the record, and I will yield back.

Mr. RUSH. The gentleman yields back.

Are there any objections?

Hearing no objections, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. RUSH. The chairman now recognizes the chairman of the committee, Mr. Pallone, for 5 minutes.

**OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY**

Mr. PALLONE. Thank you, Mr. Chairman.

Today the Energy Subcommittee begins its work for this Congress renewing our efforts to chart a path to a clean energy future. Last Congress was particularly productive for the subcommittee, culminating in enactment of the Energy Act of 2020. And I commend Chairman Rush, along with many others from both sides of the aisle, for their work on this new law that was included in the omnibus.

Last year Chairmen Rush, Tonko, and I released a draft of the CLEAN Future Act, comprehensive climate legislation to get us to a 100 percent clean economy by 2050. In the coming weeks we plan to introduce an updated version of the CLEAN Future Act that will serve as the basis for comprehensive climate action this year.

The CLEAN Future Act touches on the whole energy economy, from the power sector to buildings to transportation, all aspects we will explore at today's hearing. The bill includes a Federal clean electricity standard, or a CES, a policy that has long existed in many States. A national CES can play a key role in building a

clean power sector, which is critical to reducing carbon emissions in other economic sectors. And the CLEAN Future Act also sets forth policies to drastically reduce energy consumption in the building, transportation, and industrial sectors, among others.

Now, President Biden has made the climate crisis a centerpiece of his administration and has already taken bold actions to address climate change. I stand ready to work with him to enact comprehensive climate legislation, and I hope my Republican colleagues will join us in that effort.

Now, as we discuss the climate crisis, it is important to also recognize the effects of the COVID–19 pandemic. Last Congress this subcommittee held a hearing on the impacts of the pandemic on the energy sector, including job loss, delayed projects, and the effect of pandemic restrictions on energy demand. Pandemic-related job losses have also resulted in millions of households being unable to pay their utility bills, and that is why the reconciliation instructions our committee marked up last week included additional funding for the Low-Income Home Energy Assistance Program, or LIHEAP. And LIHEAP helps the growing number of qualifying families pay their utility bills and is especially crucial during a pandemic.

And last, it is critical that we discuss the devastating toll this week's severe winter weather is taking on our Nation. Millions are facing power outages and dangerously cold conditions, and these outages are further exacerbated by the COVID–19 pandemic.

Now, earlier this week the energy market in Texas, known as ERCOT, was forced to take 34,000 megawatts of electricity generation off the system. And since Sunday evening, over 25,000 megawatts of mostly fossil-fueled energy were offline. Of this number, most of those outages are at gas-fired power plants.

Those are the facts, as stated by Texas's own regulator. Yet some Republicans and media outlets are suggesting alternative realities. They are turning a crisis into an antirenewables campaign, and they are conveniently leaving out the fact that the majority of the failures have come from fossil fuel. So we can't allow the Texas crisis to be used as an excuse to discourage movement towards renewables. That will not help Texas or the United States.

What failed here was an energy sector that didn't consider fully our changing climate and the extreme weather that comes with it. It was a failure to fully recognize that the 100-year-old storm of yesterday may now be the 10-year storm of today. As both the Department of Energy and fossil generation companies reported yesterday, gas pipelines, wells, and plants all froze because they weren't equipped to handle the cold weather.

But I agree—I heard what Dr. Burgess said, and I agree that we need to do more in terms of resiliency. And certainly the bill that we are hoping—an infrastructure bill that we are hoping we will be doing, similar or maybe even more expansive than the Moving Forward Act that we passed last year in the Congress and through this committee, will be an opportunity for us to address some of these resiliency issues, as well. And those things are also included in our CLEAN Future Act.

But I do think that the severely limited interconnection between ERCOT and the rest of the country probably didn't help matters ei-

ther. I think it is sad that we saw these problems arise 10 years ago with another major storm that hit Texas and the Southwest, and the Federal Energy Regulatory Commission at the time issued a report, but nothing really changed. You know, the fact that Texas is almost like an island separated from the rest of the Nation's energy grids I don't think helps, because it is more difficult for us to get power to them in the time of crisis. So hopefully we won't ignore this last FERC report, and we will follow up on it.

And I also want to stress that this committee will investigate the Texas crisis further, and we will see what other actions we have to take based on that oil report as well as what we find out now. So, ultimately, this episode underscores the importance of prioritizing clean and resilient energy infrastructure, which is exactly what we aim to do with this.

So thank you again. I yield back.

[The prepared statement of Mr. Pallone follows:]

## PREPARED STATEMENT OF HON. FRANK PALLONE, JR.

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The CLEAN Future Act touches on the whole energy economy, from the power sector to buildings to transportation—all aspects we will explore at today's hearing. The bill includes a Federal clean electricity standard, or CES, a policy that has long existed in many States. A national CES can play a key role in building a clean power sector, which is critical to reducing carbon emissions in other economic sectors. And the CLEAN Future Act also sets forth policies to drastically reduce energy consumption in the building, transportation, and industrial sectors, among others.

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Finally, it's critical we discuss the devastating toll this week's severe winter weather is taking on our Nation. Millions are facing power outages in dangerously cold conditions. These outages are further exacerbated by the COVID–19 pandemic. Earlier this week, the energy market in Texas known as ERCOT was forced to take 34,000 megawatts of electricity generation off its system. Since Sunday evening, over 25,000 megawatts of mostly fossil-fueled energy were offline. Of this number, most of these outages are at gas-fired power plants.

Those are the facts as stated by Texas' own grid regulator. Yet, some Republicans and conservative media outlets are peddling alternate realities. They are shamefully turning a crisis into an anti-renewables campaign, and they are conveniently leaving out the fact that the majority of the failures have come from fossil fuel infrastructure. Unfortunately, this misinformation campaign is nothing new.

The fact is the power outages in Texas and other States throughout the Midwest and South are not a failure of any single generation technology. Every technology has been affected, including nuclear and coal. What failed was a sector that didn't consider fully our changing climate and the extreme weather that comes with it. It

was a failure to fully recognize that the 100-year storm of yesterday may now be the every-10-year storm of today.

As both the Department of Energy (DOE) and fossil generation companies reported yesterday, gas pipelines, wells, and plants all froze because they weren't equipped to handle the cold weather.

Furthermore, the severely limited interconnection between ERCOT and the rest of the country probably didn't help matters. What's truly sad is that we saw these problems arise 10 years ago this month with another major storm that hit Texas and the Southwest. The Federal Energy Regulatory Commission (FERC) even issued a report, but nothing changed. Hopefully, this time it will.

The fact that Texas is an island separated from the rest of the Nation's energy grid doesn't help because it's only more difficult for us to get power to them in a time of crisis. Hopefully, we won't ignore this last FERC report and we'll follow up on it. I also want to stress that this committee will investigate the Texas crisis further and we'll see what other action we have to take based on that report as well as what we find out today.

Ultimately, this episode underscores the importance of prioritizing clean and resilient energy infrastructure, which is exactly what we aim to do in the CLEAN Future Act.

These major outages also show that the climate crisis doesn't differentiate between red States and blue States: the whole Nation is being impacted by the climate crisis. It's time to recognize that and join together to enact the best comprehensive solutions for keeping Americans safe with affordable, reliable, and clean energy.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the ranking member, Mrs. McMorris Rodgers, for 5 minutes.

## OPENING STATEMENT OF HON. CATHY MCMORRIS RODGERS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WASHINGTON

Mrs. RODGERS. Thank you, Mr. Chairman. And I want to thank Dr. Burgess for the extra effort to sit in the lead Republican chair today. He is certainly at the right place at the right time for this hearing. Texas has the lowest energy cost in the country, along with the fastest transition to clean energy.

With that, let's recognize that there are many good ideas for developing cleaner energy systems to ensure that we win the future. The key is to recognize how we unleash American innovation and free enterprise using all our resources to protect our economic and energy security. We should build, not destroy. We should use our abundant natural resources like hydrogen and natural gas, not shutter them. We should enable people to deploy, take risks, improve, and create the next great advances so America leads a new era of entrepreneurship and innovation.

We can pursue practical policies to innovate a cleaner energy future if we work together. We should be clear-eyed about what is at stake if we get this wrong.

The radical environmental left is pushing top-down, one-size-fits-all mandates and costs on Americans, which will threaten our Nation's energy dominance and our national security. This is clear in the repeated attacks on our oil and natural gas industry and its people, which has provided tremendous opportunity and given the advances—has actually driven the advances in cleaner energy generation that are benefiting all around the globe. Yet the left is rejecting fossil energy, while also talking about transforming America's electricity system in 14 years, and the entire energy economy in 30 years.

How is that possible? What does this transformation really mean for our economy? What does it mean for families and workers? We

should look beyond the rhetoric to understand what this is really about, and we should understand the consequences on energy, reliability, household cost, and security.

The importance of reliability has been on full, heart-wrenching display this week in Texas, the South, and the Midwest. At times available electricity could not meet the record-high demand for power from the extreme cold. Wind turbines across the State froze. Natural gas production was shut in. This ultimately deprived the grid of critical energy and power, just as the demand spiked. There wasn't enough natural gas supply or baseload generation to close the gap, especially because of other weather issues and emergency priorities to heat homes and hospitals.

On Monday, to prevent more widespread power failure, the Texas grid operator, ERCOT, directed utilities to implement outages that eventually affected an estimated 5 million households. The emergency exposed systematic weaknesses relating in part to overreliance on intermittent renewables. It is a powerful reminder that electricity reliability is a life-and-death matter.

The supply of energy also is a serious pocketbook matter, especially for low-income households. Low- and middle-income families must be top of mind if this discussion turns to new, clean energy mandates and taxes. Especially during the pandemic recovery, families cannot afford an increase in their electricity and gasoline bills.

According to the Department of Energy, States with the highest low-income energy burdens, 10 percent or higher, are in the Southeast. For mostly heating and cooling, low-income households use about 36 percent more power than the national average for low-income households in other regions of our country. Fortunately, States like my home state of Washington also enjoy some of the lowest electricity rates in the Nation, thanks to our hydropower.

But imagine how families will be squeezed if top-down energy policies increase the price of electricity. What happens when people in Mississippi, Alabama, Georgia, or South Carolina have to pay the same rates as people in California or Connecticut?

And then there is economic and national security. The rush to green seeks to ban fossil energy and its quality jobs for millions of people. It will massively increase reliance on renewables and electrification of transportation. This domestic policy has global implications.

First, it won't do much to reduce global emissions. The global emissions will keep going up as developed nations seek access to affordable energy.

It will also hurt America's security and competitive edge. Absent major changes in our domestic mining and manufacturing base, increasing reliance on wind, solar, and electric batteries trades energy security for energy insecurity. It pushes carbon emissions offshore and increases reliance on Chinese supply chains. It does nothing meaningful for global climate change.

We can do better, and I hope that we all begin to pay attention to what is really at stake: reliability, jobs, affordability, and our Nation's economic security.

I yield back.

[The prepared statement of Mrs. Rodgers follows:]

## PREPARED STATEMENT OF HON. CATHY MCMORRIS RODGERS

**AMERICAN LEADERSHIP**

Thank you, Mr. Chairman. And I want to thank Dr. Burgess for the extra effort to sit in the lead Republican chair today, he certainly is at the right place at the right time for this hearing.

Texas has the lowest energy cost in the country along with the fastest transition to clean energy. With that, let's recognize there are many good ideas for developing cleaner energy systems to ensure we win the future.

The key is to recognize how we unleash American innovation and free enterprise—using all our resources to protect our economic and energy security.

We should build, not destroy.

We should use our abundant natural resources like hydro and natural gas, not shutter them.

We should enable people to deploy, take risks, improve, and create the next great advances so America leads a new era of entrepreneurship and innovation.

We can pursue practical policies to innovate a cleaner energy future ... if we work together.

We should be clear-eyed about what's at stake if we get this wrong.

The radical environmental left is pushing top-down, one-size-fits-all mandates and costs on Americans, which will threaten our Nation's energy dominance and our national security.

This is clear in the repeated attacks on our oil and natural gas industry, and its people, which has provided tremendous opportunity and driven advances in cleaner energy generation that are benefiting the globe.

Yet the left is rejecting fossil energy, while also talking about transforming America's electricity system in 14 years, and the entire energy economy in 30 years.

How is that possible?

What does this transformation really mean for our economy? What does it mean for families and workers?

We should look beyond the rhetoric to understand what the rush to green is really about.

We should understand the consequences on energy reliability, household costs, and security.

**TEXAS**

The importance of reliability has been on full, heart-wrenching display this week in Texas, the South, and the Midwest

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The emergency exposed systemic weaknesses relating in part to overreliance on intermittent renewables.

It's a powerful reminder that electricity reliability is a life and death matter.

**FAMILIES**

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For mostly heating and cooling... Low-income households there use about 36 percent more power than the national average for low-income households in other regions of the country.

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But imagine how families will be squeezed if top-down energy policies increased the price of electricity?

What happens when people in Mississippi, Alabama, Georgia, or South Carolina have to pay the same rates as people in California or Connecticut?

**SECURITY**

And then there is economic and national security.

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Absent major changes in our domestic mining and manufacturing base, increasing reliance on wind, solar, and electric batteries trades energy security for energy insecurity.

It pushes carbon emissions offshore and increases reliance on Chinese supply chains. It does nothing meaningful for global climate change.

We can do better. And I hope my colleagues across the aisle begin to pay attention to what is really at stake—for reliability, jobs, affordability, and our Nation's economic security.

Mr. RUSH. The gentlelady yields back. The Chair would like to remind Members that, pursuant to committee rules, all Members' written opening statements shall be made part of the hearing record.

Now I would like to welcome our esteemed witnesses for today's hearing.

The first witness is Dr. Stephen Pacala, who is a professor of ecology and evolutionary biology at Princeton University.

Our next witness is Ms. Paula Glover, a friend who is the president of the Alliance to Save Energy.

The next witness is Mr. Craig Gordon, the senior vice president of global affairs at Invenergy.

The next is Mr. Richard Powell, the executive director at ClearPath, Incorporated.

And finally, last but not least, Mr. David [sic] Camp III, who is the chairman of the Beaver County Commissioners.

I want to thank each and every one of our witnesses for being with us today. I must say that our witness—we have—one of our witnesses have a—1:00, a 2:45 hard stop. So we want to be mindful of this hard stop for our witness as we go forward.

And to all of our witnesses this morning, we look forward to your testimony.

And now we begin with Dr. Pacala.

You are recognized for 5 minutes for an opening statement.

## STATEMENT OF STEPHEN W. PACALA, PH.D., PROFESSOR OF ECOLOGY AND EVOLUTIONARY BIOLOGY, PRINCETON UNIVERSITY; PAULA R. GLOVER, PRESIDENT, ALLIANCE TO SAVE ENERGY; CRAIG GORDON, SENIOR VICE PRESIDENT, GOVERNMENT AFFAIRS, INVENERGY; RICHARD J. POWELL, EXECUTIVE DIRECTOR, CLEARPATH; AND DANIEL C. CAMP III, CHAIRMAN, BEAVER COUNTY COMMISSIONERS

### STATEMENT OF STEPHEN W. PACALA, PH.D.

Dr. PACALA. Thank you, Mr. Chairman, for this invitation to provide testimony. I am here as chairman of the National Academies committee that released a report on February 2nd that Chairman

Rush just mentioned, containing policies that would, over the next 10 years, put the U.S. on a 30-year path to net-zero greenhouse gas emissions.

The committee was asked to determine how to achieve net zero, but importantly, not whether or not the Nation should do so. The committee was instructed to provide both the technological blueprint for the transition to net zero and a portfolio of socioeconomic policies to ensure that the transition is fair and just.

The first of two reports covers $CO_2$ emissions from electric power, transportation, industry, buildings, and fuels, but not agricultural and forestry carbon sinks, nor non-$CO_2$ greenhouse gases that will be covered in the second. It covers only Federal actions over the first 10 years of the 30-year transition.

Lessons learned in a comprehensive review of existing information include, first, that the transition is affordable. The Nation would spend a similar or lower fraction of GDP on energy during the transition than it has over the past 30 years because of the dramatic drop in the cost of wind, solar, and lithium ion batteries.

The transition would save lives. Medical savings during the 2020s would be larger than the costs.

The transition would create more than a million new net jobs, but fossil jobs would decline.

The energy system today contains substantial injustice. Poor and historically marginalized groups suffer disproportionate harm from fossil pollution while receiving disproportionately low benefits from fossil energy.

Past transitions have left legacy workers and infrastructure behind. If we do that again, and if we do not work to eliminate existing environmental injustice, then prohibitive public opposition is likely to develop.

The report identifies technological goals with quantitative targets, including a doubling of the share of net-zero electricity, increased electrification of transport and home heating, and new infrastructure such as electrical transmission lines and $CO_2$ pipelines.

It also identifies socioeconomic goals, including revitalizing the manufacturing sector, cost-effectiveness, increasing high-quality jobs, promoting equity, diversity, and inclusion, and fair treatment of communities, businesses, and workers during the transition.

The policy recommendations are summarized in a single table, which is in the testimony. The table offers the quickest way to assimilate and understand what the report recommends. Recommendations include an economywide price on emissions starting at $40 per ton, a green bank, and standards to ensure an on-schedule transition, including zero-emissions electric power and vehicle standards.

The report calls for regulatory reforms in the electricity sector, without which net-zero power goals are unlikely to be realized.

It recommends a tripling of Federal net-zero RD&D.

It is the first report containing a comprehensive policy portfolio designed from scratch to address the social dimensions of the energy transition. This includes a national transition task force to identify workers and communities at risk, regional centers where State and local leaders can learn about what is coming and how

to manage it, community block grants for local planning, and an independent national transition corporation that would provide funding to address social impacts of the transition, and a comprehensive education and training program.

Some might be tempted to view policies targeting deployment of net-zero technology as the highest priorities, because the social consequences would lag behind deployment. However, this view has it backwards, because the technological transition and the social disruption that goes with it are already occurring and will inevitably continue. The ongoing decline in coal-sector employment is already hollowing out communities across the Nation. The recent announcement by General Motors that it will produce only electric cars by 2035 is a harbinger of similar inevitable declines in oil and gas employment.

In conclusion, a transition to a net-zero economy in the United States by mid-century is technologically feasible with energy system costs that have been manageable in the recent past. With appropriate policy, the transition could advance a number of national objectives simultaneously: a more fair and just energy system; improved international competitiveness; revitalized American manufacturing; and enhanced energy innovation.

The transition would also provide new, high-quality jobs, but at the cost of lost fossil jobs; eliminate the substantial health impacts of fossil fuels; reduce U.S. greenhouse gas emissions to zero; and enhance the Nation's leadership in climate and energy.

Thank you.

[The prepared statement of Dr. Pacala follows:]

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# Testimony before Subcommittee on Energy of the US House of Representatives Energy and Commerce Committee

Stephen Pacala
Frederick D. Petrie Professor of Ecology and Evolutionary Biology
Princeton University
Chair, National Academies Committee on Accelerating Decarbonization in the United States: Technology, Policy, and Societal Dimensions

February 18, 2021

A transformation of the world's energy system is already underway, from one dominated by fossil fuel combustion to one with net-zero emissions of carbon dioxide ($CO_2$), the primary anthropogenic greenhouse gas (GHG). This decarbonization is the result of revolutionary decreases in the cost of non-emitting technologies, public policy, changing economics of energy options, and growing preferences for renewable and zero-carbon supply. In the United States, the energy transformation will require not only a shift from fossil fuel-based to low-carbon sources of energy but also an equally fundamental economic and social transition to strengthen the economy, promote equity and inclusion, and support communities, businesses, and workers.

Because of revolutionary decreases in cost, renewable and other clean sources of electricity can now become the cornerstone of a net-zero emissions economy, as fuel for electric vehicles, efficient heat pumps, and a source of heat and clean hydrogen for industrial processes. The past decade has seen the levelized cost of wind and solar power drop nearly 70 percent and 90 percent, respectively, while the cost of lithium-ion batteries for electric vehicles dropped by 85 percent. Although the variability of wind and solar makes it impossible to maintain a reliable electricity system with these sources alone, hydropower, energy storage, bioenergy, nuclear energy, geothermal energy, and natural gas with carbon capture and sequestration are available for building a reliable system.

Most near-term emissions reductions during a transition to net zero would come from the electricity sector and the electrification of light and medium duty vehicles and home heating. Light-duty transportation and home heating are ready to deliver significant emissions reductions because low-cost, reliable, and clean electricity can be used as fuel for electric vehicles and efficient heat pumps. Substantial improvements in energy efficiency are achievable across all sectors, from buildings to transportation and industry, and can help to meet future demands for energy services cost-effectively. Although technology exists to decarbonize all parts of the energy system, some sectors remain at precommercial or first-of-a-kind demonstration stages and will require significant improvement in cost and performance to become commercially viable. These include aviation, shipping, and industrial subsectors such as steel, cement, and chemicals manufacturing.

This energy transformation is central to mitigating climate change. A transition to net-zero emissions in the U.S. economy would directly reduce global $CO_2$ and other GHG emissions by approximately 10 percent. The country's innovation during the transition would help build a suite of affordable clean energy and climate mitigation solutions for export and use around the world. A transition to net zero in the United States would nearly eliminate adverse health impacts of fossil fuel use, which may be responsible for half a million premature deaths or more over the next decade—public health impacts that fall

disproportionately on low-income communities and communities of color. Recent polling indicates that a clear majority of Americans now support action to control the country's anthropogenic GHG emissions, as do large majorities of citizens in most other countries.

Given these opportunities, a large and growing number of countries, states, cities, and corporations have pledged to reduce their net GHG emissions to zero over the next 30 years, including the U.S. under the Biden Administration. Although some groups call for a shorter or longer transition period, most target net-zero emissions by 2050 because if this goal is adopted globally, future warming would be limited to a target of 1.5 degrees Celsius. A quicker transition would require expensive replacement of long-lived capital assets before the end of their useful lives. Most proposals call for net-zero emissions with carbon sinks rather than zero emissions because some emissions sources are likely to be too difficult or expensive to mitigate with current and projected technology.

To help policy makers, businesses, communities, and the public better understand what net zero would mean for the United States, the National Academies of Sciences, Engineering, and Medicine (NASEM) convened a committee of experts to investigate how the United States could best decarbonize its energy system. This committee's statement of task (shown in Chapter 1, Box 1.2) called for the committee to "assess the technological, policy, social, and behavioral dimensions to accelerate the decarbonization of the U.S. economy" and "focus its findings and recommendations on near- and midterm (5–20 years) high-value policy improvements and research investments." The statement of task calls for two reports. This first report focuses on the electricity, transportation, industrial and buildings sectors, which comprise most of the energy system, and $CO_2$ emissions, the GHG with the greatest climate impact. In what follows, "energy system" is used as a shorthand for the union of the electricity, transportation, industrial, and buildings sectors. The report provides a technical blueprint and policy manual for the first critical 10 years of a 30-year effort to transform the U.S. energy system to net-zero GHG emissions. It focuses on "no-regrets" actions—essential near-term policies that are valuable under any feasible pathway to a net-zero emissions energy system—and the need for some hedging actions during these first 10 years to maintain optionality in the face of substantial uncertainty. For example, renewable sources of electricity will inevitably play a major role given their current low cost, but there are multiple candidates for zero-carbon firm sources of electricity needed because renewable supplies are intermittent. This implies the need for robust research, development, and demonstration (RD&D) across the range of possible candidates, and infrastructure that is specifically planned to be robust to uncertainty in the final mix deployed. It should also be noted that the committee was specifically not tasked to determine whether the nation *should* pursue deep decarbonization, but rather to evaluate options for decarbonization and the highest-priority actions to pursue, *given* that goal.

Net-zero policy is about more than non-emitting energy technologies, because a host of other issues that people care deeply about are also strongly impacted by the ways the U.S. economy produces and consumes energy. The transition represents an opportunity to build a more competitive U.S. economy, increase the availability of high-quality jobs, build an energy system without the social injustices that permeate our current system, and allow those individuals, communities, and businesses that are marginalized today to share equitably in future benefits. Maintaining public support through a three-decade transition to net zero simply cannot be achieved without the development and maintenance of a strong social contract. This is true for all policy proposals described here, including a carbon price, clean energy standards, and the push to electrify and increase efficiencies in end uses such as vehicle and building energy use. The United States will need specific policies to engage and cultivate public support for the transition, ensure an equitable and just net-zero energy system, and facilitate the recovery of people and communities hurt by the transition.

## GOALS AND POLICIES

The NASEM committee agreed on the following five technological goals and four socioeconomic goals for net-zero policy during the 2020s.

**Technological Goals**

Recent techno-economic analyses of the net-zero transition in the United States identify five near-term actions in virtually every study that are critical in the 2020s while not locking in a technological mix that might change because of technological advances or breakthroughs. At the same time, a 30-year transition would require that some significant parts of the transition be completed early, either as critical foundations to facilitate other actions, or because expensive pieces of long-lived emitting capital stock reach the end of their useful lives in the 2020s and need to be replaced with a non-emitting alternative (e.g., a gas furnace replaced by an electric heat pump) to avoid lock-in.

**Invest in energy efficiency and productivity.** Over the next 10 years, energy used for space conditioning and plug loads would be reduced in existing buildings by 3 percent per year and total energy use by new buildings reduced by 50 percent. The rate of increase of industrial energy productivity (dollars of economic output per unit of energy consumed) would be increased from a recent pace of 1 percent per year to 3 percent per year. Note that energy efficiency in transportation, buildings, and industry overlaps with electrification, because switching to electric heat pumps and motors also significantly increases the efficiency of heating and transportation relative to fossil-fueled boilers and internal combustion engines. Further, electrification provides opportunities to install broadband and smart grid technologies that enable demand-side management and grid optimization. Also, improvements in efficiency and productivity help to reduce the power loads for equipment, which can reduce the cost of capital and operations lowering hurdles for electrification in these sectors.

**Electrify energy services in transportation, buildings, and industry.** The most significant actions to accomplish this goal are as follows: reach zero-emissions vehicles as approximately 50 percent of new vehicle sales across all classes by 2030 (light, medium, and heavy); increase the share of electric heat pumps for heating and hot water to 25 percent of residential and 15 percent of commercial buildings, replacing fossil furnaces and boilers; initiate policies for new construction to be all electric in all practical climate zones; and transition low- to moderate-temperature process heat sources to low-carbon electrical power (e.g., by replacing or supplementing conventional units with electric boilers, heat pumps, or noncontact thermal sources such as infrared or microwave) totaling approximately 10 GW of capacity.

**Produce carbon-free electricity.** During the 2020s, the nation would need to roughly double the share of electricity generated by non-carbon-emitting sources to roughly 75 percent by 2030. Until 2025, this would require an average pace of wind and solar installation that each year matches or exceeds the record historical yearly deployment of these technologies and accelerates to an even faster pace from 2025 to 2030. Emitting coal plants would continue to retire at the current or an accelerated pace. Existing nuclear plants would be preserved wherever it is possible to continue safe operations. Emitting gas-fired generation would decline 10 to 30 percent by 2030 and total capacity would be roughly flat. Some new gas-fired capacity in certain regions could be built during the 2020s to replace aging assets, including coal, because it is more economical than coal regardless of age and can be used to replace aging assets and where coal retirements require replacement capacity for reliability purposes, and where new gas capacity is prepared to retire by 2050 or retrofit to combust hydrogen or be equipped with carbon capture.

**Plan, permit, and build critical infrastructure.** Build or upgrade electrical transmission facilities to increase overall transmission capacity (as measured in GW-miles) by as much as 60 percent

by 2030 to interconnect and harness low-cost wind and solar power across the country. Accelerate the build-out of the nation's electric vehicle (EV) recharging network, including at least 3 million Level 2 chargers and 120,000 DC fast chargers by 2030. This infrastructure should be a mix of private and public ownership and operation, including fleet operators. Plan and initiate a national $CO_2$ transport and storage network to ensure that $CO_2$ can be captured at point sources across the country, including in industry, power generation, and low-carbon fuels production (including hydrogen).

**Expand the innovation toolkit.** The committee proposes a tripling of federal investment in clean energy RD&D to provide new technological options, to reduce costs of existing options, and to better understand how to manage a socially just energy transition. Innovations that would fundamentally enhance the net-zero transition include next-generation energy systems for transportation, buildings, and industry; improved energy storage and firm low-carbon electricity generation options to complement variable renewable electricity; low-cost zero-carbon fuels including hydrogen from the electrolysis of water or biomass gasification; lower-cost carbon capture and use technologies; and lower-cost direct air capture. Progress is needed in particular on net-zero options for aviation, marine transport, and the production of steel, cement, and bulk chemicals. As important will be innovations in how federal policies and programs support RD&D, particularly for technologies in the demonstration and deployment stages.

Please note that regulatory reforms will also be necessary to achieve many of the above technological goals In particular, timely siting and permitting of the new electricity transmission infrastructure is likely to prove difficult or impossible without regulatory reform. Also, the above goals reflect the committee's judgment that a net-zero energy system able to meet the nation's projected business-as-usual demand for energy services will be much easier to achieve than one requiring dramatic reductions in demand for energy services. Thus, the goals do not include greatly reduced mobility or home size.

**Socioeconomic goals**

A complete transformation of the energy system would affect most aspects of life in this country, with impacts far beyond the installation of new technologies. The U.S. energy system does not currently serve all Americans well. Historically marginalized and low-income populations have energy bills that they struggle to pay and lack the capital to reap benefits from higher-efficiency technologies. They also suffer disproportionate exposure to health and environmental hazards from power generation and climate change with diminished ability to eliminate or mitigate that exposure, have comparatively little say in decision making about siting of energy infrastructure, and receive a disproportionately small share of financial and other benefits from the energy system.

The United States has long been the world's leading technological innovator, but has not effectively used this advantage to sustain domestic manufacturing that could supply domestic and international markets with low- and zero-carbon energy technologies. The decline of the manufacturing sector has cost the economy high-quality jobs, increased income inequality, and contributed to public dissatisfaction.

One cause for optimism is that the country is the best-resourced nation in the world for a transition to net zero. The United States has abundant solar and wind resources both onshore and offshore. Additionally, 40 million acres already are devoted to producing biofuels. The country has plentiful and economically accessible natural gas, and enormous geologic and terrestrial reservoirs for $CO_2$ sequestration.

A transformation to a net-zero economy could combine these natural assets with the nation's culture of innovation to produce an energy system that ameliorates ongoing social injustices in today's energy system and fairly distributes both opportunities and costs. Studies estimate that the transition could increase net employment in the energy system by roughly 1 million to 2 million jobs domestically over the next decade, although the impacts on the location and other characteristics of employment are complex. The innovation and capital expenditures required for a successful transition could revitalize the

U.S. manufacturing and commercialization sectors. But the United States will achieve these benefits only if it has the appropriate policies in place. Otherwise, the transition might exacerbate inequity, concentrate opportunity in the hands of a few, accelerate the offshoring of manufacturing, and fail to mitigate job losses in industries and regions that are left behind.

The four socioeconomic goals that net-zero policies should be designed to advance are as follows:

**Strengthen the U.S. economy.** The transition to net zero provides an opportunity to revitalize U.S. manufacturing, construction, and commercialization sectors in clean energy and energy efficiency, while providing a net increase in jobs paying higher wages than the national average. The transition would enhance U.S. leadership in clean energy and climate mitigation solutions for which global demand will reach trillions of dollars over coming decades. The net-zero policy portfolio should be designed to strengthen the U.S. economy, with comprehensive policies that enhance the manufacturing sector and promote the innovations needed during the transition.

**Promote equity and inclusion.** Policies should promote equitable access to the benefits of net-zero energy systems, including reliable and affordable energy, opportunities to benefit from the best available technology, new employment opportunities, and opportunities for financial returns and wealth creation. Net-zero policy should work to eliminate inequities in the current energy system that disadvantage historically marginalized and low-income populations. Net-zero policy must include regular opportunities for, and responses to, community input, as well as ensure fair access to benefits and fair sharing of costs, for the pragmatic reason that public support must be maintained for decades to complete a successful net-zero transition.

**Support communities, businesses, and workers**. Any fundamental technological and economic transition creates new opportunities as well as job losses in legacy industries and other associated impacts. In particular, the loss of a critical employer could devastate jobs, tax revenues, and other economic impacts in a community or even in whole regions, unless new opportunities can be attracted to replace it with low-carbon competitive employment in a timely manner. Policies should promote fair access to new long-term employment opportunities, provide financial and other support to communities that might otherwise be harmed by the transition, and ensure that jobs created through the transition are high quality, providing at a minimum a safe and secure working environment, family-sustaining wages and comprehensive benefits, regular schedules and hours, and opportunities for skills development.

**Maximize cost-effectiveness.** This goal begins with an objective to be accomplished—in this case, achieving a net-zero economy by 2050—and finding the least-cost (or most cost-effective) path to accomplish it. Here, the cost of a particular policy is the material consumption that households must give up, including any changes in taxes or government services, to achieve net-zero emissions. A policy's cost-effectiveness measures how this cost compares to the least-cost alternative that achieves the same net-zero outcome and associated benefits. Cost-effectiveness is important because society has multiple objectives, including material well-being. If the country can avoid spending more than necessary in order to achieve net-zero emissions, additional resources are available for other aspirations. However, cost-effectiveness analysis ignores how costs and benefits are distributed within an economy. A U.S. net-zero policy will necessarily need to balance cost-effectiveness with equity and other goals.

**RECOMMENDATIONS**

Table 1 at the end of this testimony provides a list of highest-priority federal policies for the next 10 years to put the United States on a net-zero path. Column 1 lists these policies, which are further summarized in the table's notes, in the discussion at the end of this testimony, and in Chapter 4 of the NASEM report. Every policy received a score for each of the technological goals (shown in column 2, and described in Chapter 2 of the report) and socioeconomic goals (shown in column 3, and described in Chapter 3 of the report). The technological and socioeconomic goals are represented by icons (defined above). Icon shade indicates how important each policy is to achieving the goal: darkest shade indicates highest priority—that the policy is indispensable to achieve the objective; medium shade means that the policy is important to achieve the objective; and lightest shade indicates a supporting role. Absence of an icon indicates that the policy would have a small positive role in achieving the objective (and might in some cases have a small negative impact). Column 4 identifies the branch of the federal government that would be responsible for the policy, and column 5 specifies the required congressional appropriation, if any.

**System-Wide Policies**

Many of the policies listed in Table1 would affect the nation's economic and social systems as a whole, given the pervasive (but often invisible) role of carbon in so many elements of Americans' day-to-day experience. The committee's set of recommended policies include some that address these system-wide impacts, facilitate the net-zero transition as a whole, and help advance most of the technological and social-economic goals.

The policy for a U.S. emissions budget covers $CO_2$ and other GHG emissions and calls for a *target of net zero in 2050* along with regular review of emissions progress and the tracking of specified milestones for technological and social goals. The committee considers a quantitative budget and regular review to be essential for the nation to keep up with the challenging pace required for the net-zero transition, to point out the need to augment policies where progress lags, and to save money where new innovation obviates the need for continuing standards or incentives or costly solutions in markets.

Table 1 also includes an **economy-wide price on carbon beginning at $40/tCO$_2$ and rising by 5 percent per year**. The advantages of an economy-wide price on carbon are that it would unlock innovation in every corner of the energy economy, send appropriate signals to myriad public and private decision makers, and encourage a cost-effective route to net zero. However, assuming that the country implements a carbon price before key trade competitors, a mechanism that levels the playing field for domestic firms and avoids emissions leakage will be necessary. Because the direct impacts of an economy-wide price on carbon would fall disproportionately on people with the lowest incomes and the fewest choices, it should be augmented by rebates and by funding programs that promote a fair and just transition. The proposed carbon price is deliberately set at a level that would not by itself cause a 30-year transition to net zero because of concerns about equity, fairness, and competitiveness. For example, the NASEM committee was not confident that it could design a package of policies that would address competitiveness and mitigate unfair impacts of a carbon price that starts at or climbs rapidly to $100/tCO$_2$.

In addition, the Table calls for the establishment of entities within the federal government to bring equitable access to economic opportunities and wealth creation during the energy transition. These policies are designed to help achieve diversity and fairness goals and to support workers, families, and communities through the transition. The recommendations include the establishment of a 2-year federal **National Transition Task Force** to evaluate the long-term implications of the transition for communities, workers, and families and identify strategies for ensuring a just transition, and a **White House-level Office of Equitable Energy Transitions** to act on the recommendations of the task force, establish just transition targets and to track progress in achieving them by federal programs. The primary policy to help communities achieve new opportunities or mitigate impending damages is the establishment of a new independent **National Transition Corporation**. The NASEM committee debated

many alternative mechanisms and chose this option because an independent corporation could take the steady long view required to guide the transition initiatives to success.

Private sources of capital are unlikely to be sufficient to finance the low-carbon economic transition, especially during the 2020s when the effort is new. In order to ensure that capital is available for this transition, the committee calls for the establishment of a **Green Bank to mobilize finance**, initially capitalized at $30 billion. Partial financing by a Green Bank would reduce risk for private investors and encourage rapid expansion of private sources capital. To better align the economy with the risks and benefits of transition policies and climate change, the committee includes a policy to require annual Securities and Exchange Commission (SEC) reporting of these risks and benefits by private companies and their inclusion in stress tests by the Federal Reserve and in all cost-benefit analyses by federal agencies.

The committee recommends a **comprehensive education and training initiative** to provide the workforce required for the transition; to improve the competitiveness of the country's building, manufacturing, and energy sectors; and to fuel future innovation. Education and training are also critical to meet societal objectives by providing fair access to new high-quality jobs.

The committee recommends a number of policies to directly enhance and expand the energy innovation toolkit—most notably by the proposed **tripling of the Department of Energy's (DOE's) funding in low- or zero-carbon RD&D over the next 10 years by Congress**, including increasing the agency's funding of large-scale demonstration projects, and the support for social science research on the social and economic aspects of advancing the transition and ensuring that it is just.

### Policies Targeting Specific Economic Sectors or Goals

The proposed carbon price would not be large enough during the 2020s to incentivize the deployment of some non-emitting technologies that have relatively high marginal cost and yet must be deployed early, either because long-lived capital stock needs replacement (i.e., a cement plant) or because delay would make the eventual rate of transition infeasible or more expensive. Thus, the committee developed some of its policies in Table 1 to target specific energy supply and distribution goals. The committee proposes, for example, a **clean energy standard for electricity** to ensure that the power sector relies increasingly on non-emitting electricity. It also proposes needed policy reforms governing clean electricity markets, amendments to the Federal Power Act to allow timely siting and permitting of new long-distance transmission, and a program to plan, permit, and install the needed new electric transmission capacity. Last, it proposes accelerated installation of smart electricity meters and an expansion of broadband in rural and low-income households. This will allow the electric system to depend upon expanded flexible demand that is enabled by pricing reforms and metering and information-infrastructure upgrades.

Under the committee's recommendations, electrification of the transportation sector and buildings would primarily be accomplished by **manufacturing and performance standards for electric vehicles and building equipment**. For transportation, these would specify fleetwide emissions standards for new vehicle sales that drop to zero in time for the on-road fleet to meet net-zero goals in 2050, appliance standards for the electrification of building heating and cooling, and policies for accelerating the development of electric vehicle charging infrastructure.

To increase the energy efficiency of buildings during the 2020s, the committee calls for weatherization, retrofits, and other support for low-income households, which would also further diversity and fairness goals, as well as emissions caps and efficiency standards for all federal buildings. Note that whole-building energy efficiency can be improved in a multitude of ways, all of which would be simultaneously nudged by the economy-wide price on carbon.

Last, Table 1 contains the committee's recommendations for policies that directly or indirectly advance a comprehensive clean-energy industrial policy. These include the following policies:

- Output-based allocations and carbon border adjustments that would accompany the carbon price in order to maintain industrial competitiveness;

- A Green Bank to help finance an expansion of clean industry and clean technology manufacturing;
- Corporate climate risk disclosure rules;
- Wholesale power market reforms;
- Education and training policies for the new energy economy;
- Expanded RD&D;
- Electrification of tribal lands;
- A package of loan guarantees and sunsetting subsidies to support installation of non-emitting industrial equipment (e.g., electric boilers) and expand clean-tech manufacturing;
- A process for planning and initiating a national network to transport and safely store $CO_2$ captured by industrial sources and perhaps by fossil electricity plants with carbon capture; and
- Procurement and other standards for companies that receive federal funds, including labor standards and Buy America/American policies.

**The Comprehensive Policy Portfolio Addressing Social Dimensions of the Transition**

The NASEM report is unique in that it complements a technical blueprint for an affordable path to net zero emissions in the United States with a comprehensive policy portfolio to address the social dimensions of the transition. Many recent plans address the technical transition and forward policies to achieve it. Others highlight the importance of a fair and equitable transition that addresses environmental justice, and some offer individual policies or extensions of existing policies targeting some of the social concerns. But none offers a comprehensive package of policies, designed from scratch, to address the full array of social challenges and opportunities of the net-zero transition.

The Committee is aware how difficult it will be to ensure a just and fair transition given the nation's handling of past transitions, and the fact that it will require local participation and proactive action everywhere. But past experience also provides a guide about what works: clear policy signals that prompt and support *inclusive early* local planning, policies that help establish new industries in communities where they are most needed, training for new employment opportunities, direct assistance where necessary, and clean-up of legacy infrastructure. Consider refinery workers on the Gulf coast, living in a town in which the refinery is the dominant employer. Modeling studies indicate that oil and gas demand will persist for some time at close to current levels during a 30-year transition to net-zero, but then decline after 2030. Our workers thus face both future unemployment and the loss of their community's tax base.

The ten regional centers described in the Table would provide a forum for governors, representatives, mayors and county officials, and tribal and community leaders to learn about what is coming and the need to plan for it—information developed by a National Transition Task Force. The community block grant program would provide planning grants for communities to learn if and how they are at risk and would require direct participation across the diversity present within the community. The regional centers would also provide a clearing house of information about the assistance that is available from the National Transition Corporation, training programs, Green Bank and other policies, as well as coordinate access to federal economic and community development programs across agencies. For example, leaders and entrepreneurs from our refinery town could apply for incentives to attract new net-zero industries, funds to maintain essential local services and remediate and reclaim legacy infrastructure, and funds and expertise to train workers for the new business and net-zero companies expanding elsewhere. The regional centers and White House Office of Equitable Energy Transitions would monitor progress, develop and exchange knowledge about effective strategies, catalyze local and regional partnerships, and propose best practices and necessary course corrections. The goal for our refinery workers is to provide

them with multiple options both inside and outside their community, to include them in the decision-making, and to provide direct assistance when necessary.

There is widespread consensus that many more jobs would be created than lost during a transition to net zero. Although locations for wind and solar are geographically constrained, appropriate sites do co-occur with most centers of fossil employment. This provides an opportunity to prioritize early deployment of wind and solar in regions that face the greatest loss of fossil jobs. Also, the majority of the needed net-zero manufacturing infrastructure is not geographically tethered, and so its development could prioritize regions that will suffer the greatest job loss.

Some might be tempted to view the policies aimed at accelerating the deployment of net-zero assets like renewable power, electric vehicles and heat pumps as the highest priorities, because the social consequences would lag behind technological deployment. However, this view has it backwards, because the technological transition, and the social disruption that goes with it, are already occurring. The ongoing decline in coal sector employment is already hollowing out communities across Appalachia, the Midwest, and the West. This decline will continue with or without policies that accelerate the transition. The recent announcement by General Motors that it will produce only electric cars by 2035 is a harbinger of similar inevitable declines in oil and gas employment.

The NASEM report identifies the myriad injustices built into our current energy system, with health impacts of fossil pollution concentrated in communities that receive a disproportionately small share of the benefits of fossil energy and have relatively little say in siting decisions. Many of these communities are dominated by low-income workers and their families, and by historically marginalized social groups. These workers struggle to afford energy bills, lack the capital and income to benefit from subsidies or tax credits, and may own homes that fail to qualify for upgrades because of code noncompliance. The portfolio of policies in the NASEM report would thus address problems that the nation is already experiencing and will continue to experience, even without policies that accelerate the transition to net-zero.

## COST ESTIMATES AND CAPITAL REQUIREMENTS

This NASEM report contains three kinds of financial and cost estimates: the net present value of the aggregate transition costs, the sum of capital required to build all the new hardware and controls in each sector, and the needed congressional appropriations. It also quotes current costs (i.e., levelized cost of energy) of alternative new resources additions. *It is important to note that only the net present value of aggregate transition costs represents a true cost to the United States*. Capital requirements and congressional appropriations can be considered investments in the country's economy that provide long-term returns to private and public sectors. Of course, all of these estimates are highly uncertain. Additionally, any direct costs are balanced against significant public and private benefits of a net-zero transition. These include the substantial avoided health impacts from air pollution within the United States, new economic and employment opportunities, significant downward pressure on global oil prices, and, if other countries also meet similar emissions reductions goals, the avoidance of a substantial portion of planet-altering climate change-related damages to the country that are not already inevitable even with a transition to net zero by midcentury. These could be in the hundreds of billions of dollars annually if estimated health benefits come to fruition and offset some, all, or more than the cost of the transition.

Chapter 2 of the NASEM report concludes that the estimated fraction of gross domestic product that the nation would likely spend on energy in a net-zero economy would be smaller than the fraction that the nation has spent on energy in the past, including the past decade (see Chapter 2, Figure 2.3). Studies reviewed in the report also estimate total cumulative incremental energy expenditures that average approximately $300 billion through 2030—a roughly 3 percent increase relative to a business-as-usual baseline of approximately $9.4 trillion (net present values of cumulative total expenditures with a 2 percent real social discount rate). It is important to note that these cost estimates do not capture general

equilibrium effects, such as changes in global oil prices. Nor do these cost estimates include impacts of changes in the country's balance of trade, which include both positive and negative factors.

Chapter 2 of the NASEM report also concludes that roughly $2 trillion in incremental capital investments must be mobilized over the next decade for projects that come online in 2030 to put the United States on track to net zero by 2050. These capital investments are not a direct cost borne by either taxpayers or energy consumers. The sum of capital investments that must be mobilized in the 2020s is much larger than the increase in total consumer energy expenditures described above because capital investments are paid back through energy expenditures over many years and because investments in renewable electricity, efficient buildings and vehicles, and other capital-intensive measures are offset by lower or non-existent fuel expenditures. Capital investment estimates are included in the report because policies will be needed to directly finance some projects and de-risk others, given that private capital markets are not currently set up for the net-zero transition.

The committee estimates that $350 billion over a 10-year period in total federal appropriations would be needed to fund the package of net-zero transition policies in Table 1. The carbon price proposed in Chapter 4 would also raise approximately $2 trillion over the decade (2021–2030), providing revenue to fully offset proposed appropriations and provide substantial funds for targeted rebates and other programs to address equity and distributional concerns.

## CONCLUSION

A transition to a net-zero economy in the United States by midcentury is technologically feasible, with energy system costs as a share of U.S. gross domestic product that have been manageable over the past decade, but it is on the edge of feasibility. Achieving net-zero by midcentury would thus require rapid rates of change and unprecedented levels of funding for RD&D, infrastructure planning, permitting and construction activity, and other changes in public policy and social systems that have to begin immediately across the energy economy, as well as unprecedented actions to build and maintain public support for the net-zero transition.

With an appropriate portfolio of policies, however, the transition would advance a number of national objectives simultaneously: building a more fair and just energy system that works for all Americans, improving the international competitiveness of the economy, revitalizing American manufacturing, and reestablishing leadership in energy innovation and technology. The transition would also provide new high-quality jobs, virtually eliminate the substantial health impacts of fossil fuels, reduce U.S. GHG emissions to zero, enhance the nation's leadership in climate and energy policy, and help catalyze the global transition necessary to avert the most damaging impacts of business-as-usual climate change.

**TABLE 1** Summary of Policies Designed to Meet Net-Zero Carbon Emissions Goal and How the Policies Support the Technical and Societal Objectives. To access a filterable web version of this table, please visit **nap.edu/decarbonization**.

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| **Establish U.S. commitment to a rapid, just, equitable transition to a net-zero carbon economy.** | | | | | |
| U.S. $CO_2$ and other GHG emissions budget reaching net zero by 2050. |  |  | Executive and Congress | $5 million per year. | Budget is central for imposing emissions discipline, although any consequences for missing the target must be implemented through other policies. Funds are primarily for administration of the budget and data collection and management. |
| Economy-wide price on carbon. |  |  | Congress | None. Revenue of $40/t$CO_2$ rising 5% per year, which totals approximately $2 trillion from 2020 to 2030. | Carbon price level not designed to directly achieve net-zero emissions.<br><br>Additional programs will be necessary to protect the competitiveness of import/export exposed businesses. |
| Establish 2-year federal National Transition Task Force to assess vulnerability of labor sectors and communities to the transition of the U.S. economy to carbon neutrality. |  |  | Congress | $5 million per year. | Task force responsible for design of an ongoing triennial national assessment on transition impacts and opportunities to be conducted by the Office of Equitable Energy Transitions. |
| Establish White House Office of Equitable Energy Transitions.<br><br>• Establish criteria to ensure equitable and effective energy transition funding. |  |  | Congressional appropriation | $25 million per year, rising to $100 million per year starting in 2025. | Federal office establishes targets and monitors and advances progress of federal programs aimed at a just transition. |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| • Sponsor external research to support development and evaluation of equity indicators and public engagement.<br>• Report annually on energy equity indicators and triennially on transition impacts and opportunities. |  | | | | |
| Establish an independent National Transition Corporation to ensure coordination and funding in the areas of job losses, critical location infrastructure, and equitable access to economic opportunities and wealth, and to create public energy equity indicators. |  |  | Congressional appropriation | $20 billion in funding over 10 years. | Primary means to mediate harms that occur during transition, including support for communities that lose a critical employer, support for displaced workers, abandoned site remediation, and opportunities for communities to invest in a wide range of clean energy projects. |
| **Set rules/standards to accelerate the formation of markets for clean energy that work for all.** | | | | | |
| Set clean energy standard for electricity generation, designed to reach 75% zero-emissions electricity by 2030 and decline in emissions intensity to net-zero emissions by 2050. |  |  | Congress | None. | |
| Set national standards for light-, medium-, and heavy-duty zero-emissions vehicles, and extend and strengthen stringency of CAFE standards. Light-duty ZEV standard ramps to 50% of sales in 2030; medium- and heavy-duty to 30% of sales in 2030. |  |  | Congress | None. | |
| Set manufacturing standards for zero-emissions appliances, including hot water, cooking, and space heating. |  |  | Congress | None. | |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| Department of Energy (DOE) continues to establish appliance minimum efficiency standards. Standard ramps down to achieve close to 100% all-electric in 2050. |  | | | | |
| Enact three near-term actions on new and existing building energy efficiency, two by DOE/Environmental Protection Agency (EPA)[a] and one by the General Services Administration (GSA). |  |  | DOE, GSA | None. | GSA to set a cap on existing and new federal buildings that declines by 3% per year. |
| Enact five congressional actions to advance clean electricity markets, and to improve their regulation, design, and functioning.[b] |  |  | Congress | $8 million per year for Federal Energy Regulatory Commission (FERC) Office of Public Participation and Consumer Advocacy. | Two of these congressional actions involve FERC, and three involve the DOE. |
| Deploy advanced electricity meters for the retail market, and support the ability of state regulators to review proposals for time/location-varying retail electricity prices. |  |  | Congressional appropriation for DOE | $4 billion over 10 years. | |
| Recipients of federal funds and their contractors must meet labor standards, including Davis-Bacon Act prevailing wage requirements; sign Project Labor Agreements (PLAs) where relevant; and negotiate Community Benefits (or Workforce) Agreements (CBAs) where relevant. | |  | Congress | None. | |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| Report and assess financial and other risks associated with the net-zero transition and climate change by private companies, government agencies, and the Federal Reserve. Private companies receiving federal funds must also report their clean energy research and development (R&D) by category (wind, solar, etc.). |  |  | Congress | None. | Risk disclosures to be included in annual SEC reports for private companies. Federal Reserve to use climate-related risks in financial stress tests. Federal agencies to include climate-related risks in all benefit cost analyses.<br><br>All banks to report on comparative financial investments in all energy sources. |
| Ensure that Buy America and Buy American provisions are applied and enforced for key materials and products in federally funded projects. | |  | Congress | None. | |
| Establish an environmental product declaration library to create the accounting and reporting infrastructure to support the development of a comprehensive Buy Clean policy. |  |  | Congressional appropriation for EPA and DOE | $5 million per year. | |
| **Invest (research, technology, people, and infrastructure) in a U.S. net-zero carbon future.** | | | | | |
| Establish a federal Green Bank to finance low- or zero-carbon technology, business creation, and infrastructure. |  |  | Congressional authorization and appropriation | Capitalized with $30 billion, plus $3 billion per year until 2030. | Additional requirements include public reporting of both energy equity analyses of investment and leadership diversity of firms receiving funds. |
| Amend the Federal Power Act and Energy Policy Act by making changes to facilitate needed new transmission infrastructure.[c] |  |  | Congress | None. | |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| Plan, fund, permit, and build additional electrical transmission, including long-distance high-voltage, direct current (HVDC). Require fair public participation measures to ensure meaningful community input.[d] |  |  | Congressional authorization and appropriation for DOE and FERC | $25 million per year to DOE for planning; $50 million per year for DOE and FERC to facilitate use of existing rights-of-way; finance build through Green Bank; $10 million per year to DOE for distribution system innovations. | Funds provide support for technical assistance to states, communities, and tribes to enable meaningful participation in regional transmission planning and siting activities. Funds to distribution utilities to invest in automation and control technologies. |
| Expand EV charging network for interstate highway system.[e] |  |  | Congressional directive to Federal Highway Administration (FHWA) and National Institute of Standards and Technology (NIST); congressional appropriations to DOE | $5 billion over 10 years to expand changing infrastructure. | FHWA to expand its "alternative fuels corridor" program. NIST to develop interoperability standards for level 2 and fast chargers.<br><br>DOE to fund expansion of interstate charging to support long-distance travel and make investments for EV charging for low-income businesses and residential areas. |
| Expand broadband for rural and low-income customers to support advanced metering. |  |  | Congress to authorize and fund rural electric cooperatives and private companies to offer broadband | $0.5 billion for rural electric cooperatives and $1.5 billion for private companies. | 10% of investment costs to expand capabilities of smart grid to underserved areas. Grants or loans to rural electric providers and investment tax incentives to companies, both focused on rural and low-income communities. |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| Plan and assess the requirements for national $CO_2$ transport network, characterize geologic storage reservoirs, and establish permitting rules.[f]<br><br>Require fair public participation measures to ensure meaningful community input. |  |  | Congressional authorization and appropriation to multiple agencies | $50 million to Department of Transportation (DOT) with other agencies involved for 5-year planning plus $50 million for block grants for community and stakeholder engagement. $10 billion to $15 billion total during the 2020s to DOE, United States Geological Survey (USGS), and Department of Interior (DOI) to characterize reservoirs. Extend 45Q and increase to $70/t$CO_2$—$2 billion per year. | Modeling studies and other analysis indicate that significant amounts of negative emissions will be needed to meet net-zero emissions. The $CO_2$ pipeline network is needed even with 100% non-fossil electric power to enable carbon capture at cement and other industrial facilities with direct process emissions of greenhouse gases and to enable capture of $CO_2$ from biomass or via direct air capture for use in production of carbon-neutral liquid and gaseous fuels. |
| Establish educational and training programs to train the net-zero workforce, with reporting on diversity of participants and job placement success.[g] |  |  | Congressional appropriations to Department of Education, DOE, and NSF | $5 billion per year for GI Bill-like program. $100 million per year for new undergraduate programs. $50 million per year for use-inspired and $375 million per year for other doctoral and postdoctoral fellowships. Eliminate visa restrictions for net- | Fields covered include science, engineering, policy, and social sciences, for students researching and innovating in low-carbon technologies, sustainable design, and the energy transition. |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| | | | | zero students. $7 million over 2020–2025 for the Energy Jobs Strategy Council. | |
| Revitalize clean energy manufacturing.[h] |  |  | Congressional appropriation and direction of Green Bank and U.S. Export-Import Bank | Manufacturing subsidies for low-carbon products starting at $1 billion per year and phased out over 10 years. No additional appropriation required for loans and loan guarantees from Green and Export-Import Bank. | Export-Import Bank should make available at least $500 million per year in low-carbon product and clean-tech export financing and eliminate support for fossil technology exports. |
| Increase clean energy and net-zero transition RD&D that integrates equity indicators.[i] |  |  | Congressional appropriation for and directions to DOE and NSF | DOE clean energy RD&D triples from $6.8 billion per year to $20 billion per year over 10 years. DOE funds studies of policy evaluation at $25 million per year and regional innovation hubs at $10 million per year; DOE- and NSF-funded studies of social dimensions of the transition should be supported by an appropriation of $25 million per year. | Establish criteria for receiving funds on equity analysis, appropriate community input, and leadership diversity of companies applying for public investments. DOE to report on equity impacts and diversity of entities receiving public funds. |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| Increase funds for low-income households for energy expenses, home electrification, and weatherization. |  |  | Congressional appropriation | Increase Weatherization Assistance Program (WAP) funding to $1.2 billion per year from $305 million per year. Direct HHS to increase state's share of LIHEAP funds for home electrification and efficiency. | |
| Increase electrification of tribal lands | |  | Congressional appropriation to DOE and U.S. Department of Agriculture (USDA) | $20 million per year for assessment and planning through DOE Office of Indian Energy Policy (DOE-IE) and USDA Rural Utilities Service (USDA-RUS); expand DOE-IE to $200 million per year. | Increase direct financial assistance for the build-out of electricity infrastructure through DOE-IE grant programs. |
| **Assist families, businesses, communities, cities, and states in an equitable transition, ensuring that the disadvantaged and at-risk do not suffer disproportionate burdens.** | | | | | |
| Please note that the primary policies targeting fairness, diversity, and inclusion during the transition are the Office of Equitable Energy Transitions and the National Transition Corporation, which are the fourth and fifth policies in this table. | | | | | |
| Establish National Laboratory support to subnational entities for planning and implementation of net-zero transition. |  |  | Congressional appropriation | Additional funding to national laboratories' annual funding commencing at the level of $200 million per year, rising to $500 million per year | To establish a coordinated, multi-laboratory capability to provide energy modeling, data, and analytic and technical support to cities, states, and regions to complete a just, equitable, effective, and rapid transition to net zero. |

| Policy | Technological Goals | Socioeconomic Goals | Government Entities | Appropriation, if Any | Notes |
|---|---|---|---|---|---|
| |  | | | by 2025, and $1 billion per year by 2030. | |
| Establish 10 regional centers to manage socioeconomic dimensions of the net-zero transition.[j] |  |  | Congressional authorization and appropriations to DOE | $5 million per year for each center; $25 million per year for external research budget to provide data, models, and decision support to the region. | Coordinated by the Office of Equitable Energy Transitions. |
| Establish net-zero transition office in each state capital. |  |  | Congressional appropriations | $1 million per year in matching funds for each state. | Coordinate state's effort with federal and regional efforts. |
| Establish local community block grants for planning and to help identify especially at-risk communities. Greatly improve environmental justice (EJ) mapping and screening tool and reporting to guide investments. |  |  | Congressional appropriations to DOE | $1 billion per year in grants administered by regional centers. | Required to qualify for funding from the National Transition Corporation. Block grant funding requires inclusive participation and engagement by historically marginalized and low-income groups. |

| KEY TO ICONS | |
|---|---|
| **DARK GREEN** icon indicates that the policy is highest priority and indispensable to achieve the objective.<br>**MEDIUM GREEN** icon indicates that the policy is important to achieve the objective.<br>**LIGHT GREEN** icon indicates that the policy would play a supporting role.<br>No icon indicates that the policy would have at most a small positive role in achieving the objective (and might in, some cases, have a small negative impact on the objective). | |
| **Technological Goals** | |
|  | Invest in energy efficiency and productivity. Examples include accelerating the rate of increase of industrial energy productivity (dollars of economic output per energy consumed) from the historic 1% per year to 3% per year. |
|  | Electrify energy services in transportation, buildings, and industry. Examples include, by 2030, moving half of vehicle sales (all classes combined) to EVs, and deploying heat pumps in one-quarter of residences. |
|  | Produce carbon-free electricity. Roughly double the share of electricity generated by carbon-free sources from 37% to 75%. |
|  | Plan, permit, and build critical infrastructure. Build critical infrastructure needed for the transition to net zero, including new transmission lines, an EV charging station network, and a $CO_2$ pipeline network. |
|  | Expand the innovation toolkit. Triple federal support for net-zero RD&D. |
| **Socioeconomic Goals** | |
|  | Strengthen the U.S. economy. Use the energy transition to accelerate U.S. innovation, reestablish U.S. manufacturing, increase the nation's global economic competitiveness, and increase the availability of high-quality jobs. |
|  | Promote equity and inclusion. Ensure equitable distribution of benefits, risks, and costs of the transition to net zero. Integrate historically marginalized groups into decision making by ensuring adherence to best-practice public participation laws. Require that entities receiving public funds report on leadership diversity to ensure nondiscrimination. |
|  | Support communities, businesses, and workers. Ensure support for those directly and adversely affected by the transition. |
|  | Maximize the cost-effectiveness of the transition to net zero. |

[a] Direct DOE/EPA to expand its outreach of and support for adoption of benchmarking and transparency standards by state and local government through the expansion of Portfolio Manager. Direct DOE/EPA to further investigate the development of model carbon-neutral standards for new and existing buildings that, in turn, could be adopted by states and local authorities. Policies targeting retrofits of existing buildings will be in the final report.

[b] FERC should work with regional transmission organizations (RTOs) and independent system operators (ISOs) to ensure that markets in all parts of the country are designed to accommodate the shift to 100 percent clean electricity on the relevant timetable. Congress should clarify that the Federal Power Act does not limit the ability of states to use policies (e.g., long-term contracting with zero-carbon resources procured through market-based mechanisms) to support entry of zero-carbon resources into electric utility portfolios and wholesale power markets. Congress should further direct FERC to exercise its rate-making authority over wholesale prices in ways that accommodate state action to shape the timing and character of the transitions in their electric resource mixes. Congress should reauthorize the FERC Office of Public Participation and Consumer Advocacy to provide grants and other assistance to support greater public participation in FERC proceedings. FERC should direct NERC to establish and implement standards to ensure that grid operators have sufficient flexible resources to maintain operational reliability of electric systems. Congress should direct and fund DOE to provide federal grants to support the deployment of advanced meters for retail electricity customers as well as the capabilities of state regulatory agencies and energy offices to review proposals for time/location-varying retail electricity prices, while also ensuring that low-income consumers have access to affordable basic electricity service.

[c] (1) Establish National Transmission Policy to rely on the high-voltage transmission system to support the nation's (and states') goals to achieve net-zero carbon emissions in the power sector. (2) Authorize and direct FERC to require transmission companies and regional transmission organizations to analyze and plan for economically attractive opportunities to build out the interstate electric system to connect regions that are rich in renewable resources with high-demand regions; this is in addition to the traditional planning goals of reliability and economic efficiency in the electric system. (3) Amend the Energy Policy Act of 2005 to assign to FERC the responsibility to designate any new National Interest Electric Transmission Corridors and to clarify that it is in the national interest for the United States to achieve net-zero climate goals as part of any such designations. (4) Authorize FERC to issue certificates of public need and convenience for interstate transmission lines (along the lines now in place for certification of gas pipelines), with clear direction to FERC that it should consider the location of renewable and other resources to support climate-mitigation objectives, as well as community impacts and state policies as part of the need determination (i.e., in addition to cost and reliability issues) and that FERC should broadly allocate the costs of transmission enhancements designed to expand regional energy systems in support of decarbonizing the electric system.

[d] (1) Congress should authorize and appropriate funding for DOE to provide support for technical assistance and planning grants to states, communities, and tribal nations to enable meaningful participation in regional transmission planning and siting activities. (2) Congress should authorize and appropriate funding for DOE and FERC to encourage and facilitate use of existing rights of way (e.g., railroad; roads and highways; electric transmission corridors) for expansion of electric transmission systems. (3) Congress should authorize and appropriate funding for DOE to analyze, plan for, and develop workable business model/regulatory structures, and provide financial incentives (through the Green Bank) for development of transmission systems to support development of offshore wind and for development, permitting, and construction of high-voltage transmission lines, including high-voltage direct-current lines.

[e] (1) Congress should direct the Federal Highway Administration (a) to continue to expand its "alternative fuels corridor" program, which supports planning for EV charging infrastructure on the nation's interstate highways, and (b) to update its assessment of the ability and plans of the private sector to build out the EV charging infrastructure consistent with the pace of EV deployment needed for vehicle electrification anticipated for deep decarbonization, the need for vehicles on interstate highways and in public locations or high-density workplaces, and to identify gaps in funding and financial incentives as needed. In coordination with FHWA, DOE should provide funding for additional EV infrastructure that would cover gaps in interstate charging to support long-distance travel and make investments for EV charging for low-income businesses and residential areas. (2) NIST should develop communications and technology interoperability standards for all EV level 2 and fast charging infrastructure.

[f] Extend 45Q tax credit for carbon capture, use, and sequestration for projects that begin substantial construction prior to 2030 and make tax credit fully refundable for projects that commence construction prior to December 31, 2022. Set the 45Q subsidy rate for use equal to $\$35/tCO_2$ less whatever explicit carbon price is established and the subsidy rate for permanent sequestration to be equal to $\$70/tCO_2$ less whatever explicit carbon price is established. A hydrogen pipeline network will ultimately also be needed, but, as indicated in Chapter 2, the time pressure to build a national hydrogen pipeline network is less severe than for $CO_2$. This is because hydrogen production facilities can be located close to industrial hydrogen consumers, unlike $CO_2$ pipelines, which must terminate in geologic storage reservoirs. Also, hydrogen can be blended into natural gas and transported in existing gas pipelines, and gas pipelines could ultimately be converted to 100% hydrogen.

[g] (1) Congress should establish a 10-year GI Bill-type program for anyone who wants a vocational, undergraduate, or master's degree related to clean energy, energy efficiency, building electrification, sustainable design, or low-carbon technology. Such a program would ensure that the U.S. workforce transitions along the physical infrastructure of our energy, transportation, and economic systems. (2) Congress should support the creation of innovative new degree programs in community colleges and colleges and universities focused uniquely on the knowledge and skills necessary for a low-carbon economic and energy transformation. (3) Congress should provide funds to create interdisciplinary doctoral and postdoctoral training programs, similar to those funded by the National Institutes of Health (NIH), which place an emphasis on training students to pursue interdisciplinary, use-inspired research in collaboration with external stakeholders that can guide research and put it to use in improving practical actions to support decarbonization and energy justice. (4) Congress should provide support for doctoral and postdoctoral fellowships in science and engineering, policy, and social sciences for students researching and innovating in low-carbon technologies, sustainable design, and energy transitions, with at least 25 fellowships per state to ensure regional equity and build skills and knowledge throughout the United States. (5) The Department of Homeland Security (DHS) should eliminate or ease visa restrictions for international students who want to study climate change and clean energy at the undergraduate and graduate level, where appropriate. (6) Congress should pass the Promoting American Energy Jobs Act of 2019 to reestablish the Energy Jobs Strategy Council under DOE, require energy and employment data collection and analysis, and provide a public report on energy and employment in the United States.

[h] (1) Congress should establish predictable and broad-based market-formation policies that create demand for low-carbon goods and services, improve access to finance, create performance-based manufacturing incentives, and promote exports. Specifically, Congress should provide manufacturing incentive through loans, loan guarantees, tax credits, grants, and other policy tools to firms that are matched with corresponding performance requirements. Subsidies provided directly to manufacturers must be tied to the meeting of performance metrics, such as production of products with lower embodied carbon or adoption of low-carbon technologies and approaches. Specific items could include expanding the scope of the energy audits in the DOE Better Plants program and expanded technical assistance to focus on energy use and GHG emissions reductions at the 1,500 largest carbon-emitting manufacturing plants; supporting the hiring of industrial plant energy managers by having DOE provide manufacturers with matching funds for 3 years to hire new plant energy managers; enabling the development of agile and resilient domestic supply chains through DOE research, technical assistance, and grants to assist manufacturing facilities in addressing supply chain disruptions resulting from COVID-19 and future crises. (2) Congress should provide loans and loan guarantees to manufacturers to produce low-carbon products, ideally through a Green Bank (see Chapter 4). (3) Congress should require the U.S. Export-Import Bank to phase out support for fossil fuels and make support for clean energy technologies a top priority with a minimum of $500 million per year. (4) Congress should create a new Assistant Secretary for Carbon Smart Manufacturing and Industry within DOE.

[i] (1) Congress should triple the DOE's investments in low- or zero-carbon RD&D over the next 10 years, in part by eliminating investments in fossil-fuel RD&D. These investments should include renewables, efficiency, storage, transmission and distribution (T&D), carbon capture, utilization, and storage (CCUS), advanced nuclear, and negative emissions technologies and increase the agency's funding of large-scale demonstration projects. By eliminating investments in non-carbon capture and storage (CCS) fossil-fuel RD&D, the net increase to the energy RD&D budget will be partially offset. (2) Congress should direct DOE to fund energy innovation policy evaluation studies to determine the extent to which policies implemented (both RD&D investment and market-formation policies) are working. (3) Congress should direct DOE and the National Science Foundation (NSF) to create a joint program to fund studies of the social, economic, ethical, and organizational drivers, dynamics, and outcomes of the transition to a carbon-neutral economy, as well as studies of effective public engagement strategies for strengthening the U.S. social contract for decarbonization. (4) Congress should direct DOE to establish regional innovation hubs where they do not exist or are critically needed using funds appropriated under item 1 above. (5) Congress should direct DOE to enhance public-private partnerships for low-carbon energy.

[j] (1) Congress should coordinate federal agency actions at the regional scale through the deployment of federal agency staff to regional offices. (2) Congress should host a coordinating council of regional governors and mayors that meets annually to establish high-level policy goals for the transition. (3) Congress should establish mechanisms for ensuring the effective participation of low-income communities, communities of color, and other disadvantaged communities in regional dialogue and decision making about the transition to a carbon-neutral economy. (4) Congress should provide information annually to the White House Office of Equitable Energy Transitions detailing regional progress toward decarbonization goals and benchmarks for equity.

Mr. RUSH. The gentleman—opening statement. The Chair now recognizes Ms. Paula Glover, the president of the Alliance to Save Energy.

Paula, it is so good to see you again. And you are recognized for 5 minutes.

**STATEMENT OF PAULA R. GLOVER**

Ms. GLOVER. Thank you, Chairman. Thank you and good afternoon, Chairman Rush, Chairman Pallone, Ranking Member McMorris Rodgers, and Dr. Burgess, for holding this hearing.

A clean energy future that works for everyone is going to require careful planning. And we all appreciate your leadership. Certainly I do. I want to recognize the members of this committee who also serve on the Alliance's honorary board: Chairman Rush, Representatives Tonko, Welch, Dr. Burgess, Representatives McKinley, and Kinzinger. I started with the Alliance just about a month ago, and I am really looking forward to working with all of you.

I also want to just send my thoughts out to those folks in Texas, my friends, my colleagues, and all of those individuals and members of my family who are really going through a very tough time. And just want them to know that we are all thinking and praying about them.

I am going to start by saying, you know, there has been a lot of back and forth recently about the risks and opportunities of the clean energy transition. And I actually believe that it boils down to one essential question: How do we handle and tackle the climate crisis in a way that uplifts every community?

How do we avoid leaving future generations the costs and life-threatening dangers of climate change while at the same time making sure we are not increasing energy costs or leaving communities behind?

We can't make this transition fair unless we are thinking of the communities that could be harmed in the process, as well as the communities that have already been harmed, communities where history tells us we need to do so much better at providing clean air, economic opportunity, and more affordable energy.

And, if I leave you with one thought with my testimony today, I hope it is that energy efficiency is the most powerful answer we have for addressing this challenge. And I would argue that energy efficiency should be the starting point in the conversation about an equitable, clean energy transition.

We can start with jobs. Energy efficiency is often overlooked as one of the largest employers in the entire energy economy. Even after losing more than 300,000 jobs during this—since this pandemic began, efficiency employs more than 2 million Americans. That is about 7 times the amount of wind and solar industries combined, and more than 10 times the size of the coal workforce.

Energy efficiency jobs are spread all over the country. They are construction workers and HVAC contractors who retrofit homes and buildings. They are factory workers making windows and insulation. They are electricians and plumbers and, increasingly, tech workers designing or installing digital controls and systems to manage energy demand. These are the type of jobs that will be created if we launch a national campaign to modernize our infrastruc-

ture by retrofitting millions of homes and buildings, creating a more efficient transportation system, and cleaning up our industrial sector.

It is an incredible opportunity to create durable, skilled trade jobs that pay good wages and that are available in 99 percent of U.S. counties. And if we do it right, we can ensure that those opportunities are available first for the communities that need them the most, whether it is a rural town in West Virginia or an urban neighborhood in Illinois.

And at the same time, we have to carefully consider energy affordability. I started my career more than 30 years ago taking payments in a gas utility. And I know firsthand about the energy burden that many families deal with. In fact, 1 in 5 U.S. households today find themselves making a choice at least once a year between paying their energy bill or buying food and medicine. And I can't begin to imagine what that must be like.

I am not here to tell you that energy efficiency is going to make that burden disappear. But what it can do is deliver hundreds of dollars in lower bills and savings that can make the difference for some families. And that cost savings is not just for consumers. Energy efficiency improvements can cut costs and increase profits for small businesses and manufacturing plants, making them more productive and competitive.

Finally, we have a pressing need to address climate change. When it comes to greenhouse gas emissions, energy efficiency is simply the fastest, cheapest, and most effective solution we have. The International Energy Agency projects that energy efficiency using existing technologies will account for nearly half of the emission reductions needed to meet the goals of the Paris Agreement.

So what do we need to do to achieve these goals? I am going to highlight several policy solutions under this committee's jurisdiction, and we urge you at the Alliance to consider them as you develop infrastructure and clean energy legislation this year.

First, we have been working with Representative Welch and others—thank you, Congressman—to develop a new program for helping small businesses improve their efficiency with an emphasis on boosting minority-owned businesses and businesses in disadvantaged communities. This plan for Main Street efficiency would target Federal grants to match existing utility programs to provide low- and no-cost efficiency upgrades to small businesses immediately and permanently, lowering their operating expenses. Since 80 percent of energy efficiency contractors are small businesses themselves, this is a small business helping small businesses.

We also strongly support a proposal championed by Representative Blunt Rochester—thank you, Congresswoman—to retrofit mission-critical public buildings around the country—our schools, hospitals, airports, and other facilities—not just to be more efficient but also to be safer and more resilient in the face of natural disasters and other emergencies. This proposal would leverage Federal funding to draw billions in private capital through performance contracting and other financing and, importantly, ensure that at least 40 percent of the projects are in low-income or disadvantaged communities.

We also strongly support expanding core efficiency programs at the U.S. Department of Energy, particularly the weatherization assistance program.

I would emphasize that all these proposals, because they are so tailored to creating jobs, go hand in hand with improved worker training programs. We support Chairman Rush's longstanding workforce legislation, the Blue Collar and Green Collar Jobs Act, because that ensures that everyone seeking a skilled position can get one.

In addition, while not under your jurisdiction, we also are looking at tax incentives that will help us grow our—grow efficiency improvements in our homes and buildings.

I believe efficiency is a foundational solution to the challenges that you are trying to address. And we at the Alliance are looking forward, and we are eager to working with you to find the best solutions for all of our communities. Thank you.

[The prepared statement of Ms. Glover follows:]

**Testimony of Paula R. Glover**
**President**
**Alliance to Save Energy**

**U.S. House of Representatives**
**Committee on Energy and Commerce**
**Subcommittee on Energy**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**February 18, 2021**

Thank you Chairman Rush and Ranking Member Upton for holding this hearing and inviting me to testify. You both have been strong supporters of energy efficiency over the years, and the entire efficiency community appreciates your leadership. I also want to recognize the members of this committee on both sides of the aisle who serve on our honorary board: Chairman Rush and Representatives Tonko, Welch, Burgess, McKinley, and Kinzinger. The Alliance is proud of our bipartisan approach, and it is gratifying to see that reflected on this committee. I look forward to working with all of you.

My name is Paula Glover and I am president of the Alliance to Save Energy, a position I've held since the beginning of the year. The Alliance is a bipartisan advocacy organization founded in 1977 and focused on pushing energy efficiency into every corner of the U.S. economy – from more efficient houses, to cars, to air conditioners and buildings. The Alliance has been involved in every major energy efficiency bill that has been signed into law since our founding four decades ago, and we look forward to continuing that this year.

There has been a lot of discussion recently, including in this committee, about the risks and opportunities of the clean energy transition. I think it boils down to one essential question that we would all agree we have to get right. And that is: How do we tackle the climate crisis in a way that uplifts every community? How do we avoid leaving future generations the costs and life-threatening dangers of climate change, while at the same time making sure we're not increasing energy costs or leaving communities without jobs today? We cannot make this transition fair unless we are thinking of the communities that could be harmed in the process, as well as communities that have already been harmed – communities where history tells us we need to be so much better at providing clean air, economic opportunity, and more affordable energy costs.

If you take anything away from my testimony today, I hope it is that energy efficiency is perhaps the most powerful answer we have for addressing this challenge. Energy efficiency means doing more with less of our energy resources. It means reducing greenhouse gas emissions and reducing energy burdens for families – while increasing jobs and economic opportunities across the economy. I would argue that energy efficiency should be the starting point in the conversation about an equitable clean energy transition.

Let's start with jobs. The economic opportunity around clean energy is so much bigger than many people realize, and energy efficiency plays a greater role than is often understood. In fact, energy efficiency is by far the largest employer in the clean energy economy. Even after losing more than

300,000 jobs since the pandemic began, efficiency employs more than 2 million Americans. (Please see jobs by Congressional District chart in Appendix A). That's about seven times that of the wind and solar industries combined, and more than 10 times the size of the coal workforce. Energy efficiency jobs are spread all over the country – they are construction workers and HVAC contractors retrofitting homes and buildings, factory workers making windows and insulation, electricians and plumbers, and increasingly, engineers and tech workers designing or installing digital controls and systems to manage energy demand.

These are the types of jobs that will be created if we launch a national campaign to modernize our infrastructure by retrofitting millions of homes and buildings, creating a more efficient transportation system, and cleaning up our industrial sector. It is an incredible opportunity to create durable, skilled-trade jobs that pay good wages and that are available in 99% of U.S. counties. And, if we start our planning today, we can ensure that those opportunities are available first for the communities that need them most – whether it's a struggling rural town in West Virginia or a low-income neighborhood in Chicago.

We also must carefully consider energy affordability. I started my career accepting payments in a utility billing department, and I know first-hand what the energy cost burden looks like for struggling families. One in five U.S. households has had to reduce or forego food, medicine, and other necessities just to pay their energy bills. Imagine at the end of the month being forced to choose between feeding your family or keeping the lights on. I am not here to tell you that energy efficiency can make this burden disappear. But what it can do is deliver hundreds or even thousands of dollars a year in lower bills, savings that can make all the difference for a family struggling to get by.

And the cost savings are not just for consumers: Energy efficiency improvements can cut costs and increase profits for small businesses and manufacturing plants, making them more productive and competitive.

Finally, we would of course not be here today if it were not for the pressing need for tackling climate change. When it comes to greenhouse gas emissions, energy efficiency is simply the fastest, cheapest, and most effective solution we have. The International Energy Agency projects that energy efficiency – using existing technologies – will account for nearly half of the emissions reductions needed to meet the goals of the Paris Agreement. Yet we are significantly off track for meeting that target, and the agency reports that global efficiency gains have been slowing since 2015.

For all its benefits, energy efficiency suffers from one primary obstacle, which is that it often requires upfront investment. The most meaningful efficiency improvements often require up-front spending or capital to reap long-term gains. And of course, our society and our markets are often looking for the opposite. This is where policy comes in – where this committee and this Congress can help bridge the gap and deliver a more efficient and sustainable future.

So what needs to be done?

First, I would emphasize that we need to continue strengthening the core energy efficiency programs at the Department of Energy that steadily and consistently deliver efficiency gains. Programs like appliance and equipment standards and building energy codes are critically important. We build 1 million new homes a year in this country, and they will be in the ground for 50 or 100 years, so having sound building

energy codes is essential for getting them built right in the first place to avoid decades of unnecessary emissions and costs. We urge you to support bolstering the role the department plays in providing technical assistance and other resources to help states that want to adopt model buildings codes do so.

Similarly, having a consistent and robust appliance and equipment standards program is foundational for lowering our emissions and reducing consumer costs. The Appliance Standards Awareness Project estimates that standards alone save the average household some $500 per year. We applaud the Biden administration's recent efforts to get those standards back on track with the kind of stable, predictable programs that both advocates and industry want.

The Weatherization Assistance Program is another core program at the Department of Energy proven to deliver energy efficiency to communities that otherwise may not be able to access its benefits, but it is in high demand and has long waiting lists across the country. We propose not just increasing funding but also developing new approaches to ensure that households that need the assistance most can get it. Too many of our lowest-income households are turned away when their houses aren't in good enough condition to be weatherized, and we should find solutions for overcoming those obstacles.

We are also excited about the emerging technologies work the department is doing, particularly the Building Technologies Office's Grid-Interactive Efficient Buildings program and Connected Communities Funding Opportunity. The Alliance calls this Active Efficiency – optimizing energy use by integrating traditional energy efficiency solutions with opportunities presented by digital technologies. It is the next frontier in efficiency, and the Department of Energy can play a key role in ensuring that the U.S. leads in the development and deployment of Active Efficiency solutions.

We also strongly support efforts to improve energy efficiency at the federal level. As you know, the federal government is the largest energy user in the nation, spending some $6 billion per year on energy for its buildings alone. It's one thing for a financially strapped homeowner to delay making efficiency improvements when they simply don't have the resources, but it is short-sighted and wasteful for the federal government to fail to capitalize on these improvements that would save taxpayers money. There is a significant opportunity for the federal government, through programs such as the Federal Energy Management Program, to reduce federal spending on energy bills while also leading by example and accelerating the adoption of new efficiency technologies.

As I mentioned earlier, the energy efficiency sector has been hard hit by the pandemic. With investment dropping and efficiency programs in some cases shut down, we have seen more than 300,000 job losses in the sector since March, according to Bureau of Labor Statistics data analyzed by Environmental Entrepreneurs and others,

In response to this crisis, the Alliance has developed a suite of priorities that is specifically aimed at quickly creating jobs and economic activity while reducing carbon emissions – and at the same time ensuring the opportunities and benefits are delivered equitably. We urge you to consider them as you develop infrastructure and clean energy legislation this year. I will highlight several of them here that particularly are under the committee's jurisdiction.

First, we are working with Representative Welch and others to develop a new program for helping small businesses improve their efficiency, with an emphasis on boosting minority-owned businesses and businesses in disadvantaged communities. This plan – which we're calling the Main Street Efficiency Act

– would target federal grants to match utility incentives to provide low and no-cost efficiency upgrades to small businesses – immediately and permanently lowering their operating expenses. Since 80% of energy efficiency contractors are small businesses themselves, this is small business helping small business.

We also have helped lead and strongly support a proposal championed by Representative Blunt Rochester to retrofit mission critical public buildings around the country – our schools, hospitals, airports and other facilities – not just to be more efficient but also to be safer and more resilient in the face of natural disasters and other emergencies. This proposal calls for leveraging federal funding to draw billions in private capital through performance contracting and other financing, and, importantly, ensures that at least 40% of the projects are in low-income or disadvantaged communities. We know that our nation's infrastructure desperately requires upgrades, and this bill would do that while locking in decades of cost and emission savings.

While these aren't under the committee's express jurisdiction, I would highlight that we also are working with the tax-writing committees to win badly needed reforms and improvements to tax incentives encouraging energy efficiency improvements in homes and buildings, and we also have a suite of proposals to modernize the U.S. transportation system to make it more efficient, equitable, and sustainable.

I would emphasize that all of these proposals – because they are so tailored to creating jobs – go hand in hand with improved worker training programs. We strongly support Chairman Rush's longstanding workforce legislation – the Blue Collar to Green Collar Jobs Development Act – because it will ensure that anyone seeking a skilled position can get the training they need.

In closing, I believe energy efficiency is a foundational solution to the challenges this committee is trying to address and must be a part of the conversation at every turn. We at the Alliance are eager to work with all of you to move solutions forward in this Congress. Thank you again for the opportunity to testify, and I'm happy to answer questions.

APPENDIX A

| U.S. House of Representatives Subcommittee on Energy<br>Energy Efficiency Sector Employment By District | | | |
|---|---|---|---|
| **Member (District)** | **Pre-COVID-19 EE Jobs** | **Statewide Decline** | **Est. Job Losses, District** |
| Rep. Bobby Rush (D-Ill.-01), Chairman | 5,237 | 7.0% | 367 |
| Rep. Scott Peters (D-Calif.-52) | 10,236 | 13.3% | 1,361 |
| Rep. Michael Doyle (D-Pa.-14) | 5,015 | 18.2% | 913 |
| Rep. Jerry McNerney (D-Calif.-09) | 4,687 | 13.3% | 623 |
| Rep. Paul Tonko (D-N.Y.-20) | 5,701 | 7.3% | 416 |
| Rep. Marc Veasey (D-Texas-33) | 129 | 7.8% | 10 |
| Rep Kim Schrier (D-Wash.-08) | 6,308 | 19.5% | 1,230 |
| Rep. Diana DeGette (D-Colo.-01) | 11,314 | 6.7% | 758 |
| Rep. G.K. Butterfield (D-N.C.-01) | 10,143 | 15.1% | 1,532 |

| | | | |
|---|---|---|---|
| Rep. Doris Matsui (D-Calif.-06) | 6,310 | 13.3% | 839 |
| Rep. Kathy Castor (D-Fla.-14) | 5,664 | 13.9% | 787 |
| Rep. Peter Welch (D-Vt.-AL) | 11,032 | 11.4% | 1,258 |
| Rep. Kurt Schrader (D-Ore.-05) | 4,265 | 10.7% | 455 |
| Rep. Ann Kuster (D-N.H.-02) | 5,444 | 7.7% | 42 |
| Rep. Nanette Barrigan (D-Calif.-44) | 1,772 | 13.3% | 236 |
| Rep. Don McEachin (D-Va.-04) | 6,065 | 10.2% | 619 |
| Rep. Lisa Blunt Rochester (D-Del.-AL) | 12,543 | 12.3% | 1,543 |
| Rep. Tom O'Halleran (D-Ariz.-01) | 4,500 | 10.6% | 477 |
| Rep. Frank Pallone (D-N.J.-06), Ex Officio | 2,378 | 15.9% | 378 |
| Rep. Fred Upton (R-Mich.-06), Ranking Member | 5,547 | 16.9% | 938 |
| Rep. Michael Burgess (R-Texas-26) | 1,553 | 7.8% | 121 |
| Rep. Bob Latta (R-Ohio-05) | 8,567 | 12.6% | 1,079 |
| Rep. David McKinley (R-W.Va.-01) | 2,790 | 12.9% | 360 |
| Rep. Adam Kinzinger (R-Ill.-16) | 4,814 | 7.0% | 337 |
| Rep. Morgan Griffith (R-Va.-09) | 4,259 | 10.2% | 434 |
| Rep. Bill Johnson (R-Ohio-06) | 5,321 | 12.6% | 670 |
| Rep. Larry Bucshon (R-Ind.-08) | 6,709 | 12.9% | 865 |
| Rep. Tim Walberg (R-Mich.-07) | 8,347 | 16.9% | 1,411 |
| Rep. Jeff Duncan (R-S.C.-03) | 4,036 | 13.2% | 533 |
| Rep. Gary Palmer (R-Ala.-06) | 6,630 | 16.5% | 1,094 |
| Rep. Debbie Lesko (R-Ariz.-08) | 1,149 | 10.6% | 122 |
| Rep. Greg Pence (R-Ind.-06) | 5,660 | 12.9% | 730 |
| Rep. Kelly Armstrong (R-N.D.-AL) | 5,581 | 13.3% | 782 |
| Rep. Cathy McMorris Rodgers (R-Wash.-05), Ex Officio | 5,695 | 19.5% | 1,111 |
| **Subcommittee Total** | **195,401** | **12.5%** | **-24,431** |
| **Sources: BW Research Partnership and E4TheFuture** | | | |

Mr. RUSH. Thank you, Ms. Glover. The Chair now recognizes Mr. Gordon.

Mr. Gordon, you are recognized for 5 minutes.

**STATEMENT OF CRAIG GORDON**

Mr. GORDON. Thank you, Subcommittee Chairman Rush, Mr. Chairman Pallone, Ranking Member Rodgers, and Acting Member Burgess for inviting me to participate in today's hearing. My name is Craig Gordon, and I am senior vice president of government affairs at Invenergy.

Invenergy is a privately held clean energy company that develops, owns, and operates large-scale renewables, gas-fired generation, as well as energy storage and electric transmission. Starting with just 6 employees in 2001, Invenergy will employ more than 1,500 employees by the end of the year. Invenergy has developed 175 utility-scale clean energy projects, with the capacity of over 27,000 megawatts, and has completed more than 40 billion in project financings. We focus on renewables because, as our CEO, Michael Polsky, loves to say, it just makes sense.

Before I begin my testimony, I would like to briefly address the recent reliability issues in Texas and neighboring States. These events underscore the importance of your work to ensure a reliable and affordable grid as the realities of climate change are hitting us in unexpected ways.

On behalf of Invenergy I want to say that we are deeply troubled and saddened by the events that have unfolded. The system failed in Texas for 2 reasons: first, because the market and the resources themselves were not designed to sustain such extreme cold weather—wind, gas, coal, and nuclear operations were all disrupted—no single resource type bears all the blame; second, since Texas is electrically isolated from the rest of the grid, available generation elsewhere could not be imported to address the shortfall.

Even now, as the crisis in Texas and elsewhere continues, the real investigations into what went wrong haven't even begun. But the recommendations I made in the file testimony already point to the path forward. They were true before the disaster hit, and they are painfully true today.

First, transmission. There is simply no way to achieve the ambitions of this administration and the American people without more of it. Higher penetrations of renewables throughout the country require a massive investment in transmission infrastructure. Transmission connecting diverse regions of the country and different types of technologies with complementary generation profiles is key to solving this challenge.

Second, long-term energy policy. Without a national policy to direct the country toward a decarbonized grid, we will only make incremental progress. And without a long-term approach, the industry will not be able to plan for projects and infrastructure across the multiyear development and supply chain timelines that are required for these huge investments. A patchwork of State policies has filled the void of a Federal policy so far, but real progress has been limited because every State does it differently. An overarching goal would align all States and help address thorny issues.

Additionally, there are several other policies that aren't squarely under the jurisdiction of this committee that are critical to meeting these goals.

First, Congress should consider policies that allow for monetization of energy tax credits at 100 percent of their value to address the tightening tax equity market.

Second, Congress should consider Federal incentives like an investment tax credit for transmission to unlock renewables and improve reliability of the grid.

Third, Congress should increase resources and develop advanced technologies to ensure the long-term compatibility of renewable energy and our national security.

The transition to a decarbonized grid will create significant socioeconomic benefits. For example, we create good-paying jobs in rural and historically disadvantaged communities. Invenergy invests in training and STEM programs to produce the next generation of workers in communities we serve. Approximately 10 percent of Invenergy's employees are veterans, and we continue to recruit from that great talent pool.

In addition to job benefits, the affordable, emissions-free power that our industry generates can help alleviate environmental burdens, especially in low-income areas, or those most susceptible to harmful environmental impacts. Indeed, a thoughtful expansion of clean energy can contribute to a just transition in an equitable, clean-energy economy.

The urgency with which we must all tackle this challenge has never been greater. Fortunately, we have the tools to do so. The path to achieving our goals is not mysterious. Transmission is as core to the economy of the future as the highway system is to interstate commerce today. What we have before us is a once-in-a-lifetime opportunity to tackle the most existential threat modern mankind has ever faced. And we must, because it just makes sense.

Thank you again for the opportunity to address this subcommittee.

[The prepared statement of Mr. Gordon follows:]

**Testimony of**

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**Before**

**U.S. House Committee on Energy and Commerce**

**Subcommittee on Energy On**

**"A Smarter Investment: Pathways to a Clean Energy Future"**

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## Introduction

Thank you, Chairman Pallone, Ranking Member Rodgers, Subcommittee Chairman Rush, and Subcommittee Ranking Member Upton, for inviting me to participate in today's hearing to discuss the best policy pathway to a clean energy future. I applaud your attention to this important subject and recent work to develop an ambitious plan to get us on this path, including development of the CLEAN Future Act.

I am Craig Gordon, Senior Vice President of Government Affairs for Invenergy. I have nearly 20 years of power industry experience, and I have been with Invenergy for more than half of its 20-year history in a range of roles. Prior to joining Invenergy, I spent over eight years with a large Midwestern utility, where I held multiple positions, including power trader and power plant dispatcher. My industry experience is largely shaped by the commercial activities of the power sector, and I am now drawing on these experiences to inform Invenergy's governmental affairs efforts.

Invenergy is the leading independent and privately held clean energy company in the United States. Our headquarters is located in Chicago, Illinois, and we have regional development offices throughout the United States, Mexico, Canada, Europe, and Japan. Invenergy develops, owns, and operates large-scale renewable and other clean energy generation facilities, as well as energy storage and electric transmission, throughout the country and around the world. Starting with just six employees in 2001, Invenergy plans to employ more than 1,500 full-time employees by the end of this year. Invenergy employees possess a wide range of specialties, including wind and solar technicians, power plant operators, project and construction engineers, wildlife and environmental impact specialists, and many more. These jobs are spread throughout the country and around the world, especially in the communities where our projects are located. Approximately 50 percent of our employees work at project sites, while the others work in our corporate headquarters or in one of our satellite offices. We are also proud to say that approximately 10 percent of our workforce are U.S. military veterans.

In the two decades since its formation, Invenergy has developed 175 utility-scale clean energy projects that produce over 27,000 megawatts of generation capacity, and we have completed more than $40 billion in financing transactions to support this growth. The vast majority of our projects are located in the United States, and many of our projects are located within some of the districts of the members of this Subcommittee. For example, in Congressman Kinzinger's district in Illinois, Invenergy owns and operates a 600-megawatt combined cycle natural gas plant, a series of wind farms that produce nearly 210 megawatts, a series of energy storage facilities rated at 36.5 megawatts, a 20-megawatt solar farm, and

a test facility for new solar prototypes. We are also conducting a pilot project for producing hydrogen from our renewable resources in the district. In Congresswoman Lesko's district in Arizona, Invenergy is working on a utility-scale energy storage project called El Sol for Arizona Public Service. El Sol is a 50-megawatt project and will provide up to 200 megawatt hours of clean energy per cycle. And, in Congressman Wahlberg's district in Michigan, Invenergy recently completed construction on Crescent Wind, a 166-megawatt wind facility that was purchased by Consumers Energy. Further east in Congressman Latta's district, Invenergy recently completed construction of the 150-megawatt Hardin Solar project in Hardin County, Ohio; we are also currently building a second 150-megawatt phase of Hardin Solar (Hardin II), as well as other solar and storage projects in early stages of development in his district.

In Congresswoman Schrier's district on the West Coast, Invenergy owns the Vantage wind facility, which is a 90-megawatt project in Kittitas County that sells its output to Pacific Gas & Electric. Immediately south, Invenergy is developing up to 400 megawatts of solar in Congressman O'Halleran's district in Navajo County, which may also include an energy storage component. We also have other solar and storage projects across his district in various stages of development. Back on the East Coast, in Rep. Butterfield's district, Invenergy is developing a 75-megawatt solar project called Edgecombe Solar in Edgecombe County, North Carolina. Aside from the specific examples mentioned so far, Invenergy has wind, solar, and storage projects in various stages of development in the districts of the following Congressmen: McEachin, Upton, Griffith, Buschon, Pence, and Armstrong. Collectively, these utility-scale projects represent billions of investment dollars, millions of dollars in payments to local communities and states, and thousands of construction, operation, and maintenance jobs.

Invenergy is widely recognized as a leader in the clean and renewable energy space. Our focus on meeting the needs of our utility and commercial and industrial (C&I) customers has enabled us to stay competitive and ahead of the curve. In recognition of our leading role in the clean energy industry, Invenergy's President and Chief Operating Officer, Jim Murphy, was recently chosen as the interim Chair of the Board for the newly created American Clean Power Association (ACP), the nation's premiere clean energy trade association focused on transforming the U.S. power grid to a low-cost, reliable, and renewable power system. By uniting the power of wind, solar, transmission, and storage companies and their allied industries, ACP is championing policies that enable the continued growth of renewable energy in this nation.

**Summary**

Throughout the first decade of the 21st Century, the renewable energy sector struggled to establish itself, constantly battling high costs, unproven technology, low efficiencies, and the perception held by many utilities that renewables were inferior and unreliable. Today, the world looks very different. The current pace of growth in the renewable industry is largely due to the fact that costs have dropped significantly, the technology and efficiencies have improved dramatically, and utilities now regard renewable energy as integral to satisfy their present and future energy needs. In fact, utility holding companies, such as American Electric Power, Berkshire Hathaway Energy, Duke Energy, Nextera and Xcel Energy, are now some of the biggest owners of renewable energy. Many of these companies and other smaller utilities have established their own aggressive renewable energy or decarbonization goals.[1]

While the economics of renewables have vastly improved over the last decade, the lack of a consistent national energy policy has impeded the growth of the industry. In this void, over 25 states have created a

[1] Race to 100% Clean (detailing utility emissions targets), https://www.nrdc.org/resources/race-100-clean.

patchwork of policies intended to address climate change or emissions from the power sector. Without a national policy that would guide states towards the same goal, overall progress on decarbonization of the energy sector has been and will continue to be limited with incremental improvements in total emissions. It is also is largely undisputed that decarbonization goals must be paired with major investments in new transmission infrastructure to achieve success. And, from a technical perspective, there is simply no way the energy industry can achieve the ambitious decarbonization goals of this Subcommittee and the Biden administration absent massive transmission infrastructure investments to make the grid more efficient, reliable, and resilient. Federal incentives (which reduce customer costs, as opposed to increase investor returns) are necessary to spur development of new transmission needed to meet these goals. In addition to the need for a national energy policy and policies that encourage massive investments in transmission, there are also a variety of other policies tangential to the work of this Subcommittee that we believe can promote clean energy investments, including monetization of tax credits, federal incentives for transmission, and additional investments in military and weather radar technology. Finally, as described in more detail below, these policy recommendations are critical to address the Subcommittee's goal of promoting environmental justice and equity, because they will promote investments in clean energy infrastructure, create good jobs, and address carbon emissions that have a disproportionate impact on disadvantaged communities.

The need to identify a national policy is clearly recognized in the CLEAN Future Act's ambitious comprehensive proposal of sector-specific and economy-wide solutions that aim to transition the nation to carbon-free energy.[2] Hopefully, Congress shares the interest of this Subcommittee in addressing climate change, and plans to seriously consider new policy tools, like those mentioned above, to help drive this transition. As a representative of the country's largest private clean energy developer, owner, and operator, and as a member on behalf of the largest renewable energy industry group in the nation, I offer the following observations and recommendations for Congress to consider as it weighs the best policies for decarbonizing the electric sector in the most cost-effective and reliable manner.

1. **Accelerating the Clean Energy Transition Requires Massive Investments in Transmission Infrastructure**

A robust electric transmission system is an essential part of any credible pathway towards a zero-emissions electricity sector that will form the foundation for a decarbonized economy. In fact, attaining the climate and clean energy goals set forth in the CLEAN Future Act, or any other national climate or carbon goals, will not be possible without significant, immediate transmission investment and appropriate policy signals. Multiple studies on realizing the decarbonization of the electric system over the coming decades have noted the critical need for expanded transmission, on the order of 3-5 times current annual investment levels, to meet that goal.[3] For example, a recent report from the Mid-Continent Independent System Operator (MISO) notes that high-voltage transmission will aid reliability in a high-renewables grid.[4]

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[2] Decarbonizing the electricity sector is important not only because the power sector has historically been responsible for a large share of U.S. GHG emissions, but also because many technologies to reduce pollution in other sectors—such as plug-in electric vehicles, clean manufacturing, and zero-emission buildings—rely on clean energy electrification to make them true low- and zero-carbon alternatives.

[3] *See e.g.* Aggarwal and O'Boyle, Energy Innovation Policy Paper for the 2035 Report (2020) at 13-15, https://www.2035report.com/downloads/; Net-Zero America Project (2020) at 10, https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf.

[4] MISO's Renewable Integration Impact Assessment (2021), https://cdn.misoenergy.org/RIIA%20Summary%20Report520051.pdf.

In a separate draft academic report from the National Academies of Sciences, Engineering, and Medicine entitled "Accelerating Decarbonization of the U.S. Energy System," experts state that, in this decade, overall transmission capacity must be increased, "by as much as 60% to interconnect and harness low-cost wind and solar power across the country."[5] It is clear that, without policies that facilitate massive investments in transmission, some of the best renewable resources in the country will be stranded, and many system-wide benefits will be lost. Congress should consider policies that improve interregional planning processes, incentivize improvements and new technology to make transmission more efficient, and improve existing transmission siting and environmental permitting processes.

Renewables have come far despite the limitations of the antiquated electrical grid, but the explosive growth called for in coming years requires will be severely thwarted without an expanded and smarter transmission system. America has abundant renewable energy resources, but in many cases, these resources are "stranded" due to insufficient transmission capacity.[6] Accessing these resources requires paying for and building transmission that, when paired with renewable energy, will produce long-term savings for customers (as well as produce significant environmental and reliability benefits). As the grid has begun to shift to renewable energy, which has zero marginal cost, the generation component of electricity prices has gone down, while the delivery component (transmission and distribution) has risen.[7] Overall electricity rates for customers are holding steady or increasing only modestly.[8]

Investments in transmission - and policies that support timely transmission development and deployment - are highly beneficial. Transmission saves customers money, reduces wasted energy, and improves grid reliability and resilience. Particularly important for reliability and resilience is the ability of transmission to integrate geographically diverse resources with complementary generation profiles. Geographically diverse generation that is interconnected by interregional transmission can reduce the need for rolling power outages resulting from severe local weather conditions because the transmission lines interconnect to areas that are less impacted. This can allow load-serving entities to balance load with available generation from geographically diverse locations, potentially hundreds of miles away, improving reliability and resiliency. In addition to the reliability and resiliency benefits, investment in transmission has historically provided significant monetary returns (in the form of savings on energy costs) to customers – for example, a portfolio of forward-looking projects in the Midwest has provided between $2.60 and $3.90 in benefits for each dollar spent.[9] And the rapid development and expansion of transmission infrastructure will create millions of jobs. For example, one recent report found that with accompanying carbon policy, as many as 1.5 million transmission-related jobs (and over 6 million electric-sector jobs)

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[5] National Academies of Sciences, Engineering, and Medicine at 7, *Accelerating Decarbonization of the U.S. Energy System*, https://www.nap.edu/catalog/25932/accelerating-decarbonization-of-the-us-energy-system.
[6] Utility Dive, Propelling the transition: New and better transmission is key to zero carbon, https://www.utilitydive.com/news/propelling-the-transition-new-and-better-transmission-is-key-to-zero-carbo/582331/.
[7] EIA, Electricity Prices Reflect Rising Delivery Costs, Declining Power Production Costs, https://www.eia.gov/todayinenergy/detail.php?id=32812.
[8] EIA, Average Price of Electricity to Ultimate Customers, https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_03
[9] *See* Pfeifenberger, Improving Transmission Planning: Benefits, Risks, and Cost Allocation (Nov. 6, 2019) at 10, https://brattlefiles.blob.core.windows.net/files/17555_improving_transmission_planning_-_benefits_risks_and_cost_allocation.pdf. *See also* Southwest Power Pool, Value of Transmission (2016) https://www.spp.org/Documents/35297/The%20Value%20of%20Transmission%20Report.pdf (benefit: cost ratio of 3.5:1).

could be created in the Eastern Interconnection by 2050.[10] These jobs are typically high-paying, and because many transmission components are produced domestically, additional manufacturing jobs are likely to be created as a byproduct of expanding our grid.

The Federal Energy Regulatory Commission's (FERC) existing rules have done little to encourage the development of interregional transmission lines, which can provide significant benefits by diversifying energy resources and reaching more customers that want access to clean power. Wind and solar make up the bulk of projects seeking to interconnect to the grid today,[11] and transmission ensures that clean, cheap electricity can be delivered from where it is available to where it is needed. Invenergy appreciates the Subcommittee's work on the CLEAN Future Act, which includes a provision that would encourage FERC to improve the interregional planning process to allow projects benefitting multiple regions to move forward, with costs shared among the customers that benefit from them. It remains imperative that FERC create these new rules that would, in effect, incentivize new lines, and the proposal in the draft bill, or one like, it is a good start in this direction. It is also worth noting that transmission planning today fails to account for resources in new generation interconnection queues, meaning that transmission is not being developed where and when it is most needed. Interregional planning efforts should promote competitive procurements for new transmission and major transmission upgrades to ensure that investment costs are kept in check. Developers like Invenergy are incentivized to keep costs of these important projects as low as possible, which leads to lower power costs for electric customers.

Congress should also consider ensuring that transmission planning fully accounts for current trends and technologies. For example, offshore wind generators are seeking to interconnect close to large population centers, which may require upgrades to existing transmission to accommodate and close coordination between states, grid operators, utilities, and developers, as well as federal regulators to ensure these upgrades are timely and cost-effectively made. Transmission development complements other technologies, including energy storage[12] and distributed energy resources.[13] Interconnection policies need to keep up and accommodate highly flexible "hybrid" resources consisting of co-optimized and jointly operated renewables and storage. Additionally, advanced energy technologies can ensure that existing and new transmission lines are fully utilized; these include dynamic line rating (adjusting the amount of energy lines can carry in real time), power flow controls (routing energy over lines to avoid congestion), and topology optimization (using software to maximize grid efficiency). Congress should consider enacting policies that ensure that tomorrow's grid is not built with yesterday's technology by providing incentives for new technology and allowing for interconnection of hybrid resources.

Finally, Congress should consider reforming existing siting and permitting processes so that projects are developed and built expeditiously, in an environmentally responsible manner, to meet project milestones and timelines. To advance needed transmission buildout, the federal government should establish defined processes for transmission reviews so that necessary transmission and connected generation can be built

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[10] Clack, Goggin, Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S. (2020) at 11-15, https://www.vibrantcleanenergy.com/wp-content/uploads/2020/10/EIC-Transmission-Decarb.pdf.

[11] ACEG Interconnection Report (2021), https://cleanenergygrid.org/wp-content/uploads/2021/01/Disconnected-The-Need-for-a-New-Generator-Interconnection-Policy-1.14.21.pdf.

[12] MISO Renewable Integration Impact Assessment at 90, https://www.misoenergy.org/planning/policy-studies/Renewable-integration-impact-assessment/#t=10&p=0&s=&sd=.

[13] Clack, Vibrant Clean Energy, WHY LOCAL SOLAR FOR ALL COSTS LESS (2020) at 78 https://www.vibrantcleanenergy.com/wp-content/uploads/2020/12/WhyDERs_ES_Final.pdf.

and can come online on schedule and on budget. The transmission review process should ensure early-stage alignment between and across federal agencies, such as the Fish and Wildlife Service and the Army Corp of Engineers, to create a predictable and consistent process for environmental review and permitting. This is particularly critical for projects that cross multiple jurisdictions, where reviews must be coordinated between multiple offices, regions, or districts. For proposed projects on the federal lands, federal land management agencies should be directed to utilize, and improve on, existing tools and best management practices that have been identified to reduce the time needed for permitting. In addition, federal environmental permitting should, to the extent possible, be coordinated with state transmission siting so that developers can meet critical timelines. Transmission developers are prepared to work with local communities and regulators to build trust with state and local regulators and landowners, and to ensure that environmental or economic impacts of transmission lines are fully accounted for, and that those local communities – not just the end customer or the generator – benefit from these projects. To encourage broad community and state support for new transmission, Congress should also consider state incentive programs such as additional broadband funding for "last mile" internet service to ensure rural access to high speed internet. Broadband and new transmission can be sited in the same rights-of-way to reduce costs. The federal government can also ensure that transmission siting on federal lands has a well-defined and consistent process that maximizes certainty while minimizing delays and litigation. Finally, federal agencies could use existing authority to intervene in state siting proceedings as a last resort, in the rare instance where delays become unreasonable.

**2. <u>A National Clean Energy Policy is Necessary to Decarbonize the Electric Grid</u>**

While the economics of renewables have vastly improved over the last decade, due in no small part to existing federal and state policies, the lack of a consistent national energy policy has impeded the growth of the industry. In the void, over 25 states have created a patchwork of policies intended to encourage clean energy in one way or other. Some have opted for renewable and clean energy standards, while others have attempted to encourage carbon capture and sequestration. Some have tried multiple ways, and all have seen varying degrees of success. Without a national energy policy to guide all 50 states forward, overall progress has been limited. Some states without aggressive clean energy goals have far exceeded them, while other states with aggressive goals have fallen far behind for lack of resolve or due to ineffective policies.

The transition to clean energy is unlikely to happen rapidly on its own because, at least in restructured states, investment and operating decisions are driven by competitive market forces that do not currently account for the cost of carbon emissions. A well-designed market-based mechanism for pricing carbon in the market, as well as other supporting policies, can operate as an efficient means to cut emissions, fostering a shift from the current fleet of generation to cleaner energy resources. In particular, a comprehensive, coordinated, and market-based approach to reduce emissions in the power sector that recognizes the social cost of carbon will provide increased demand for renewable energy and move America toward a cleaner future, identifying the least-cost power, through broad competition, across low-carbon and carbon-free energy sources.

A federal carbon pricing program (direct or indirect) can change the relative cost of resources by making fuels with relatively greater emissions more expensive than those with relatively lower emissions, sending an economic signal that percolates through the entire marketplace. This signal provides an incentive for all decision-makers in the market to look for ways to reduce emissions, and the flexibility to make decisions based on their own information and circumstances.

When applied to the electricity sector, either as part of an economy-wide policy or on its own, an important attribute of a robust carbon pricing program is to ensure that all emissions are priced consistently over time. Another key to guaranteeing the effectiveness of the program is to ensure that the policy is in place over a long-time horizon (10-plus years). This will provide electricity generators of all types and efficiencies a long-term incentive to reduce their emissions in whatever manner makes economic sense, allowing significant flexibility for the power sector overall to reduce its emissions, and provide the certainty for cleaner generation to come online. With development cycles for renewables and associated infrastructure that take years, it is important a federal carbon program provide the stability that it will remain in place for the foreseeable future.

A tradeable clean energy standard (CES) such as the one proposed in the CLEAN Future Act could be a suitable alternative if pricing carbon directly is not possible, or it could also be a complementary policy alongside a carbon price. The CES approach makes use of economic incentives and can be designed to be technology neutral. A well-considered CES can approach the economic efficiency of emissions reductions achieved under a carbon pricing approach.[14] In fact, modeling of proposed CES policies has shown that a CES can put the power sector well on its way to full decarbonization with modest effects on nationally averaged electricity rates.[15]

In comparing climate policy options (with all else being equal), the greater the number of accessible options to reduce emissions, the lower the total costs of the policy will be. In fact, some of these policies could be complementary (*e.g.*, a CES in the electric sector and a carbon tax applied to other areas of the economy). Provided they are well-designed and do not create undue and conflicting administrative burdens on regulated entities, with clear price signals, long time horizons, and broad applicability, any of these carbon-based programs could hold significant promise for decarbonizing the electric grid. Each has its relative benefits, and the challenges with any of them are not insurmountable and all could be transformative in decarbonizing the power sector, as well as other parts of the economy, as long as they avoid unintended consequences (such as causing existing renewables to be prematurely retired, sacrificing the emission benefits they provide).

Market forces have already driven growth in renewables, with many major utilities making the transition to them because of cost advantages which has been supported, in part, energy tax credits that have been available for limited time periods. Over the past decade, non-hydroelectric renewable generation has more than tripled, partly due to declining costs. Between 2009 and 2020, the levelized costs of utility-scale solar and wind have come down by 71 and 90 percent, respectively.[16] Costs for energy storage are similarly falling, with a 35 percent decrease in one year since early 2018, making renewables plus storage competitive with natural gas in many markets.[17] Utilities, in response to these changing conditions and the need to address climate change, have increased the level in which they rely on renewables, and many have even set targets of getting to 100 percent zero emissions by midcentury. This has already resulted in

[14] Resources for the Future, https://media.rff.org/documents/SCCC_Comments_Final_Merged.pdf.
[15] Resources for the Future, https://www.congress.gov/116/meeting/house/110174/witnesses/HHRG-116-IF03-Wstate-PalmerK-20191030.pdf.
[16] Lazard, Levelized Cost of Energy and Levelized Cost of Storage – 2020, https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2020/.
[17] Bloomberg (2019). Battery Power's Latest Plunge in Costs Threatens Coal, Gas. Available at: https://about.bnef.com/blog/battery-powers-latest-plunge-costs-threatens-coal-gas/.

a decrease in emissions from electricity generation, which have dropped by over 27 percent since 2005.[18] For instance, in 2017, nearly 50 percent of emissions reductions in the power sector relative to 2005 were attributable to increases in non-carbon generation.[19] With further policies to stimulate renewables and even further lower the cost of renewables, it can be expected that more utilities will accelerate their transition plans to a clean energy future and more emission reductions will be captured.

Renewable energy can also be reliably integrated into the existing power mix without compromising the stability of the power sector and, thus, energy reliability to consumers.[20] Renewables can provide a suite of essential grid reliability services.[21] Other advanced energy technologies, such as battery storage, can provide important reliability services to the grid that promote further adoption of and investment in clean energy generation.[22]

### 3. Complementary Priorities to Cost-Effectively Ensure a Decarbonized Grid

#### *a. Monetization to Support Lack of Available Tax Equity*

Renewable energy projects are unique in that they are eligible for a federal production tax credit (PTC) or investment tax credit (ITC). But, in order to benefit from these credits, projects must secure capital from tax equity investors who claim the credits to offset their tax liabilities. The supply of tax equity has always been limited and highly concentrated, and there is only so much equity available for renewable projects in that market.[23] The proliferation of new solar projects, which are eligible for ITCs, "front ends" the need for tax equity as the full credit needs to be monetized in the year that the project is placed in service. COVID-19 economic impacts have further exacerbated these issues and tightened the tax equity market. Tax equity investors have less ability to offset tax liabilities when an economic downturn lowers their overall tax liability—in other words, they have less "tax appetite." As the pandemic has progressed since spring 2020, economic uncertainty has led to several tax equity firms taking a pause—or exiting altogether—from the tax equity market. In aggregate, a recent Bloomberg New Energy Finance report estimated that the growth of up to 30 GW in renewable projects could be threatened as up to $23 billion in capital becomes unavailable.[24]

To address the crisis of a tightening tax equity market, Congress should enact a policy such as that being considered in the Senate right now that allows clean energy developers to monetize existing tax credits

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[18] Energy Information Administration (2019). Monthly Energy Review Table 11.6., https://www.eia.gov/totalenergy/data/browser/xls.php?tbl=T11.06&freq=m.
[19] Energy Information Administration (2018). US Energy-Related Carbon Dioxide Emissions, 2017, https://www.eia.gov/environment/emissions/carbon/pdf/2017_co2analysis.pdf.
[20] Princeton Report (finding that "the United States could reach 90 percent zero-carbon electricity by 2035 [and] maintain reliability").
[21] *See, e.g.,* DOE 2018, https://www.energy.gov/eere/success-stories/articles/eere-success-story-beyond-power-wind-plants-can-provide-full-suite (wind capable of providing frequency support, ramping and balance, and voltage control); NREL 2017, https://www.nrel.gov/docs/fy17osti/67799.pdf ("Tests showed fast and accurate PV plant response to AGC, frequency, voltage, power factor, and reactive power signals under a variety of solar conditions").
[22] *See* NERC 2021, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/Master_ESAT_Report.pdf ("[B]attery storage can provide sufficient frequency response to support grid frequency stability and improve frequency performance for large generator tripping events and other frequency disturbances for a future high penetration [inverter-based resource] grid with heavily reduced grid inertia.").
[23] State of Tax Equity Market, https://www.projectfinance.law/publications/state-of-the-tax-equity-market.
[24] Bloomberg, https://about.bnef.com/new-energy-outlook/.

at their *full value*. Allowing developers to monetize the credits would untether the clean energy industry from the constraints placed on the market by tax equity because it would create an avenue for projects to raise capital from traditional sources and claim the PTC and ITC directly from the Internal Revenue Service in conjunction with their annual tax filing. Monetization also allows the industry to access the full spectrum of infrastructure financing options. This gives developers the ability to acquire capital faster and with more certainty, benefits that will immediately inure to the communities that are counting on jobs and investments from these projects. And, providing a monetization option for existing credits comes at no cost to taxpayers—the value of the ITC/PTC is the same, regardless of the entity that claims it. Full value monetization will allow planned renewable projects to move forward more efficiently, and it will allow new market entrants and projects to secure financing. This gives renewable energy developers the maximum flexibility to deploy capital and, in turn, deploy projects to decarbonize the grid.

***b. Transmission ITC to Lower the Cost of Transmission***

As mentioned above, new long-distance electric transmission is the missing link for delivering the best renewable resources in America to the population centers where that power is desperately needed. Indeed, increased transmission development is essential for the cost-effective and reliable decarbonization of the electric sector. The cost of building that needed transmission can have a large initial price tag, even if those costs are more than repaid in reduced rates over the life of the project. To ease this burden and encourage the much-needed deployment of electric transmission to connect to renewable-rich regions to markets, Congress should consider policies that immediately extend the federal ITC to certain types of electric transmission investments. This would help unleash transmission that can, in turn, unlock renewables that are stranded or support the development of projects that are held up in the expensive and time-consuming interconnection queue process.

Senator Heinrich's S. 3107 (from the 116th Congress) provides a strong starting point by focusing on high-voltage transmission lines and innovative transmission technologies to bring additional clean energy resources onto the grid.[25] Providing a transmission tax credit, especially for long-distance transmission, ensures that the full cost of the delivery of clean power is eligible for federal incentives, thus allowing developers to submit cost-effective bids to those utilities standing on the sidelines. It would also incent developers to build much-needed interregional transmission projects that enable more projects to be built in the most cost-efficient way possible. In other words, the benefits of a transmission ITC are compounded, because it will spur new transmission development as well as new energy generation development as a result of the expanded capacity, both of which will create thousands of new jobs and facilitate huge investments in the communities where the projects are located. While the cost recovery for transmission lines is an area in need of regulatory attention, in the interim, an ITC for certain types of transmission would provide an immediate improvement that will reduce costs to customers and increase regulatory certainty to ensure transmission is able to deliver clean energy to market.

***c. Effective Mitigation Policies so that Wind Projects and Military Operations Can Coexist***

Decades of experience in developing wind farms in the U.S. and around the world has demonstrated that wind turbines, radar, and military training can coexist. The renewable industry recognizes that, in some instances (depending on location), wind farms can impact military operations. The industry has worked for decades with the military to safely site wind farms to avoid interference to military projects. As the

[25] *See* S.3107 - Electric Power Infrastructure Improvement Act, https://www.congress.gov/bill/116th-congress/senate-bill/3107/text?r=2&s=1.

wind industry continues to expand into the best wind resource areas of the country, the potential for radar interference is rising and must be solved. The federal government must commit to funding the necessary technological upgrades that will ensure that our national security is not compromised. To the extent any issues may arise after a project is constructed, interference can be avoided through mitigation measures.[26]

In order to reach a clean energy future, we need more regulatory certainty regarding the review process for renewable projects related to military projects. The Department of Defense Military Aviation and Installation Assurance Siting Clearinghouse (Clearinghouse) facilitates review by individual military services, major commands, and installations of proposed energy projects to ensure military compatibility. The office has functioned effectively since its creation under the Obama Administration in 2011. However, the budget for the Clearinghouse (approximately $2.1 million) has been flat or declined while the workload has significantly increased. In total, the Clearinghouse facilitated the review of 5,600 wind projects in 2018. This was up from 4,200 in 2017 and 3,700 in 2016. Congress should consider significantly increasing the funding for the Clearinghouse and military services/installations involved in energy project reviews to ensure the timely processing of proposed wind projects needed to meet clean energy goals.

It is worth noting that, for many situations, advances in radar technology could offer clear solutions. For example, scientists at the Massachusetts Institute of Technology's Lincoln Laboratory have designed a faster, more powerful "sidecar" computer processor to solve the interference issue experienced at Shepherds' Flat Wind Project.[27] In addition, multiple radars can be linked together to look on all sides of a wind project, 3-D radar enables military equipment to see through and above wind farms, and infill radar can provide supplemental coverage to an existing radar.[28] Federal investment in new radar systems and accelerated efforts to develop, test, and deploy mitigation options, are efforts that our industry not only supports, but is willing to lend a hand in implementing. The Federal Aviation Administration, Department of Defense, Department of Energy, and the National Oceanic and Atmospheric Administration, in collaboration with industry, need additional resources (dollars, staff and/or consultants) to prioritize development, testing and deployment of options (hardware, software) to reduce potential impacts from land-based and offshore wind turbines on different types of radars. The renewable industry stands ready to assist with data, site access, cost sharing, and mitigation ideas.

**Comprehensive Clean Energy Policies Support Workers, Communities, and the Environment**

At Invenergy, we are committed to leading workforce development efforts in the fast-growing clean energy field, as well as bringing the benefits of clean energy to everyone, including historically marginalized communities. Our growing workforce is evidence of the fact that the clean energy transition will create a variety of secure, sustainable jobs in clean energy for individuals in communities previously dominated by fossil fuel jobs, as well as for veterans, rural communities, and other otherwise disadvantaged communities. We also believe these jobs, as well as the benefits of clean power generated

[26] In such rare cases, our industry may also negotiate a mitigation agreement with DoD. https://www.energy.gov/sites/prod/files/2016/06/f32/Federal-Interagency-Wind-Turbine-Radar-Interference-Mitigation-Strategy-02092016rev.pdf at 2-3.
[27] DOE, Federal Interagency Wind Turbine Radar Interference Mitigation Strategy, https://www.energy.gov/sites/prod/files/2016/06/f32/Federal-Interagency-Wind-Turbine-Radar-Interference-Mitigation-Strategy-02092016rev.pdf.
[28] *Id.* at 5; DOE, Wind Turbine Radar Interference Mitigation Fact Sheet, https://www.energy.gov/sites/prod/files/2018/04/f51/WTRM_Factsheet_Final_2018.pdf.

by our projects, should be available to everyone, no matter the region or socioeconomic status of the people living there.

The clean energy workforce has skyrocketed in recent years, with the growth of solar and wind sectors rising by 24.5 percent and 16 percent, respectively. For instance, clean energy employment nationwide totaled 3,355,419 at the end of 2019, up from 3,264,383 jobs only a year earlier.[29] As we continue along the path to a clean energy future, we will create millions of additional jobs to develop and construct projects, manage the operations of these projects, and conduct ongoing maintenance of all connected systems. The renewable industry is committed to making sure they continue to be good, secure jobs.

Invenergy values the commitment made by the men and women who have served in uniform, as well as the dedication, strong work ethic, and leadership skills they bring to the renewable industry. Approximately 10 percent of Invenergy's employees are veterans, spanning from wind technicians to plant managers at energy centers across the country. In 2017, Invenergy received the Honoring Investments in Recruiting and Employing American Military Veterans Gold Medallion Award from the U.S. Department of Labor, which recognizes companies who have demonstrated exemplary efforts to recruit, employ and retain our nation's veterans.[30] Invenergy is also a founding partner of Veterans Advanced Energy Summit, a national program affiliated with the Atlantic Council that is designed to address the trends, technologies, and policies that are shaping the energy sector and developing a community of veterans and allies committed to advancing U.S. energy leadership. These types of efforts extend beyond Invenergy; for instance, the U.S. wind industry employs veterans at a rate of 61 percent above the national average.[31]

In addition, Invenergy recognizes that there is incredible untapped workforce potential in low-income communities, communities of color, rural and underserved communities, and communities where fossil resources have been retired. We are committed to investing in training and STEM programs to produce the next generation of workers in these communities. For example, Invenergy created a $30,000 per year scholarship in Deuel County, South Dakota, where we recently completed a utility-scale wind project, to benefit students at the local high school. We also have partnerships or relationships with many organizations across the country that support education programs in areas where our projects or offices are located, including organizations such as the Chicago Urban League and Project SYNCERE in Chicago. And, in 2019, Invenergy made a three-year sponsorship commitment to support Future Farmers of America (FFA) chapters nationwide.[32] Invenergy is the first sustainable energy company to establish a nationwide investment of this scale with FFA, and since more than half of Invenergy's U.S.-based renewable energy projects are in mostly rural areas where there is already an FFA chapter, Invenergy has a unique opportunity to make meaningful connections with like-minded people who believe in FFA's mission.

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[29] *See, e.g.*, Clean Energy Jobs America 2019, https://e2.org/reports/clean-jobs-america-2019; Clean Jobs, Better Jobs, https://e2.org/wp-content/uploads/2020/10/Clean-Jobs-Better-Jobs.-October-2020.-E2-ACORE-CELI.pdf.
[30] Invenergy Services Honored with 2019 HIRE Vets Gold Medallion for Commitment to Hiring Veterans, https://invenergy.com/news/invenergy-services-honored-with-2019-hire-vets-gold-medallion-for-commitment-to-hiring-veterans.
[31] *Winds Powers Job Growth*, Am. Wind Energy Ass'n, https://www.awea.org/wind-101/benefits-of-wind/powering-job-growth.
[32] *Invenergy announces first-of-its-kind 'four-star' sponsorship of the National FFA*, https://invenergy.com/news/invenergy-announces-first-of-its-kind-four-star-sponsorship-of-the-national-ffa

Despite these and other exciting investments Invenergy makes in the communities where we are located, simply creating workforce development programs may not be enough to tackle preexisting economic inequality and deliver meaningful career opportunities and paths to success in our industry. The clean energy industry must ensure that the benefits of clean energy, including jobs and environmental improvements, are available to all communities, including those hardest hit by the impacts of climate change. We also have an opportunity to ensure that the workers we invest in have the physical and social infrastructure and community resiliency to succeed. For example, Invenergy has a number of projects in predominantly low-income rural areas. These projects bring hundreds of jobs and millions of dollars to these communities, as well as other direct investments into the communities (for example, Invenergy often contributes to local education and sports programs and other community benefits). The clean energy industry is a significant driver of job creation and economic growth, and we recognize that these efforts will only be effective if we play our part in investing in the community as a whole—and provide solutions that are bigger than just a single training program or job opportunity.

Finally, I want to highlight that the deployment of renewable energy offers a unique opportunity to address environmental and social justice conditions in low-income communities, communities of color, Tribal and indigenous communities, and rural and underserved communities ("environmental justice communities"), while spurring the American economy. The renewable industry acknowledge that air pollution and other harmful environmental impacts disproportionately affects individuals in environmental justice communities. For instance, asthma rates among communities of color are twice as high as those among White children.[33] Indeed, environmental degradation serves to exacerbate health inequities, which is inextricably linked to the social inequities that exist in our society today. So, while we are rebuilding our economy from the economic downturn caused by the novel coronavirus, we believe that we must invest in clean energy infrastructure with deliberate actions that can advance the lives of environmental justice communities.

Zero-emission renewable energy, like that created by Invenergy's clean energy projects, alleviates the disproportionate share of environmental burdens placed upon low-income communities and helps more equitably distribute environmental benefits to those communities.[34] The low-cost, emissions-free electricity that our industry provides serves environmental justice goals at a community level. These benefits can be furthered by making clean energy more affordable, investing in environmental justice communities, and creating clean energy jobs across the country.

As we proceed on the clean energy path together, we must be vigilant to ensure that road involves smart investments to ensure a "just transition" and an equitable clean energy economy.

**Conclusion**

Thank you again for the opportunity to address this Subcommittee. The urgency with which we must tackle climate change has never been greater. Fortunately, we already have all the tools that are necessary

[33] *Green Causes Are Not Always Colorblind: Racial Disparity in Energy Issues*, CHESTER ENERGY AND POLICY (Mar. 5, 2018), https://chesterenergyandpolicy.com/2018/03/05/green-causes-are-not-always-colorblind-racial-disparity-in-energy-issues/.

[34] Uma Outka, *Environmental Justice in the Renewable Energy Transition*, 19 J. ENVTL. & SUSTAINABILITY L. 60 (2012), https://scholarship.law.missouri.edu/cgi/viewcontent.cgi?article=1420&context=jesl.

to deal with this challenge and transition to a clean energy future, and they can be deployed cost-effectively and reliably given all the advances of the renewable industry over the prior decades. More than ever before, the private and public sectors are aligned and moving in the right direction. The path to achieving our goals is not mysterious. We need the resolve of the federal government and the cooperation of our state and local governments to facilitate the necessary build-out of the transmission system to deliver clean energy. Transmission is as core to the future of our electrified economy as the interstate highway system has been to interstate commerce today. We need the federal government to establish a comprehensive, long-term energy policy that will serve as a guide for the public and private sectors so that periodic changes in government leadership are not disruptive to achieving the overarching goal of a clean energy future. Finally, we need to take this opportunity to ensure a just and equitable transition for our marginalized communities.

What we have before us is a once in a life-time opportunity to collaboratively tackle the most existential challenge that modern mankind has ever faced. And we must because as our CEO Michael Polsky has said countless times about renewable energy, "it just makes sense."

Mr. RUSH. I want to thank you. Our next witness is Mr. Powell. Mr. Powell, you are recognized for 5 minutes.

**STATEMENT OF RICHARD J. POWELL**

Mr. POWELL. Good afternoon, and thank you, Chairmen Rush and Pallone, Dr. Burgess, and Ranking Member McMorris Rodgers, and members of the committee. I lead ClearPath. We advance policies that accelerate clean energy and industrial innovation. An important note: We receive no industry funding.

As I stated the last time I had the honor to address this committee, climate change is an urgent challenge that merits significant policy action at every level of government and the private sector. We need look no further than Texas and across the Midwest to see the havoc extreme weather can have on the energy system. As America creates the grids of the future, we must utilize all forms of clean energy to ensure reliability.

As this committee considers its part in U.S. climate and clean energy policies, those solutions should be ambitious, but also technology inclusive, politically realistic, and pragmatic. Policies must also support U.S. jobs.

Too often solutions are oversimplified to a set of false choices: renewable versus fossil; economy versus environment; immediate action versus inaction. The reality is solutions to make the global clean energy transition cheaper, faster, and more flexible.

Policy proposals must also reflect the global nature of the challenge. A molecule of $CO_2$ emitted in Shanghai has the same impact as one released in Chicago. Policies like fuel switching, shutting down traditional energy production, or simply subsidizing certain technologies will do little to impact global emissions and may lead to loss of American jobs. A more effective strategy is rooted in American clean energy abundance, innovation, and exports.

Today I will, first, level-set on where we are today; second, discuss policy to achieve a clean power future affordably and reliably; and third, look at options to reduce U.S. industrial emissions.

So where are we today? Emissions are significantly down. Retail electricity prices have been flat, helping manufacturing jobs come back to America. Returning these jobs is also leading to lower global emissions because our environmental standards are tougher than China's. America's largest electric utilities, including Southern Company, Xcel Energy, Duke Energy, and DTE, have committed to reaching net-zero emissions by 2050. Sixty-eight percent of the country is now served by a utility with a significant carbon goal.

But these utilities have emphasized that many of the 24/7 clean technologies required to get them to that zero are not commercially available today. Xcel Energy said, even with their first-rate access to wind and sun, existing technology is sufficient to reach only 80 percent clean. We need policies to enable technologies that can eliminate the final 20 to 50 percent of power sector emissions.

According to the International Energy Agency, only 2 of 14 critical power technologies are on track to deploy. We recommend that policymakers now work with industry, not against them. The Energy Act of 2020 is a perfect example. The most significant energy legislation in over a decade, your new law lays the foundation for

a comprehensive commercialization strategy that focuses the world-class American innovation engine on these key technologies. It includes more than 20 major new demonstration programs for long duration storage, carbon capture, advanced nuclear, geothermal, and direct air capture. It also expands DOE's work in industrial emissions and hydrogen.

We congratulate you on the Energy Act, and now we must look to implementation, ensuring accountability at DOE and appropriately investing so your legislative success goes from letters in law to clean steel in the ground.

Now, getting it built. We have all heard the Biden administration's mission to build back better. But right now we can only build new clean energy and reduce $CO_2$ emissions as fast as we can permit new projects. The mission ought to be to build cleaner faster. Currently, the Federal permitting process can take 5 to 10 years to complete, and cost millions of dollars. The good news: Your colleagues have introduced a number of proposals to modernize.

Lastly, financing. Large-scale energy innovation needs to bring together private and public investment to scale up deployment and bring down costs. At the end of 2020 and early this year, you hit a policy trifecta for carbon capture, new aggressive R&D authorizations, a carbon capture tax credit, 45Q extension, and final administrative rules on how developers can properly claim the credit. While 45Q was a major victory, we also need a better structure for helping incentivize big investments and driving down costs. The Energy Sector Innovation Credit would update the energy portion of the tax code by allowing cutting-edge technologies to gain commercial viability.

Now, our power sector work has been that the U.S. will not meaningfully reduce emissions without more clean and affordable technologies. This is even truer in the industrial sectors. More than 10 million hardworking Americans are employed there, and ensuring those jobs stay in America must remain a priority. Energy-intensive, trade-exposed industries like steelmaking absolutely require affordable new technologies to help them decarbonize. Without them, we risk not only losing essential U.S. jobs but leaking the industrial activity to countries with worse emissions, like China, effectively increasing the risks of climate change.

A serious debate on climate solutions must include a dose of political and technical realism. Climate change is an urgent problem that must be addressed today. It is imperative for all sides to agree that building cleaner energy in America will rebound our economy from COVID–19, create jobs, and have a significant global impact.

Thank you for this opportunity. I look forward to the discussion.

[The prepared statement of Mr. Powell follows:]

**Testimony of Richard J. Powell**
**Executive Director, ClearPath, Inc.**
**U.S. House Energy and Commerce Subcommittee on Energy**
**A Smarter Investment: Pathways to a Clean Energy Future**
**February 18, 2021**

Good morning Chairman Rush, Republican Leader Upton, and other members of the Committee. My name is Rich Powell. I am the Executive Director of ClearPath, a 501(c)3 organization that develops and advances policies that accelerate breakthrough innovations to reduce emissions in the energy and industrial sectors. To further that mission, we develop cutting-edge policy solutions on clean energy and industrial innovation. ClearPath provides education and analysis to policymakers and collaborates with relevant partners to inform our independent research and policy development. An important note: we receive zero funding from industry.

Thank you for the opportunity to appear before you today and for holding this important hearing. Climate change is an urgent challenge that merits significant policy action at every level of government and the private sector. We need to look no further than the events in Texas and across the Midwest this week to see the havoc extreme weather can have on the energy system. Preparing our grid to be reliable in the face of unique challenges is an important issue we will face moving forward. In the case of Texas, we have seen multiple forms of generation units go offline due to weather. At the height of the outages, The Electric Reliability Council of Texas (ERCOT) was experiencing over 34 GW of generation shutdowns including 27 GW of which were thermal gas or coal plants.[1] Wind and solar generation units also experienced weather-induced capacity loss of around 4-5 GW. More than 4.5 million people in Texas have gone without power as a result of the blackouts, and about half a million more across the Midwest similarly experienced a lack of power.[2] As America creates the grids of the future, we must recognize the challenges each form of energy faces and utilize all forms of clean energy to ensure reliable energy at the system level. We must also consider ways to strengthen our physical grid, as many areas in Texas faced prolonged outages due to downed power lines.

As this committee considers its part in a serious set of U.S. climate and clean energy policies, those solutions should be ambitious but also technology-inclusive, politically realistic, and substantively pragmatic. Policies must also support U.S. jobs. Too often, solutions are oversimplified to a set of false choices: renewable versus fossil, economy versus the environment, immediate action versus inaction. The reality is that solutions – as evidenced by Texas – must follow a comprehensive agenda to make the global clean energy transition cheaper, faster and more flexible. This will be essential for deep, global emissions reductions by mid-century, while also ensuring American competitiveness.

Serious federal policy proposals must also reflect the global nature of the challenge: a molecule of carbon dioxide emitted in Shanghai has the same impact as one released in Chicago. Policies that simply accelerate American fuel switching, shut down traditional energy production and

[1] ERCOT, Hourly Resource Outage Capacity
[2] U.S. DOE, Extreme Cold & Winter Weather Situation Report

industry, or merely subsidize already commercialized technologies will do little to impact global emissions, and may well lead to loss of American jobs. A more effective strategy is rooted in American clean energy abundance, innovation and exports.

We believe that this committee can continue to play a major role in America's response to the global climate challenge. With this in mind, I will discuss a few topics today:

- First, let's level-set with **where we are today**. U.S. emissions are down, energy prices are stable, and reshoring of manufacturing is underway, leading to more jobs. There is a big voluntary push among utilities to reach net-zero by 2050 – with a big caveat that we don't have all the technologies we need to get there.
- Second, we need an aggressive and politically realistic policy agenda to work with industry to get to a clean power future. First we need to **innovate** – the clean energy innovation wins in the recently passed Energy Act of 2020 now must be implemented.
- Third, in 2020, for the first time, U.S. **industrial emissions** may have exceeded power emissions, and will likely be the top source in the future. ClearPath is expanding our work into clean steel, cement and hydrogen. We see an even MORE important need to have an innovation-based, affordable approach to decarbonizing industry.

## Where We Are Today

Saying that we need to transition to a clean energy economy is a bit misleading – that transition is well underway, in large part thanks to legislation this committee enacted as early as the Energy Policy Act of 2005. U.S. greenhouse gas emissions are down by more than 20 percent since 2005, and over the same period, power sector emissions have declined by approximately 40 percent.[3]

[3] Rhodium Group, Preliminary US Greenhouse Gas Emissions Estimates for 2020

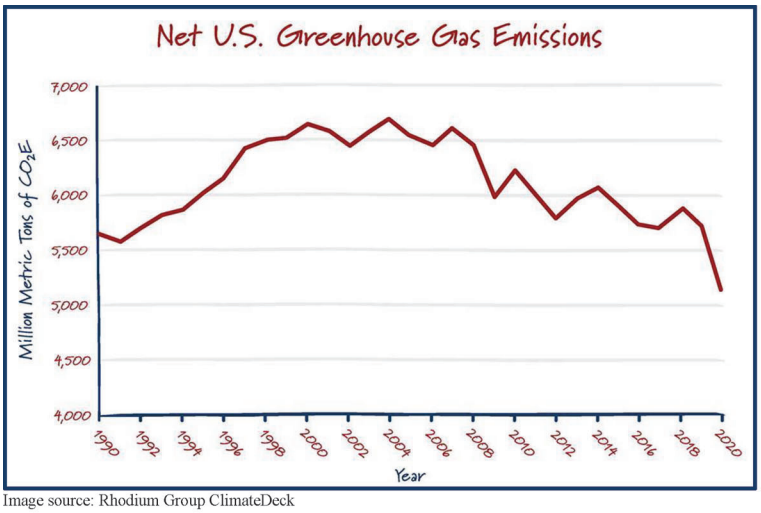

Image source: Rhodium Group ClimateDeck

At the same time, after accounting for inflation, retail electricity prices have been flat for the last decade.[4] Over the last four years, more manufacturing jobs have come back to America, in part due to America's stable, affordable energy. Returning these manufacturing jobs to the U.S. is also leading to lower emissions because our environmental standards are tougher than in China. The latest numbers for traditional energy and energy efficiency sectors employed approximately 6.8 million Americans[5], according to the 2020 U.S. Energy & Employment Report. Traditional oil, gas, and nuclear energy jobs are some of the highest paying jobs in the energy sector.

Additionally, more than 12.8 million Americans were employed in the highly energy-dependent and energy-cost sensitive manufacturing sectors in early 2020.[6] This includes about 350,000 Americans employed in primary metals manufacturing, including iron and steelmaking, and close to 200,000 additional Americans who work in cement and concrete manufacturing.[7][8] Across all sectors of the energy economy, there have been significant job losses due to Covid-19, many of which have not been recovered.

Some of America's largest publicly owned utilities and major corporations are taking action against climate change, both to reduce emissions and to adapt to natural changes. Energy companies must plan for the long term, and the executives who lead these companies take climate threats seriously. America's largest electric utilities, including Georgia-based Southern Company, Minnesota-based Xcel Energy, North Carolina-based Duke Energy, and Michigan-

[4] Energy Information Administration, Electricity Data Browser
[5] NASEO and EFI, 2020 U.S. Energy & Employment Report
[6] BLS, Current Employment Statistics Highlights
[7] BLS, Workforce Statistics
[8] BLS, Current Employment Statistics - CES (National)

based DTE have committed to reaching net-zero emissions by 2050. According to the Smart Electric Power Alliance[9], 68 percent of all electricity customer accounts in the country are now served by a utility with a significant carbon emissions reduction goal, and 19 of the 48 companies setting goals are for net-zero or carbon-free power by 2050.

Private sector actions lead the change and let markets, not mandates, blaze the path. While encouraging, policymakers too have a role. Enabling and partnering with the private sector on breakthroughs that can address the global nature of the challenge will be at the core of any long-term solution. The utilities making big bold commitments have stated publicly that many of the 24/7 clean technologies required to get them to net-zero emissions -- while maintaining affordability and reliability -- are not yet commercially available.

Xcel Energy, whose territory extends across some of the windiest and sunniest regions of the country, has one of the most ambitious climate goals in the industry of 80 percent clean by 2030 and 100 percent clean by 2050. They have said that, even with their first rate access to wind and sun, existing technology is sufficient to reach only 80 percent clean, but not 100 percent clean:

> "renewable generation and storage alone face significant technical and economic challenges if relied on exclusively to achieve carbon-free electricity. For example, the relatively short duration energy storage available today and anticipated in the future does not address seasonal challenges that arise when a system dependent on renewable resources experiences several days or weeks with low wind or solar generation. Even with continually declining prices, variable wind and solar resources are expected to provide diminishing value at high saturations. Fully relying on renewable sources could result in a costly overbuilding of the system where each incremental megawatt provides less capacity value, renewable curtailments reach high levels and massive investments in transmission and storage are required.
>
> We need a suite of new, carbon-free resources that can be dispatched to complement our continued adoption of renewable energy, energy efficiency and demand response. Our research shows that these new resources will be the key to achieving a carbon-free generation fleet without a costly overbuilding of the energy grid...These technologies may include carbon capture and storage, power to gas, seasonal energy storage, advanced nuclear or small modular reactors, deep rock geothermal and others not yet imagined."[10]

Every clean technology tool in the toolbox will be needed to meet economic development and environmental objectives. If utilities believe they have the technologies and tools to eliminate 50 to 80 percent of emissions, dependent on their region of the country, we need to ensure that we have policies to enable technologies that can eliminate the final 20-50 percent of power sector emissions – which represents more than 400 million metric tons per year. Yet only two of 14 critical power sector technologies are on track to deploy at the proper rate to reduce emissions on

[9] Smart Electric Power Alliance, Utilities' path to a carbon-free energy system by 2050
[10] Xcel Energy, Building a Carbon-Free Future

time, according to the International Energy Agency (IEA).[11] Requiring further emissions reductions before those technologies are ready poses significant risks to the reliability and affordability of our energy system, and to the millions of workers whose jobs rely on that energy supply.

But, thanks to your leadership, we are on the right path. In the last three Congresses, you increased Energy R&D investments more than 50 percent, significantly expanded the 45Q tax credit for carbon capture in 2018, and passed the monumental Energy Act of 2020 with moonshot R&D programs and longer-term extensions of deployment incentives.

## Policy Agenda to Enable an Even Cleaner Power Sector

As noted above, we have observed a strong trend of corporate voluntary commitments to decarbonize and an accompanying call for innovation, permitting reform, and early deployment incentives to enable those commitments while maintaining affordability and reliability. We recommend that policymakers answer these calls, and work with industry, not against them.

Effective policies to make clean energy cheaper include both pushes and pulls – they invest in basic and applied R&D, demonstrate technologies in public private partnerships, and accelerate early deployment. This early deployment enables the all-important "learning by doing," which has driven the huge cost declines in natural gas, wind, and solar, leading to more affordable energy for consumers. Financing policy is a critical component of that learning by doing.

### A. Clean Energy Innovation

The Energy Act of 2020 is a perfect example of how to find common ground on clean energy solutions. The Energy Act was the most significant energy legislation we have seen in over a decade, and in one bill, you passed moonshot demonstrations for clean energy innovations for natural gas, nuclear energy, carbon capture, energy storage, hydropower, direct air capture, fusion and other technologies.

The Energy Act makes commonsense updates to all areas of research and development policy for the first time in 13 years – a time before the widespread affordable energy abundance that has been provided by hydraulic fracturing and low cost renewable energy. It updates America's policies on energy efficiency, technology transfer, and grid modernization. It refocuses DOE to meet the most pressing challenges of this decade.

Most importantly, the new law lays the foundation for a comprehensive clean technology commercialization strategy, that focuses the world-class American innovation engine around key technologies the IEA has identified as essential to meeting deep, global decarbonization goals. The legislation establishes aggressive demonstration programs for technologies long in the works like advanced reactors, carbon capture and enhanced geothermal systems. In addition, it

[11] IEA, Tracking Clean Energy Progress

authorizes new programs for innovative technologies such as a carbon dioxide removal X-Prize, the DOE-U.S. Department Of Defense joint long-duration storage initiative, critical minerals supply chain RD&D, the clean industrial technology program, and a milestone-based fusion energy program. These programs will create more U.S. jobs and private sector investments for cutting-edge breakthroughs.

Congratulations on your accomplishments with the Energy Act of 2020 – now, we must look to implementation. The Energy Act authorized an aggressive program of demonstrations on an even more aggressive timeline, more than 20 new technology demonstrations by the mid-2020s. This will require unprecedented execution from DOE over the next several years. Your job in Congress is just beginning with the passage of the law – attention must now be turned to ensuring accountability of the DOE and appropriately investing through the appropriations process so your legislative successes go from letters in law to clean steel in the ground.

### B. Build Cleaner Faster

We've all heard The Biden Administration's mission to "Build Back Better," but right now, we can only build new clean energy and reduce CO2 emissions as fast as we can permit new projects. If we are to truly build back better, the mission ought to be ***Build Cleaner Faster.*** Speed will be a real priority – all of the analyses about what it will take to transition to a clean energy economy show that we'll need tens of thousands of miles of new pipelines carrying hydrogen and other clean fuels, along with captured carbon dioxide away from power plants and industrial facilities. We'll also need immense new transmission infrastructure to carry electricity around an increasingly electrified country – not to mention needing hundreds of new power plants sited everywhere – enormous wind farms and solar fields, geothermal wells, new nuclear plants and clean fossil plants, and repowered hydro dams. This will be the largest continental construction project in history.

New research[12], which involved 10 Princeton University researchers and eight external collaborators, lays out five pathways for the United States to deeply decarbonize the economy. In all scenarios, the required pace of building new infrastructure is rapid. According to the research, "the United States would need to expand its electricity transmission systems by 60 percent by 2030, and may need to triple it by 2050. The current power grid took 150 years to build. Now, to get to net-zero emissions by 2050, we have to build that amount of transmission again in the next 15 years and then build that much more again in the 15 years after that."

In order to build new clean infrastructure at that scale, we need to permit the projects. Currently, the federal permitting process can take a project as long as five to 10 years to complete and cost millions of dollars. The good news: a number of legislative proposals to modernize the permitting process are being written as we speak. Congressional support in making the permitting process more efficient is essential for two reasons: one, stewardship of taxpayer resources, and two, scaling clean energy rapidly, which also creates jobs. The need to act is

[12] Princeton University, Big but affordable effort needed for America to reach net-zero emissions by 2050, Princeton study shows

urgent, and the federal permitting process is of concern if we are to meet these ambitious climate goals and spur economic growth. Legislative proposals like the Federal Permitting Reform and Jobs Act by Rep. Kelly Armstrong or the Building U.S. Infrastructure through Limited Delays & Efficient Reviews (BUILDER) Act by Rep. Garret Graves are good places to start.

### C. Drive Down Costs

Large scale energy innovation sometimes needs to bring together private and public investment in order to scale up deployment and bring down costs. We have seen this model work for solar, wind, natural gas and other clean energy technologies. For example, Texas entrepreneur George Mitchell figured out how to break up shale rocks to release the natural gas stuck inside. This process, called hydraulic fracturing, initially got off the ground and moved towards commercialization through government-funded R&D and tax credits.

At the end of 2020 and early this year, you hit a policy trifecta for carbon capture: new, aggressive R&D authorizations, a carbon capture tax credit ("45Q") extension in the Energy Act of 2020, and final Administrative rules on how project developers can properly claim the 45Q credit.

The 45Q tax credit extension will provide some certainty to utilities and other industrial sources and further incentivize the build-out of CCUS projects from 2023 to the end of 2025. The Internal Revenue Service (IRS) also finalized their new rules[13] implementing the credit just 10 days after Congress passed the extension. According to analyses from the Rhodium Group, a leading research firm, a permanent extension of the 45Q credit, as proposed by Reps. Schweikert and Wenstrup in Leader McCarthy's carbon sequestration energy package in early 2020, could drive deep emissions reduction in facilities across more than 30 states, and about one-tenth of all U.S. industrial sector-emissions would be economical to capture.

While the 45Q tax incentive is a major victory, we also need a better, long-term structure for helping co-finance big investments and driving down costs. Energy sector innovation and broader efforts to address climate change should resemble the best of the tech start-ups in the U.S.: fast, innovative, exciting and good for consumers. But the complexity of the energy tax code and market can stymie American ingenuity.

Last Congress, a bill sponsored by your colleagues on Ways and Means, Reps. Tom Reed (R-NY) and Jimmy Panetta (D-CA), could be a major missing financing piece of the clean energy innovation puzzle – especially when added to the recent suite of Energy Act of 2020 wins to grow the U.S. innovation engine.

This Energy Sector Innovation Credit, or ESIC, would update the energy portion of the tax code by allowing cutting-edge technologies to gain commercial viability and upend the status quo without distorting the free market. The importance of grid diversity is playing out before our eyes in Texas, and we should ensure all the clean energy tools are available in the toolbox.

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[13] IRS, 45Q Rules

Without ESIC, these technologies lack the tax incentives needed to draw them into the market in a timely manner as net-zero-by-2050 goals are on the horizon.

To truly solve the global climate challenge, America must also be able to export the proven technologies and create new clean energy markets. Everything Americans are innovating and demonstrating must not only have a niche in our own energy sector, but also apply to countries like Nigeria or Indonesia that are growing exponentially – and consider what U.S. technology best fits their development goals.

To do this, we need to leverage the U.S. trade and development agencies, like the Export-Import Bank of the United States (ExIm) and the U.S. International Development Finance Corporation (DFC). Each of these agencies offer robust financing options for technologies important to the developing world and due to the size of energy projects, almost every major project requires financing backstops from the exporting country. Cementing the mission of clean energy exports and development in these agencies by law will go a long way to building new clean energy markets globally for American products.

ExIm has already taken a step in this direction by introducing its 'transformational exports program.' This program focuses on pushing back on China's Belt and Road Initiative in key sectors including renewable energy. By expanding this program to include all clean energy sources, we can put all clean technologies on the same footing and enable more financing options for key technologies.

## Next Challenge: Clean Industrial Innovation

At ClearPath, reducing power-sector emissions has been our primary focus; however, this year, we are excited to add the industrial sector to our portfolio. Combined with the power sector, this expands our scope from tackling a quarter of U.S. carbon emissions to half.

Our mantra in power-sector work has been that the U.S. will not meaningfully reduce emissions without more clean and affordable technologies. This is perhaps even truer in the industrial sector. The U.S. natural gas revolution and its dramatic impact on reducing U.S. emissions demonstrate the immense potential of clean energy abundance. Fortunately, we're not starting from scratch in industry. A number of clean power technologies can be readily translated to the industrial sector, expanding markets for carbon capture, advanced nuclear for clean heat and more.

At the end of the year, Congress also provided a legislative head start. Tucked inside of the Energy Act of 2020 were measures to phase out industrial super pollutants[14], create clean industrial technology research and demonstration programs[15], and improve permitting processes.

Manufacturing and heavy industry have been America's backbone since our industrial

[14] Scientific American, Congress Passes Major Climate Legislation in Year-End Omnibus
[15] Senate ENR Committee, Murkowski, Manchin, House Colleagues Reach Agreement on Energy Package for Year-End Appropriations Bill

revolution. More than ten million hardworking Americans are employed in these essential sectors, and ensuring those jobs stay in America must remain a priority. Industrial decarbonization cannot undermine U.S. competitiveness.

Even more so than in the power sector, trade-exposed industries will need highly affordable options to decarbonize their operations. Without them, calls for decarbonization are more likely to lead to so-called "leakage" of that manufacturing activity to less environmentally friendly countries abroad. Not only will we lose out on industrial jobs and economic activity, but we may do more harm than good on carbon emissions as the industry abroad has poorer controls or relies on more carbon intensive electricity. Technological breakthroughs are needed to make clean industrial technologies cost-competitive with existing processes.

In fact, to reduce emissions, we should focus on just the opposite approach, not risking that leakage but creating a welcoming business climate here in the U.S. to return manufacturing here where environmental standards are tougher than in China. China is exporting both outdated polluting technology and goods with enormous embedded emissions – neither are in America's best interest.

## Conclusion

A serious debate on climate solutions must include a dose of political and technical realism. Climate change is an urgent problem that must be addressed today, not tomorrow. It's also imperative for all sides to agree that building cleaner energy in America will rebound our economy from the COVID-19 pandemic, create jobs and have a significant global impact. Indeed, many members of this committee know firsthand that bipartisan cooperation on clean technology policy is not only attainable but essential.

Thank you again for this opportunity, and I look forward to the discussion.

[Pause.]
VOICE. You may need to unmute.
[Pause.]
Mr. RUSH. Mr. Camp, you are now recognized for 5 minutes.

**STATEMENT OF DANIEL C. CAMP III**

Mr. CAMP. Thank you. Good afternoon, Chairman, Majority Chairman Rush, Dr. Burgess, Chairman Pallone, Ranking Member McMorris Rodgers. I want to thank you for having me be part of today's important hearing.

As Chairman Rush said, my name is Daniel Camp. I currently serve as the chairman of the Beaver County Board of Commissioners.

Beaver County and most of Pittsburgh Region's affinity and strong endorsement for the energy sector isn't tied to a common political ideology, because the support crosses political boundaries. The energy sector support can't be limited to one particular generation, because many Boomers, Millennials, and those in between living in Western Pennsylvania are supportive of our energy sector in Western PA. In my opinion, our support of the energy sector can be, in large part, due to the family-sustaining jobs they have been providing for many years.

Therefore, policy—tax through increased taxes, regulation, and diverse rhetoric against certain types of producers within the energy sector are justifiably seen as personal attacks by those working within those specific sectors, as well as the businesses benefiting those workers and their families.

Ultimately, if these attacks are achieved through new public policy, they are risking these workers having the ability to pay their mortgage and pay their own utility bills. Please just think about that when you are considering this. The desire for some policymakers to kill a particular industry and to invoke punitive policies against that industry alone will impact folks in my area in a way that jeopardizes their ability to put a roof over their family's heads and continue to keep food on their tables.

The reality of this is that hundreds of thousands of people, many working in our trade unions in Western PA, rely on the natural gas industry's ability to produce natural gas in the Marcellus and Utica shales. And thousands of moms and dads rely on Consol Bailey's mine to provide for their children each and every month. Combine those jobs with downstream jobs whose survival directly depends on those energy sources being readily available and affordable—yes, in Beaver County that includes Shell's petrochemical multibillion ethylene cracker plant.

But let's be reminded, Shell is the fourth-largest company in the world. I am not going to sit here today and argue that they can't afford to pay higher prices for their feedstock. But I know small manufacturing companies that can't afford the same price increases, nor have the Capex dollars to retrofit their plants to an alternative energy source.

The manufacturing sector has seen a resurgence recently, because of the affordability and readily available energy resources that we have here. As you know, regulations that increase the cost of energy production, even on large companies like Shell, EQT,

Chevron will certainly be passed down the supply chain and ultimately be paid by their vendors, and even their customers. That means truck drivers, food workers, local union workers, power plants, and even homeowners will incur those higher costs too.

Many of these small regional companies that can't afford those increases—the situation in Western Pennsylvania and our support for all energy sources can be summarized by looking at the employment statistics.

Now, I am aware that some people and groups will distort statistics to fit their agenda. But that is not my reason for being here today. I am merely here to give my personal observation about reasons behind why so many people that I represent support this energy sector in Pennsylvania. That is, the natural gas industry supports almost 24,000 production-related jobs.

Pennsylvania jobs are specifically attributed to the natural gas industry's total 106,000 people, and an outstanding 323,000 jobs are supported solely by that industry. The petroleum and oil industry, almost 24,000 jobs associated with production alone. Combine natural gas and oil, $23 billion in wages for Pennsylvanians. The coal industry directly supports more than 10,000 jobs; nuclear, 5,000-plus indirect jobs. Wind and solar combined for 8,000, and hydro 400.

There may be other others who testify that certain types of energy have done wonderful things for their local economies and communities. But the reality today is that some have not had the same impact as the energy sector. And therefore, the support for those others are very proportional.

I thank you for your time, and I look forward to answering any questions. Again, thank you.

[The prepared statement of Mr. Camp follows:]

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**House Committee on Energy and Commerce's Subcommittee on Energy**

**"A Smarter Investment: Pathways to a Clean Energy Future"**

Testimony of Daniel C. Camp III

Thank you Chairman Rush & Ranking Member Upton for asking me to be a part of today's important hearing. My name is Dan Camp, and I currently serve as the Chair of the Board of Commissioners in Beaver County, Pennsylvania.

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can be in large part due to the family sustaining careers that they have been providing.

Therefore, policy attacks through increased taxes, regulation, and divisive rhetoric against certain types of energy producers are justifiably seen as personal attacks by those working within those specific sectors as well. Ultimately, if these attacks are achieved through new public policy, they risk affecting these workers having the ability to make their mortgage payment and to pay their own utility bills. Please just think about that, a desire for some policy makers to kill a particular industry or to invoke punitive policies against an industry— will impact folks in my area in a way that jeopardizes their ability to put a roof over their family or to keep their house heated in the winter.

The reality is that hundreds of thousands of people, many working in our trade unions, in Western PA rely on the natural gas industry's ability to produce natural gas in the Marcellus and Utica shales. And thousands of moms and dads rely on Consol's Bailey Mine to provide for their children every month. Combine those jobs with the downstream jobs whose survival directly depends on those energy sources being readily available and affordable.

Yes, in Beaver County that includes Shell's multi-billion cracker plant, but let's be honest Shell is the 4th largest company in the world. I'm not going to sit here and argue that they couldn't afford to pay higher prices on their feedstock. But I know small manufacturing companies can't afford those same price increases, nor have the cap x dollars to retrofit their plants to an alternative energy source. The manufacturing sector has seen a resurgence recently, because of affordable and readily available energy sources.

As you know, regulations that increase the cost of energy production even on large companies like Shell, EQT, Chevron, will inevitably be passed down the supply chain and ultimately paid by their vendors and customers. That means truck drivers, food workers, local union workers, power plants, and home owners will incur those higher costs too. Many of those are small regional companies that can't afford those increases.

The situation in Western PA and our support for all energy sources can be summarized by looking at the employment statistics. Now I'm aware that some people & groups will distort statistics to fit their agenda. But that's not my reason for being here. I'm here merely to give my perspective about the reasons behind why so

many of the people I represent support the energy sector in Western Pennsylvania.

That is- the natural gas industry supports almost 24,000 production related jobs, Pennsylvania jobs that are specifically attributed to the natural gas industry total 106,000, and an astounding 323,000 jobs are supported by the industry. In the petroleum oil industry, almost 24,000 jobs are associated with production alone. Combined natural gas & oil support $23 billion in wages for Pennsylvania. The coal industry directly supports more than 10,000 jobs. Nuclear: another 5,000 plus direct jobs. Wind & solar combine for 8,000, and hydro another 400.

There may be others who testify that certain types of energy have done wonderful things for their local economies and communities: But the reality is that some have not had the same impact as others. And, therefore the support for those others are proportional.

Mr. RUSH. I want to thank the witness. And we have now completed all the opening statements for the witnesses, and we will now move to Member questions. Each Member will have 5 minutes to ask questions of our witnesses. And I will start by recognizing myself for 5 minutes.

A component of the National Academies report on decarbonization involves the elimination of inequities in the current energy system that already severely disadvantage the disenfranchized. In the coming days I intend to introduce a bill to establish a Department of Energy office to advance principles of energy equity and all the conditions and resources to that very end.

Dr. Pacala, I want to ask you. What else must we do to eliminate the inequities of the current energy system, while creating, at the same time, a clean energy future?

[No response.]

Mr. RUSH. Dr. Pacala? Will you unmute, Dr. Pacala? You are muted.

[No response.]

Mr. RUSH. Can you hear me? Dr. Pacala?

[No response.]

Mr. RUSH. Dr. Pacala?

[No response.]

Dr. PACALA. Can you hear me now?

Mr. RUSH. Yes, we hear you now, Dr. Pacala.

Dr. PACALA. OK, sorry. The system was—we have a big storm going here, and I think the wires are blowing around. It would not unmute.

Mr. RUSH. All right.

Dr. PACALA. So our report—the committee included experts in environmental justice and experts on the social consequences of technological transitions and what to do about it.

The—as a—for a climate and energy person like me, it was a real education to learn how much inequity is built into our current energy system, with disproportionate health exposure to fossil pollutants in communities of color and low-income workers across the country, how much energy prices contribute to poverty, how unavailable the kinds of opportunities that we afford people, like tax credits for electric cars, are to low-income communities who lack capital, and how difficult it is for low-income communities often to take advantage of Federal programs that do exist because, for instance, their homes can be noncompliant with codes.

So we recommended a sort of an integrated portfolio to address the ongoing energy injustice, and forward-looking to have the transition itself also be fair and just, because workers are—some communities and workers would be otherwise damaged. This starts with a task force, a national task force to map where the energy injustice is in the country. There are good sector-specific studies, but nothing comprehensive. So we need first a top-down look at this.

And then we have an integrated program of a White House office to coordinate 10 regional centers where representatives and mayors and others can get together to learn what can be done and to plan a national transition corporation that works with a green bank to provide capital, community block grants, so that they can plan and

then apply for projects; a DOE extension service to provide technical know-how; a comprehensive education and training program; additional funding in LIHEAP and the Weatherization Assistance Program.

And so, in combination, this package is designed to provide workers with multiple options during the transition, and to protect communities that would lose a dominant employer, and to eliminate the injustice that we have built into the energy system to date.

Mr. RUSH. All right, thank you. I have—my time is almost out, according to the clock, although I think that the—well, let me just yield back the balance of my time.

And now the Chair recognizes the chairman of the full committee, Mr. Pallone, for 5 minutes.

[Pause.]

Mr. RUSH. Frank, you got to unmute, Frank.

Mr. BURGESS. So, Mr. Chairman?

Mr. RUSH. Yes?

Mr. BURGESS. This is Burgess.

Mr. RUSH. Oh, Mr. Burgess.

Mr. BURGESS. Sometimes we go to the acting ranking member——

Mr. RUSH. Yes, absolutely. My error. Please forgive me.

Mr. BURGESS. Well, don't——

Mr. RUSH. You are now recognized, the acting ranking member of the subcommittee, my friend, Dr. Burgess, for 5 minutes.

Mr. BURGESS. Thank you, Chairman Rush.

And Ms. Glover, welcome to you. I have been on your board for some time, and I have always believed that energy efficiency is the common ground that we probably can find between all of the disparate political philosophies that weigh in on these energy questions.

And I will just tell you my own experience with energy efficiency has really taught me just exactly what you are saying, that you can achieve 40 percent or greater reductions in your energy consumption. So if we look at it just from the standpoint of the consumer, by making wise choices with energy efficiency, whether it be in retrofitting a home, a new build, or even just a selection of particular appliances or products, your group does bring a wealth of expertise and knowledge and a significant voice to the discussion. So I thank you for being here today.

I do an energy efficiency summit every non-COVID year in my district, and I find it to be very well attended, and people are actually hungry for the type of information that you provide.

Ms. GLOVER. Thank you, Dr. Burgess.

Mr. BURGESS. And Mr. Rush, I think too, you know, in the future, we would do well to include Ms. Glover in future discussions because energy efficiency sometimes just kind of gets pushed to the side. But it is one of the most readily available to the end energy consumer—a way that they have of impacting their energy purchases.

Mr. Powell, thank you for being on our group today. Thanks for your testimony. Can you just—you did a very great job in your written testimony providing information about grid reliability. So

the changing of the energy sector—I would infer from that that you believe has weakened our energy reliability.

Dr. PACALA. Can you hear me?

Mr. BURGESS. Yes.

Dr. PACALA. OK, good. Well, so our committee didn't investigate whether or not there has been any short-term decrease in grid reliability. What we did was to focus on how to decarbonize the grid and maintain its high reliability. And this is, of course, technologically feasible. The key, of course, is to have not just—is to have firm sources of power that can be relied upon at any time. As we have seen in Texas, when the firm sources of power fail, you are in trouble.

And also it is important to—transmission, because you can interconnect areas from, you know, areas where demand is lower than average to areas where demand is higher than average.

So the—I want to be very clear that it is possible to build a net-zero electricity grid that is as reliable as the grid we have today, or as the grid that we had 10 years ago.

Mr. BURGESS. So if I may, I got notice over the weekend—I believe it was on Saturday—that ERCOT was buying power from Mexico and Southwest Power Pool. I presume that that was a price phenomenon, rather than a weather phenomenon. But obviously, those sources were closed off as soon as it got cold in those neighborhoods, as well. But ERCOT is not an entirely closed system. There are inputs and there are egresses into other parts of the grid.

Mr. Gordon, I wonder if I might ask you: You operate wind turbines in Texas, is that correct?

Mr. GORDON. Yes, sir, that is correct.

Mr. BURGESS. And you also operate natural gas facilities in Texas, is that correct?

Mr. GORDON. That is correct.

Mr. BURGESS. Can you speak to the overall impact on the reliability of both of those as energy sources?

Mr. GORDON. Yes. So I think, to answer your question, Congressman Burgess, we saw an unprecedented weather event hit Texas over the last week, which included significant icing on wind turbines. Our wind turbines are designed for cold-weather operation, so our turbine operations weren't impacted by the temperature so much as they were by significant icing. So we had icing, you know, for several days, and our technicians had worked around the clock to try to, you know, get the icing—so they can resume operations.

On our natural gas facility we have a peaking plant in Ector County, and we were unable to procure gas for the plant over the sustained time of this event. So our inability to get gas prevented us from operating. I think what our experience was is consistent with what other gas generators experienced, as well. Because our facility did not have dual fuel, we weren't able to operate. Had, you know, an ERCOT system been designed to pay for capacity as other systems do, our facility could have had dual fuel capabilities. But there is just no compensating that right now to do that.

Mr. BURGESS. Right. There has actually been a move away from dual fuel capabilities for some number of years.

And although—and I am going to yield back. And I can appreciate that it is an unprecedented—but, you know, this happened in 2011, the same situation occurred, it just didn't last as long. So—and I remember Governor Perry's response to that was to recommend the construction of several new coal power plants to sort of bolster the energy grid in Texas. He was rebuffed in that by the mayors of Dallas and Houston, who did not want to see new coal generation built in Texas. Some redundancy, clearly, is necessary.

But thank you, Mr. Rush, I will yield back my time.

Mr. RUSH. The gentleman yields back. And now that we return to regular order, I will now yield 5 minutes to the chairman of the full committee, Mr. Pallone, for 5 minutes for questioning.

Mr. Pallone, you are recognized.

Mr. PALLONE. I will unmute myself. Thank you, Chairman Rush.

I am trying very hard today and in the future to have us move towards a collective, you know, bipartisan response to the climate crisis. I mentioned our CLEAN Future Act, which has been introduced, but I also want the Republican Members to understand that, if at all possible, we would like to see a bipartisan response to the climate crisis.

And I am concerned today, starting with the Governor of Texas, that, you know, that somehow renewables are being blamed for this, what happened in Texas, or the suggestion is being made that we shouldn't move towards—you know, not necessarily by members of this committee, but the suggestion is being made that this should be some reason for us to stop moving towards a clean energy future, or not encouraging renewables.

And, you know, I really wish that we could avoid that, because I do think that renewables have to be a major part of this. It is not to say that we are going to rule out fossil fuels, or gas, or hydroelectric—which is, actually, a renewable, hydro is a renewable. So I don't know. I just—you know, I don't want this devastating situation in Texas to be blamed on renewables, because I just think that is false. The blame lies in the failure to properly consider how climate change and extreme weather events impact the grid.

And the answer, as Dr. Burgess said, is to move towards more resiliency with the grid and other—and also resiliency for, you know, for power lines and gas lines and everything else, as well as looking towards the issue of whether or not it may—you know, there should be more interplay between the Texas grid and the grids in the other parts of the country.

So let me just ask Mr. Gordon. Based on recent statements from ERCOT, it appears that, although 12,000 megawatts of wind and solar did go offline, the region was only expecting to rely upon 2,800 megawatts of wind this winter to meet energy demand. Meanwhile, ERCOT lost well over 25,000 megawatts of thermal generation, much of it natural gas, that it was relying on to meet the winter energy demand.

So, again, I am not trying to get into this, but I think that the suggestion is being made that renewables are the cause of this power crisis. But it is not—I want you to comment. I mean, is it fair to say that the failure to ensure a reliable natural gas supply was a major cause of the outages that we are now facing, as compared to any failure of renewables, if you will?

Mr. GORDON. Thank you, Chairman. I guess, to answer your question, again, we don't want to cast aspersions on any particular type of technology, either. Having said that, wind, as everyone knows, is naturally variable, and it goes up and it goes down hour by hour, day by day. And, as ERCOT has noted, wind, as a portfolio in the system, actually outperformed day-ahead expectations.

So, when all things were considered, wind did better than ERCOT's own system operators expected it to. And, as for what happened to the natural gas supply system, I really don't have insight into what happened there, other than I suppose it was too cold for gas to flow.

Mr. PALLONE. But I mean, right now, I mean, ERCOT was much more dependent on the natural gas generation to meet the winter energy demand. I mean, there is no question of that. I mean, that is just a fact, correct?

Mr. GORDON. That is true. I mean, ERCOT has coal and nuclear and natural gas and wind, and all work in concert with each other. They are economically dispatched, and we don't run more gas than we need to when the wind is up, and we expect—and ERCOT knows that gas will be available when the wind is down. It is, you know, how the system has operated pretty much flawlessly for a decade.

Mr. PALLONE. Right. But, you know, my concern is—I don't know if you want to answer this, but maybe I will just say it—that, look, the bottom line is that Texas was not prepared for this. You know, gas pipelines in Texas are not, you know, insulated the way they are in the Northeast. The bottom line is that Texas and all of us had to prepare for these extreme weather events. And more must be done across the board, whether it is—you know, whether it is coal powered, gas, wind, whatever it is.

I just don't think it is fair to suggest that somehow wind was the real problem here, or that renewables were a real problem here. I mean, they don't even rely on those that much in the winter. And—but if you don't want to comment on that, you don't have to. If you want to, go ahead, you have got 10 seconds.

Mr. GORDON. OK, yes. I mean, I think wind is a—is often the whipping boy of the energy industry. So we are kind of used to it. But it is unfair, and it is untrue. If we had more infrastructure, transmission infrastructure, this could have been avoided.

Mr. PALLONE. All right. Thank you very much, Mr. Gordon.

Thank you, Mr. Chairman.

Mr. RUSH. The Chair now recognizes the ranking member, Mrs. McMorris Rodgers.

Mrs. RODGERS. Thank you, Mr. Chairman, and I want to start just by saying to the chairman of the full committee, Mr. Pallone, that I appreciate you saying that you would like to work with us, Republicans and Democrats, to move to the clean energy future. We would welcome that. We would love to work together on innovation and removing regulatory barriers to more clean energy.

Our concern is really when American energy resources, whether it is pipelines like Keystone, are canceled with the stroke of a pen or other Executive orders are removing American energy resources and fuel sources and really impacting America's leadership and our

future, that is important to our economy as well as our national security.

But I want you to know we stand ready to work together. And I think these are important discussions that we are having.

I appreciated—Mr. Powell, I liked your theme about build cleaner faster. So I would like to explore that a little bit more with you, because we had testimony in the Environment Subcommittee last week that highlighted a serious problem: 90 percent of solar panels are imported; 80 percent of the key components for wind turbines are imported. Asian companies dominate global battery production, and account for 80 percent of all planned factories. China also dominates critical minerals. It supplies 90 percent of the rare earth minerals. And China right now is announcing that they will allow the banning of exports of strategic minerals to companies and nations that are considered a national security threat. That is a problem.

So today, we—you know, we continue to hear this drumbeat of building out the wind and the solar energy and restricting the oil and natural gas development. This is on a collision course. And what that means is that we are going to be losing our hard-earned energy independence and become reliable on these vulnerable supply chains from countries like China, or will be offshoring our emissions to nations with lower standards. So that is no help for the climate, and it will harm our own security.

So, Mr. Powell, I wanted to start—because I don't think that this is an acceptable path for American leadership and for us to win the future. So would you just comment on how you believe the United States should focus on building on our own strengths, our—and ensure that we have a secure energy supply, and that we are also addressing global emissions?

Mr. POWELL. Absolutely. Thank you so much, Ranking Member McMorris Rodgers. Let me congratulate you again on your election to the ranking membership of the committee. And thank you for your leadership on the Energy Act of 2020, and so much of your support for hydropower policy—I know an issue we have talked about many times before—and energy innovation, broadly.

You know, I think that there is a couple of components to this, on retaking American leadership on clean energy, both domestically, here in the United States and, even more importantly, exports. I think that begins with innovation.

We have fallen behind in domestic ownership and domestic manufacturing on a number of key clean energy technologies and a number of the components of those technologies. We need to focus on a next generation of technologies, where we can retake leadership. We still have a chance to lead in advanced nuclear energy, and long-duration storage, in carbon capture technologies that can use the natural fossil fuel abundance we have the United States, but do it in a cleaner and cleaner way every year. We can lead on advanced geothermal technology.

And we can do more to ensure that there are strong and robust domestic supply chains for critical minerals. That means opening up mining resources for critical minerals here in the United States and using innovation to find more earth-abundant substitutes for those materials. We don't necessarily have to use exactly the same

mix of materials and elements that we have used so far and that have made us quite dependent on China and other nations with very poor labor standards like the Democratic Republic of Congo, for example. We can find substitutes for a lot of those materials that are more available either here in the United States or in our allied countries. So I think——

Mrs. RODGERS. Great.

Mr. POWELL [continuing]. Innovation, opening up exploration, and finding alternatives.

Mrs. RODGERS. In just these last few seconds, would you comment on the prospects of nuclear technology—because there is some exciting technology being developed in Washington State—and if it would help overcome the transmission problem that we are seeing even in Texas right now?

Mr. POWELL. Absolutely. As I think everyone has said, no technology was unscathed in Texas. But I think nuclear did probably a little better than average in Texas. Only one of the nuclear units, to my understanding, went down. Nuclear is a highly resilient part of any clean energy mix, of any energy mix, and I think that we can find even more resilient and even more advanced designs for nuclear.

I am extremely excited about the 2 designs that are likely to be piloted and demonstrated in Washington State in the coming 5 years. That is part of the Advanced Reactor Demonstration Program started in the previous administration at the Department of Energy that is going to set up 2 commercial-scale, fully commercialized—it is like selling electricity to the grid, demonstrations of advanced reactor technologies. These are the next generation. They don't use water to cool them. They have a number of different attributes that make them cheaper and more efficient, and potentially offering the same safety for a significantly lower cost profile. So I am very excited about those developments, and I hope Congress will support them.

Mrs. RODGERS. Thank you.

And thank you, Mr. Chairman. I yield back.

[Pause.]

Mr. RUSH. The gentlelady yields back. The Chair now recognizes Mr. Peters for 5 minutes.

Mr. PETERS. Thank you, Mr. Chairman. Thanks for having this fascinating hearing. And I want to start on behalf of the residents of San Diego, California, by expressing our concern and prayers for the tremendous challenges facing the folks in Texas and nearby areas. I commit to working with you to find out the facts behind what has gone wrong and honestly figure out the ways that the Federal Government can play a role in ensuring reliability.

I also want to acknowledge that the transition to cheap natural gas has lowered carbon dioxide emissions. But, because this has become a talking point in this committee, I want to again remind everyone that, if we don't control fugitive methane emissions along the way from production to end use, there is no climate benefit.

And if I had more time, I would also like to explore the carbon tax with Dr. Pacala, as his report touts the advantages of pairing well-designed carbon tax—and by that I mean one that can mitigate the negative distributional impacts on society—with other am-

bitious climate policies. But I will defer that for our discussion of how we pay for infrastructure investment, because I think that matches that well.

Today I want to use my time to talk about transmission. It is widely acknowledged that the national power grid needs to be modernized to make it more secure, resilient, and efficient. It also needs to be interstate. The United States has tremendous renewable energy resources that have not been—not yet been tapped. But often these resources—sun, wind, geothermal, hydropower—are in remote or rural areas.

According to research from the Department of Energy's National Renewable Energy Lab, if we connect centers of high renewable resources with centers of high electric demand by building a macrogrid—that is, an overlay of high voltage DC lines—and optimize that grid for the Nation's best wind and solar, we can dramatically reduce carbon emissions, while improving system resiliency and reducing wholesale power costs. A macrogrid will enable more robust and more competitive wholesale power markets, which translates to lower costs for consumers. One model shows consumers saving $42 billion annually by building HVDC transmission, allowing power to flow across the seams between electricity regions.

And one more point about U.S. competitiveness. The Brattle Group estimates that the U.S. electric industry needs 200 gigawatts of new transmission capacity in order to accommodate widespread electrification. China has already done this and more. By the end of 2021 China will have developed over 250 gigawatts of new interregional transmission capacity over the last 7-year period. In contrast, we, the United States, have added 3. We need 200; we have added 3. So clearly the scale of the challenge is significant, just as clearly the current regulatory environment hampers our collective ability to meet this challenge.

So I want to ask a question first to Ms. Glover. It certainly hasn't been for lack of trying. Why is it so difficult for us to build large-scale transmission projects across State lines? And what role does Congress have to play in removing the barriers, once and for all?

And then—Ms. Glover and then maybe Mr. Gordon.

Ms. GLOVER. Thank you, Congressman. I am not sure that I am the best person to respond to your question, because my focus typically isn't on the building of transmission lines. So I will yield that time to someone who is more suited, if you don't mind. But I would welcome an opportunity to kind of do some research on the Alliance's position and get back to you.

Mr. PETERS. That is great. Mr. Gordon?

Mr. GORDON. Yes, Congressman, thank you for the question.

Invenergy historically has been developing wind, solar, thermal resources. And right now it sees the need for long-distance, high-voltage transmission, really, to connect the windiest parts of the country that don't have any real electric connectivity to deliver the best wind to where the load centers are.

So we stepped into a project that had been in development for nearly a decade. And these projects take a long time. It is an 800-mile line project from southwest Kansas that would ultimately go through Missouri and Illinois and terminate just across the Indiana

border, and would carry upwards of 4,000 megawatts of clean, renewable power. The interesting thing about this line in the context of the hearing today is it would be designed so they could carry power in both directions, as needed.

Mr. PETERS. Right, right.

Mr. GORDON. So if we have an abundance of wind——

Mr. PETERS. Right.

Mr. GORDON [continuing]. Normally in southwest Kansas, we could take it all the way to the eastern part of the grid.

Mr. PETERS. Can I just add Mr. Powell—or from Mr. Powell—I don't know, I am going to run out of time—but ERCOT itself explained in its comments to FERC that many ISOs and RTOs said that large-scale transmission is the key to resilience: "One of the most critical elements"—this is ERCOT—- "of system resilience is ensuring that the transmission system is planned in a way to ensure continued operations following an unexpected outage of one or more generators or transmission elements."

Mr. Powell, you have 5 seconds to react to that.

Mr. POWELL. Well, thank you very much, Congressman Peters. Thank you for your leadership on all these issues.

In that short amount of time I will—you know, I will—as Dr. Burgess noted, ERCOT is not entirely an island. There is transmission that interconnects it with the rest of the grid. I think every observer of this, you know, would note that more transmission probably would be helpful here, if there were larger, better interconnections to—particularly on the east and west, there may have been an opportunity to bring in more resources.

Obviously, there are cost implications to that. And it has been, as you noted, devilishly difficult to site and permit those new wires. So I think we need to figure out both the regulatory and permitting issues that would enable that, and figure out how to pay for those and maintain a—you know, affordability in the local power supply.

Mr. PETERS. Mr. Chairman, my time has expired, but I do see an opportunity to work with Mrs. Rodgers on regulatory relief on this issue, in particular, and I yield back.

[Pause.]

Mr. RUSH. The Chair recognizes Mr. Latta for 5 minutes.

Mr. LATTA. Well, thanks, Mr. Chairman, and thanks very much for holding today's hearing, and thanks for our witnesses for being with us today.

Also, I want to express my thoughts and prayers for the folks down in Texas for everything that they are going through from this about once-in-a-century winter storm, and that, you know, we want to do everything we possibly can. We are committed to making sure that we get the assistance to them.

Mr. Chairman, we can continue to work with the private sector to promote job creation, innovation, and emissions reduction, and energy security by embracing a diverse portfolio of domestic energy sources, or we can pursue a top-down, heavy-handed government policy that can destroy our economy, put millions of Americans out of work, and stifle innovation through onerous bureaucratic red tape. And, unfortunately, what we have been seeing so far is that the Biden-Harris administration is going to take that second path.

If I could start with Commissioner Camp, and as a former county commissioner myself here in Wood County, you know, you have spoken previously to the committee about the benefits that your county has experienced because of these energy projects. Could you go into more detail? I know you did some in your opening statement about that, but could you go into more detail about the types of program investments that Beaver County has made—been able to make because of this revenue stream that you have gotten?

Mr. CAMP. Thank you, Congressman. Absolutely. I had the honor to testify in 2019 to the Subcommittee on Environment and Climate Change to discuss the petrochemical plant that we were able to land here in Beaver County in 2016. We are—on the process, they are still at the time to be finished here very soon.

We have seen tremendous investments from not only Shell Petrochemical but the downstream organizations who are here in Beaver County and the southwestern Pennsylvania region through the infrastructure, the highways, center township. My home community has been granted a new water treatment facility with 100-year span. Our community college has been donated millions of dollars for a process technology lab, where—we have these companies who are starting to invest into our community because they are going to be calling it their home.

Not only are they investing in our higher education, they are also investing in our minority communities, who are not capable of the technology—through their investments, because of the global pandemic here, we are capable of having these schools now have classes online.

So we are seeing a great deal of investment, not only through Shell but through all the other companies who are downstream jobs of Shell, who are now planting their feet in the ground.

Mr. LATTA. Well, thanks very much, Commissioner, for your leadership in the county.

Mr. Powell, if I could go to a follow-up on some questions that our Republican leader was talking about on the nuclear side, how can Congress and the new administration build on the achievements of the Energy Act of 2020 to accelerate the development and deployment of the domestic fuel supply for advanced nuclear companies?

Mr. POWELL. Thank you very much, Congressman Latta. Thank you for your leadership on this issue and your legislation around creating a reserve of HALEU fuel.

Just to take a step back, on advanced nuclear there are a couple of components to getting this up and running.

Component one is to demonstrate the technologies, to actually show the world, show utilities, show potential industrial users that it is real, that it could actually work.

Step two is making sure that we have the fuel to run the things, because they run on higher-test fuel, or high-assay, low-enriched uranium. Currently we don't have a supply of HALEU fuel in the United States, and we need to establish a reserve for one of those.

And then we need to start actually building a robust supply chain for that HALEU fuel here in the country.

And then last, we probably need some deployment incentives to provide the early financing, which would bring those technologies

into the market, just as so many other technologies have had those early incentives.

And so I think we can work on all of those things. There could be appropriations and oversight of the Department of Energy to make sure those demonstrations work. There can be legislation like yours, to establish programs to set up a HALEU reserve and a robust supply of this fuel. And there could be new incentives created like the Energy Sector Innovation Credit that would provide incentives to pull these things into the market.

Mr. LATTA. Well, thank you. Let me ask real quick in my few seconds remaining, just to follow up, because, again, I am really worried about rare earth minerals. And you were also talking about finding other elements that could be a substitute. Can we do that on our own in this country, without having to rely on countries that don't like us?

Mr. POWELL. I sure hope so, because, as was noted previously, I worry that those countries may shut off the supply to these technologies, or threaten to shut off the supply to these minerals and resources whenever we get into areas of geopolitical tension. I think this needs to be a top priority for both our private sector and for our innovators at the national labs and other research institutions, and finding ways to get around this.

I am very excited about some of the developments in earth-abundant battery chemicals, even an organic battery chemical, so it would basically take things like organic chemicals—think like sugars and fats—and be using those as the way that we would store huge amounts of energy in new batteries and storage systems. So I think that there is a lot of potential here, but it needs to be adequately resourced at the research stage.

Mr. LATTA. Thank you very much.

Mr. Chairman, my time has expired, and I yield back. Thank you very much.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Doyle for 5 minutes.

Mr. DOYLE. Well, thank you, Mr. Chairman. And I want to thank you and the acting ranking member for holding this hearing today. I want to thank all the witnesses for their testimony, and give a special shout out to Commissioner Camp, a fellow Western Pennsylvanian. It is good to have you here on the panel.

The commissioner knows in Western Pennsylvania we are an all-of-the-above region. We do fossil fuels, we do nuclear, we do renewables. And the people that work in those industries don't love one better than the other. What they love is to feed their families. And that is what we are talking about.

So we know that, over time, there is going to be a transition as we take renewables and put more on the grid and deal with their intermittency by using things like advanced nuclear and storage so that we can lessen the need on fossil fuels. But when we make this transition over time, the key is to make sure that we don't leave people behind, that we don't leave families behind, that if we are going to create new manufacturing and a clean economy, that we build those plants in areas where people may be displaced because they are working in industries that we are going to be less reliant on. I think that is going to be the key to success.

But we are glad to have all the panelists here.

Mr. Gordon, we have all heard about the struggle of utilities getting past that 80 percent figure. Everyone I have talked to is saying, you know, we can reduce 80 percent, but it is that last 20—you know, to get us to net-zero carbon by 2050—that is the tough part. How important will energy storage and reducing its costs be to expanding renewable energy?

Mr. GORDON. Thank you, Congressman Doyle, for your question. And, as it happens, I was born in Indiana, Pennsylvania, and lived there for 11 years, so I am also a Western Pennsylvania native.

I think, to your question directly, you know, energy storage is going to be a critical component to the future of the generation stack, and reducing those costs will be imperative, of course. I think what we are largely looking forward to is, you know, additional cost reductions over time, different types of batteries being designed, and ultimately working with new technologies like hydrogen to see how hydrogen can play a role with battery storage, as well. So I think we are very optimistic.

But you are right, the last 20 percent, that last mile, is going to be more expensive than the first 80. And we just need to put our heads together. And I think, as a country, we have got some pretty bright minds. And if we are committed to it, I think we can make it happen.

Mr. DOYLE. Thanks.

Mr. Powell, you mentioned how important driving down emissions in the industrial sector will be. Improvements at industrial facilities, they are big, capital-intensive projects. And outside of tax credits for carbon capture, how would you suggest we create a long-term structure for cofinancing big emission-reducing investments?

Mr. POWELL. Thanks for the question, Congressman. Thanks as well for your leadership on so many of the innovation provisions that landed in the Energy Act of 2020, a very important sector, and your support for all of these different technologies.

Carbon capture and incentives for carbon capture are actually—are absolutely an excellent place to start for industrial emissions. So probably the fastest way we can bring those emissions down is simply capturing them before they leave the plant, and using the same underlying process.

We can also do two other major things. One is to find alternative ways to supply some of the heat that go into industrial processes. That is the largest single source of those emissions. And so that would be providing clean heat in those facilities. So that would be with an advanced nuclear reactor that could provide a lot of that heat, with hydrogen or renewable fuels, those sorts of things, or the fuels themselves with carbon capture.

The other thing we can do is provide different processes in the first place. So, for example, think about a steel plant that doesn't use coking coal to do that reduction of steel but instead does electrochemical reduction. There is a company up in Boston called Boston Metals that is pioneering new technology around that and would use direct electrical current to do that reduction of the iron ore.

Mr. DOYLE. Thank you, Mr. Powell. I want to get this question to Dr. Pacala, too, because I think it is important.

All of you have testified that ensuring we don't leave communities behind as we move to a cleaner economy is crucial. And I believe that fervently. What policies do you see as critical to ensuring that future energy development or the manufacturing of energy equipment is done in those areas who have historically been affected by pollution or losing their jobs, their fossil fuel jobs? What do you say to that, Dr. Pacala? What do we need to do to ensure that?

Dr. PACALA. Well, the package that we proposed is designed to do exactly that, right? So the idea is that—let's suppose that you are a town and we are in middle America with a dominant employer that is going to be lost. And the wind and solar jobs are great, but they don't compensate for this highly concentrated employment in your town. It is worthwhile understanding that more towns gain resources than lose them. Where they lose them, they lose them in a way that would otherwise be catastrophic.

And so what could be done? Well, the idea first is that you have to anticipate the loss and plan for it in advance because, if it catches you by surprise, that is it, right?

And so the idea is to have a bunch of regional centers, together with State offices that work together, where Representatives of Congress, and mayors, and Governors, and other officials can meet to understand what regionally is likely to happen, and to serve as a conduit for planning grants to towns and to counties. And there, the idea is to anticipate what is going to happen and when, with technical assistance that other programs would provide.

Having discovered that something was going to happen——

Mr. DOYLE. I see we are way over our time, and I want to be polite to my fellow colleagues, but we will talk more about this. Thank you so much.

Mr. Chairman, I apologize, and I yield back.

Mr. RUSH. The Chair now recognizes the gentleman from West Virginia, Mr. McKinley, for 5 minutes.

Mr. MCKINLEY. Thank you, Chairman. And as a good friend, it is always good to see you.

I thought the premise of this hearing was going to be about the decarbonization, accelerating the decarbonization in the United States. And I have been functioning for years now on the fact that climate change is a global issue and requires a global solution.

So we have heard from previous panels, including Gina McCarthy, when they said that, if America alone decarbonizes, the impact on the global environment would be virtually immeasurable. And then they went on to say that, as long as countries like China and India are expanding their dependence on fossil fuels, America will still experience wildfires on the West Coast, droughts and floods in the Midwest, and hurricanes in the East.

So I guess the issue is, can America decarbonize? Absolutely. I would agree it can. But at—what is the cost to families, communities, and businesses that are reliant on fossil fuels?

This report that everyone is referring to was silent about Hazard, Kentucky; Gillette, Wyoming; Cadiz, Ohio. There are no transitional employment opportunities in those areas.

So to Rich Powell, let me ask a couple of questions of you. First, I say, Rich, I agree with your testimony where you said serious

Federal policy proposals must also reflect the global nature of the challenge. Let me ask, Rich, have you read the National Academy report?

Mr. POWELL. I have.

Mr. MCKINLEY. OK. Do you think that there were—maybe there was—given that there were no representatives who were not academics among the authors, and based on their tweets and papers that they have published, do you believe that the authors may have had a bias against fossil fuels?

Mr. POWELL. It certainly seemed like an objective was first to think first about decarbonization, and maybe secondarily about the transmission impacts.

Mr. MCKINLEY. OK. Do you agree that one of the authors who tweeted out that—and his quote was in his tweet, showing—these are the people that put this—that "America can eradicate poverty by decarbonization." Do you agree with that?

Mr. POWELL. I don't think it is the first way we would eradicate poverty.

Mr. MCKINLEY. But that was the statement, that decarbonization is going to eradicate poverty.

And then, also, part of the study was, quote, it was to "build an energy system without social injustices that permeate the current system." Do you think it does permeate the current system?

Mr. POWELL. I don't. I believe that there can be——

Mr. MCKINLEY. OK, let me get back on point, through, Rich, because I have got some more questions I would like to get with you. So back on point, were the policies outlined in this study—because it was very comprehensive, and very thoughtfully put together from white papers that they published. But will it encourage other nations like China and India to actually follow our lead and reduce their emissions?

Mr. POWELL. It focuses on U.S. emissions reductions.

Mr. MCKINLEY. Yes.

Mr. POWELL. The one piece that might have a global impact is the R&D section, and that could reduce the cost of global emissions. But beyond that, it is largely silent on the global question.

Mr. MCKINLEY. Now, since the anti-fossil-fuel zealots that we deal with in Washington are agitating for America to choose this simplistic route, just—in other words, discontinue fossil fuels. That is one way to do it. You can. That is a fork in the road, you can take that, and we can not use fossil fuels. But wouldn't America be better off, better advised if they adopted a more pragmatic approach to capturing carbon through advanced innovation and deployment?

Mr. POWELL. We should. We should be focusing on reducing emissions, not eliminating fossil fuels.

Mr. MCKINLEY. Thank you. So wouldn't that approach protect the economy, reduce carbon emissions, and develop a technology that we can export around the world for other nations that are offensive in their emissions? Wouldn't that be the better approach, rather than just doing away with fossil fuels?

Mr. POWELL. Prioritizing carbon capture so that we can make the breakthroughs that the rest of the world can then use to

decarbonize should really be at the top of the list of our energy innovation priorities.

Mr. MCKINLEY. So, Rich, would you think that—would you concur that the global environment will not improve measurably if America alone decarbonizes?

Mr. POWELL. I would.

Mr. MCKINLEY. OK. Is there—what policies—in the remaining few seconds here, what else would you be saying for us that we should be adapting?

Mr. POWELL. Well, I think, if you look back at the Energy Act of 2020, the technology that received the most bipartisan support in that very bipartisan bill was carbon capture. That bill now calls for a massive demonstration program for carbon capture technologies. But a lot of work remains to actually implement that. And so I would encourage this committee and all of Congress to focus now on implementation.

Mr. MCKINLEY. Thank you very much, and I yield back the balance of my time.

Mr. RUSH. My friend yields back. The Chair now recognizes Mr. McNerney for 5 minutes.

Mr. MCNERNEY. Well, I thank the chairman for the hearing, and the ranking members.

Your witnesses—your testimony has been very important and useful, so thank you for coming out, or appearing today. Like all of my colleagues, I am extremely concerned about what is taking place in Texas. Millions are suffering in the cold with no immediate end in sight.

Dr. Pacala, we have heard from Mr. Gordon about what happened to cause the blackouts in Texas. Would you walk us through your understanding of what happened?

Dr. PACALA. Yes. I am not an expert, but I have consulted experts on it, and my understanding is just about what has been said, predominantly. There was, in fact, a failure of some of the generating capacity across the board, and it was across all types of generating capacity. So the thermal units—that is, natural gas and coal plants and nuclear plants—all had a failure rate. And the cause was primarily, you know, different routes in which the cold can prevent the plant from operating. So that, for example, if you have got a pipeline from a production field to a power plant, when the production field goes down because of cold, the fuel stops.

There was also some loss of wind capacity. The wind capacity that went down was a little bit less in sort of percentage terms than the thermal capacity. But it is not really a meaningful difference, right? So—and those were primarily due to pipes freezing.

And beyond that, I think that what has been said about the interconnectivity of the Texas grid is right, right? If you had more interstate transmission, you had high voltage lines that could bring power in, they would have been better off.

Mr. MCNERNEY. Well, thank you. At last week's markup in this committee, we heard a lot from Republicans about California blackouts. And now we are seeing the same thing happen in Texas.

Republicans again are blaming renewable energy this time for Texas' problems. This is ludicrous. This is ludicrous because—and both States are similar: extreme weather related to climate change,

together with underinvestment in our electric utility and infrastructure and resilience. Reducing renewables will just accelerate climate change and increase the suffering of our constituents.

So, moving on, as we continue to confront the severe impacts of climate change, it is critical to prepare by hardening the grid. The issue is front and center to me, since California has its share of natural disasters and extreme weathers.

Mr. Gordon, should the Federal Government have a role in grid hardening for extreme weather events?

Mr. GORDON. Thank you, Congressman. I do think that the Government should have a role in hardening the grid for extreme weather events, yes.

Mr. MCNERNEY. Well, do you have any recommendations for resilience improvements that are also clean?

Mr. GORDON. Well, I think, going back to the infrastructure question, getting more transmission built, connecting to renewable resources would be by definition a clean way of doing that, while hardening the grid for reliability and resiliency for when these events happen.

Mr. MCNERNEY. Thank you.

Dr. Pacala, same question. Is there a role for the Federal Government in grid hardening with respect to clean weather, and how do we make sure that that is done in a way that produces clean energy?

Dr. PACALA. So there is absolutely a role. And the report that we released has very specific recommendations for regulatory reforms that are critical to get the grid reforms in place, certainly in time to do a rapid decarbonization of the U.S. grid.

And there are two difficult actions in Congress that we think are essential. One is a clarification of the Federal Power Act, so that it is understood that it does not limit the ability of States to use policies to support the entry of zero-carbon resources into electric utility portfolios and wholesale power markets. And the second is an amendment of the Energy Policy Act to assign FERC the responsibility to design the national interest electricity corridors.

And then there are a whole host of other recommendations that are very specific and that you can find in the—mostly in the footnotes to that table I talked about.

Mr. MCNERNEY. Well, I am going to ask, in my remaining time, Ms. Glover, do you think there is a role for electrification as a part of the effort to improve resilience?

Ms. GLOVER. I think there probably is a role for electrification, but I think there is also a much larger role for energy efficiency in improving resilience. Right? The less that we use opens up capacity, and it helps utility companies and others not to have to invest in some infrastructure if we do energy efficiency right and make those kinds of investments.

Mr. MCNERNEY. Thank you. Let's get back to efficiency.

All right, I yield back, Mr. Chairman. Thank you.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Griffith for 5 minutes.

Mr. GRIFFITH. Thank you very much, Mr. Chairman. Let me say first I look forward to seeing the science on what caused this cold snap in Texas. I know it is easy to go and say this is a part of cli-

mate change, and that may be a contributing factor. But apparently there was a similar weather pattern in Texas in 1928, which is why one of our earlier folks talked about this happening about once a century in Texas, because apparently it has happened before. So I don't know that we can put all of the cold weather in Texas at the feet of climate change or global warming.

Ms. Glover, thank you so much for talking about energy efficiency. I do have some good-paying jobs in my district with that, in a coal district, but I do appreciate you highlighting that very much.

And some have called for the complete elimination of using our fossil fuels, and I was pleased to hear Chairman Pallone say that, while we may shift and transition and lower that number, that he didn't see it being eliminated from part of our mix. And it is interesting, because one of my professors, a science researcher at Virginia Tech working on fossil fuels, has lamented in the past that never before have we eliminated or tried to eliminate an energy source, whether we started with wood, et cetera. With the exception of whale oil, we have never eliminated one. We have reduced it, depending on market conditions, and it improved efficiencies, but we have never eliminated one of our potential energy sources. And I think that is important to keep in mind.

Mr. Powell, I appreciate you mentioning that we are trying to make false choices, that you have to choose one or the other. I am an all-of-the-above kind of guy. I like your concepts of using more innovation. You talked with my colleague, Mr. McKinley, about reducing emissions, and that that ought to be at the top of our list, and doing the research to reduce that.

I would point out that, in my district—and they are all over the country, but one in my district, MOVA Technologies, has been working on panel bed filtration systems that not only eliminate $CO_2$, but eliminates, depending on what panel you have and what industry you are dealing with, it eliminates all kinds of other pollutions. It is already out of the test phase and is now into the—in the small-test phase—and it is now going to the next level. And these are the kinds of things that I think we need to be working on, as well.

Now, we can invest all the money we want to in research and innovation, but if industry is disincentivized to install new technologies, it will be for naught. Last week I had a meeting with the pulp and paper workers—challenges associated with the New Source Review permitting program. And we have learned that the NSR often discourages new investments at facilities like paper mills, a furniture factory in my district, other manufacturing plants and power plants. It discourages them from making small bites of the apple. They are told if you take a small bite, you have got to swallow the whole apple.

I have reintroduced the New Source Review Permitting Improvement Act, H.R. 245, which would reform the program so that we can upgrade U.S. facilities with new pollution control technology. But not having [audio malfunction] all at one time. Is New Source Review a barrier to reducing emissions, Mr. Powell?

Mr. POWELL. Yes, sorry, you froze there for a second, but I think I heard the question. Thanks so much for the question. Thank you

for your leadership on this vital issue for carbon capture technologies, really for all technologies which would help reduce the emissions from existing facilities.

It absolutely is a barrier in its current form. I do not think that the original drafters of the Clean Air Act understood this kind of scenario. I think they would have probably framed New Source Review in a different way, had they been thinking about things like carbon dioxide emissions at the time. I think reforming that so that we don't have NSR as a barrier, and so that you don't enter an entirely different regulatory regime if you simply bolt one thing on to a facility which significantly helps reduce the emissions. That actually has the exact opposite effect of, I think, what folks would have been trying to accomplish with the original New Source Review revisions.

And so I think reforms are urgently needed, and I think your proposal is an excellent step in that direction.

Mr. GRIFFITH. Thank you very much. I mean, look, a lot of times people characterize it as just trying to get rid of the rules. No, what we are trying to do is make the rules so that they can be used effectively. And, if you take one bite at the apple every 3 or 4 years, a factory can make its facility a whole lot better. If you have to do the whole thing at one time, they are never going to do it, and it slows down our ability to control emissions.

I was pleased to hear, you know, discussion, and I know the intent is good about, you know, being prepared and planning—and this would have been Mr. Pacala—being prepared and planning. I come from an area where there is a lot of coal production and a lot of lost jobs already. But I will tell you that there is a December 6, 2019, New York Times article, which I forwarded to committee staff because I would like to have it introduced into the record.

This article talks about a town—10 years has been spending money trying to reinvent their economy. They have created a law school with some of their money. They have created a pharmaceutical school, or a pharmacy school in their community. And they have spent—according to that article, they have spent approximately $170 million over this 20-year period trying to, you know, reinvent themselves.

Now, there are all kinds of other issues—road access —that we are working on. But I will tell you that——

Mr. RUSH. Will the gentleman——

Mr. GRIFFITH. Give me just one second, thank you. But I will tell you that 1 in 6 jobs is still coal-related, and the county is getting hit hard.

Mr. RUSH. The gentleman——

Mr. GRIFFITH. I yield back, I apologize. Thank you, Mr. Chairman. I apologize.

Mr. RUSH. That is quite all right. The Chair now recognizes Mr. Tonko for 5 minutes.

Mr. TONKO. Thank you, Mr. Chair, and this is a great hearing, and there is so much to cover. I will try to get through as much as I can.

I don't think we should overlook the importance of energy efficiency and decarbonizing our energy system. There are many widely available, cost-effective measures that can be done to improve

the energy efficiency as well as the health and safety of homes. But we need to recognize that many low-income people aren't going to take advantage of a tax credit. And for this category of individuals, often they pay a much higher percentage of their incomes on energy bills.

So, Ms. Glover, what is the role for a program like DOE's Weatherization Assistance Program to improve energy efficiency of low-income homes?

Ms. GLOVER. Thank you so much, Congressman, for that question. You know, WAP program, the weatherization program, is an important program for low-income consumers. And certainly, I would say even middle-income consumers would, if they could take advantage of it, would want to. It certainly needs to be funded more, and there have been some requests to add more funding to that program.

But I would also say that, as you as you all in—as Members of Congress have been thinking about how do we direct that funding to the right families. And so part of that thinking has to be what are the communities that we are going to start with first. Is weatherization, in and of itself, that program, going to be enough of an investment for some communities in rural and urban communities around this country? Their homes are not ready for even basic weatherization. And so we do have to think about what is the proper investment, and do we need to build on top of existing programs to make those communities more resilient, in terms of energy efficiency.

Mr. TONKO. OK, thank you. And do you believe this program helps promote more equitable energy policy?

Ms. GLOVER. I do think that it does. I just—I think that it is—you know, look, we—there are so many things we need to invest in. And I think that weatherization—and that program is probably one of those programs that needs greater investment.

Mr. TONKO. Thank you. And last year Congress enacted reforms to strengthen the program, and President Biden has called for weatherizing 2 million homes. So I think that is a great shot in the arm.

Ms. Glover, do you believe funding for a program like the Weatherization Assistance Program should be considered for inclusion in a future infrastructure package?

Ms. GLOVER. I do. I do believe that funding for that could be included in a future infrastructure package.

But I want to say that, you know, if we are trying to impact low- and moderate-income families, it is not just the weatherization program that can do that. There are other programs, as well, and other proposals out there that also—our small business proposal, I think, is a good one. It talks about how you bring jobs to these communities and small business growth to those communities, as well as ensuring that the businesses in those communities are thriving.

I think Congresswoman Blunt Rochester's bill on mission critical and building infrastructure is another important program that can help not only those communities in terms of making them more resilient, but also in terms of jobs and small business opportunity and addressing our equity needs.

So there are lots of programs that I think have been proposed that will get us where we need to be and at the same time address our issues around climate change, decarbonizing our energy grid, and providing economic opportunity to communities around the country, particularly those who are suffering the most.

Mr. TONKO. Thank you.

And Dr. Pacala, could you give us a sense of why the NAS report recommended increasing funding for weatherization?

Dr. PACALA. Yes, the—we recommended both an increase in funding in the low-income—in LIHEAP and in the Weatherization Assistance Program because of the need to upgrade infrastructure, which has lagged behind and which disproportionately impacts the incomes of low-income Americans already.

And so there are—we did discuss the inefficiencies built into some of those programs but on balance thought that we ought to put more money into them. So there are specific numerical amounts in the recommendations, and it followed a review of the performance of both of those programs.

Mr. TONKO. Thank you. Thank you very much.

Mr. Powell, I am excited to hear that ClearPath is getting involved in the industrial sector. Do you believe low-emissions hydrogen could play a role in decarbonizing certain manufacturing processes?

Dr. PACALA. Thanks for the question, Ranking Member [sic] Tonko, thanks for your leadership on the Energy Act of 2020, as well.

I absolutely believe that hydrogen could be a big part of that solution.

As I mentioned earlier, low-carbon heat is going to be a core component to decarbonizing the industrial sector, and low-emission hydrogen, whether that is produced from natural gas, but carbon capture from renewable electrolysis, from nuclear electrolysis, or maybe a whole lot of processes that we don't even understand or realize yet could be a really significant part of that transition.

Mr. TONKO. Thank you very much.

Well, Mr. Chair, I think I have exhausted my time, so I will yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Johnson for 5 minutes.

Mr. JOHNSON. Thank you, Mr. Chairman. I will be really brief, so I can get to my questions. But as I listen to my colleagues and some of our witnesses today, we keep hearing proposals for, I quote, "deep decarbonization" that would serve, really, only to kill good-paying American jobs while simultaneously increasing our supply chain dependency on China, embolden Russia, and, ironically, do very little to decrease total global carbon emissions.

I keep thinking, why would we want to go down that road? Well, I think we might have found the answer. One of our witnesses today, in their prepared testimony, cited a desire to achieve a—and I quote—"fundamental economic and social transition."

So, I am wondering, are decarbonization policies about climate or energy at all, or is it more about power and control?

Outside of this Zoom hearing, in the real world, abundant American resources are being leveraged to create jobs, revitalize commu-

nities, and strengthen American manufacturing. So I have a question for Commissioner Camp.

Thank you for joining us, Commissioner. My district is not far from Beaver County, just across the State line in eastern and southeastern Ohio. We have a site ready for a similar, I think, cracker facility. And, just as in Beaver County, it is intended to take advantage of the vast natural gas resources right below our feet in Ohio and Pennsylvania. It is still awaiting a final investment decision, but, God willing, if construction begins on this project, we will see our communities benefit immediately with thousands of workers coming to town. Is that your perspective, will we see those thousands of workers coming to town?

And also, what does it mean for a community with a proud but distant industrial past to have heavy manufacturing like this return?

Mr. CAMP. Congressman Johnson, thank you very much. I worked closely with the previous board in Belmont County, Ohio, where that proposed petrochemical plant is being set forth. Absolutely, we see right now—in 2019, as I said before, when I testified in front of the Subcommittee on Environment and Climate Change, we had roughly 3,500 employees on site. Today we have 7,950 employees on site; 7,000 are working there during the day, 950 in the night turn. We are seeing that.

But not only are we seeing that at the plant itself, we are seeing the effects of them, even through this global pandemic, support our community. Our tax base has gone up due to this. There is a pilot program in place with Shell Petrochemicals for 20 years, 25 years. But we are going to see the downstream jobs. There are many, many, many options on property up and down Interstate 376, which is our headquarter here, where the train—rail meets the river and Interstate 376. You can't purchase a piece of property in Beaver County right now that is an industrial site, because the options are exercised.

Mr. JOHNSON. So the bottom line is, it is far from over.

Mr. CAMP. It is far from over. We won't start seeing these downstream manufacturing jobs, the companies who utilize the rubber pellets that Shell Petrochemical will be making, for years. Once they start production, these companies will then start to look at building facilities in Beaver County, Western Pennsylvania, Allegheny County, Westmoreland, even into Ohio and West Virginia in Representative McKinley's district.

Mr. JOHNSON. Well, good. Well, good. Well, let me go to Mr. Powell now. Thank you, Commissioner.

Mr. Powell, you made an important point earlier about how a molecule of carbon released in Shanghai has the same impact as if it was released in Chicago. Well, what I am hearing from my Democratic colleagues today is too much of a focus on reducing carbon emissions domestically, regardless of the cost to American jobs like those in Beaver County, without acknowledging that climate change isn't just America's problem to confront. In fact, even if America reduced its emissions to zero, there wouldn't be a measurable effect on the global climate.

We need to take a step back here and put the American people first. Rather than trumpeting gimmicks like the Paris Accord,

which gives a free pass to huge global emitters such as China and India, we have an opportunity to support pragmatic policies that can build new and carbon-free technologies like nuclear here in the U.S. and enable them to be built internationally.

So, Mr. Powell, do you believe there is room for bipartisan consensus on improving advanced nuclear technology?

And how best can we modernize our export process, which not only has clean energy benefits but supports U.S. interests and national security?

Mr. POWELL. Thanks for the question, Congressman. Thank you for your support for modernizing our nuclear exports infrastructure.

I believe there is bipartisan consensus on advanced nuclear energy. It was one of the technologies highlighted in the Energy Act passed in December, demonstrating new pieces of that.

I do think that the exports process, both the 810 agreements and the 123 process, do need to be modernized. We have to remember it is not a choice about whether a country is going to accept new nuclear technology. It is whether they are going to accept U.S. technology or Russian or Chinese technology. And our preference would be that it was American technology with American safeguards and where America captures the economic opportunity and the benefits and the jobs of those exports.

Mr. JOHNSON. Well, thank you. Thank you, Mr. Powell.

Mr. Chairman, I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Veasey for 5 minutes.

Mr. VEASEY. Mr. Chairman, thank you very much. And of course, as you know, Mr. Chairman, we are going through catastrophic weather events right now in Texas. And it is—you know, it is really bad. I am not going to mince words about it. It is as bad as it seems from afar. People don't have heat. People haven't had heat for days. We have had a record number of people going in to local hospitals because of carbon monoxide poisoning, trying to stay warm. It is bad. And I want to thank you for hosting this hearing today. And I wanted to ask some questions specifically related to this catastrophic energy failure that we are having in our State right now.

The extreme weather events over the last few days have caused a massive failure to deliver electricity to those who desperately need it, as I just pointed out, and the inability of some of these power plants to produce electricity when our communities needed it the most meant that people in 254 counties all across our State are going without power.

And now we are at a point now, Mr. Chairman, to where there are people having to boil water. We have several places here in the Dallas-Fort Worth Metroplex where people are under boil alerts, because they don't have fresh water. I even—I have heard of at least one hospital that doesn't have fresh—that doesn't have adequate clean water.

And, in the days and weeks to come, we will be examining the questions of infrastructure-related causes, looking at what measures can be taken to properly weatherize and insulate our power plants of all fuel types.

Another important issue for us to consider is how we can better connect Texas to the national grid to allow for interregional transmission to bring electricity from other areas of the country. And yesterday I sent a letter to FERC with a desire to start a conversation on this. There will be many benefits and challenges of allowing limited energy transfers into ERCOT territory in certain emergency situations. There are a number of legal and technical infrastructure hurdles that we will need to overcome for greater interconnection, and I believe that every option should be explored so we can avert any other potential disasters that we may have in the future.

And, as we continue to search for answers, I am glad that we have some experts on power generation with us here today. And Mr. Craig—and I don't want to get into the silly season of comparing things that—that has been too much of the conversation, that has been utterly ridiculous, that people are comparing these things. We obviously had failures with all of our platforms in ERCOT, and we need to figure out how we can weatherize these things. And I want to ask you, given that a large part of the blame for the Texas grid failure was due to some of our more traditional fuels around natural gas and coal and nuclear, and not having adequate weatherization and insulation, can you speak a little bit about a—what—about weatherizing a power plant for cold weather looks like?

Mr. GORDON. Thank you, Congressman. I am not sure I am the expert on how to weatherize a coal plant or a gas plant. I do think there are ways to do so. I think folks at ERCOT and the generation owners ought to, you know, consult with folks in the Dakotas, and Minnesota, and places like that, where they are dealing with these sort of things, you know, year in and year out.

I will say, however, that the way the market is designed doesn't encourage additional investments in generation technology. For instance, we have peaking plants in Ector County. They do not have the capacity to burn fuel oil in a situation like this. If the ERCOT market was structured such that there was a way to compensate for that additional reliability, you would have plenty more generating-owning companies invest in the dual fuel capabilities to ensure that, when a situation like this comes, that there will be, you know, backup fuel to keep the generation going.

I would also say that additional investments in energy storage which don't require water would be a smart investment, as well. And again, you know, always going back to more transmission to connect different parts of the Texas grid, as well as to different parts of——

Mr. VEASEY. Thank you very much.

Mr. Chairman, I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Bucshon for 5 minutes.

Mr. BUCSHON. Well, thank you, Mr. Chairman. And this is a great hearing. It is timely.

Look, I am an all-of-the-above energy believer. I think we should continue to pursue innovation and technology advances across the energy-generating space. You know, my district is a coal district, however, and I just, you know, want to remind people that, actually, coal may be the most reliable source of energy in this situa-

tion, because you have a stockpile at your plant, you don't require a pipeline, and—when the wind and solar panels don't get frozen up or covered in snow.

That said, that is why I think we need to continue to innovate across the energy space and not forget about fossil fuel.

I also am very happy that part of this conversation has been about energy efficiency, because, you know, I grew up in a small town, 1,500 people. And I can tell you the homes are 100 years old, and they are very energy inefficient. That is a very big piece of this.

Mr. Gordon, how did Invenergy wind projects perform in Texas, and how many megawatts out of the total system had to be shut down due to cold weather and icy conditions?

Mr. GORDON. Thank you, Congressman, for the question. At various points of the last several days, many of our wind farms were not operational. However, at no point over this period did all of our wind projects fail to operate. So it was hit or miss. It was really dependent on the location of the facility. You know, some facilities were iced over more than others, and so some came through, you know, doing very well, better than expectations.

Mr. BUCSHON. OK, how did Invenergy's natural gas units perform during the same period?

Mr. GORDON. Yes, sir. So we were not able to procure natural gas. The transmission pipelines were not available.

Mr. BUCSHON. OK, so—I mean, I am just going along the lines of innovation and technological advances that can help all aspects of our energy generating system, including natural gas, including wind. And, I guess in Texas, we saw a domino effect, where the wind started to fail early in the wintery conditions, which constrained the system. And then, as natural gas, coal, and nuclear facilities—plants began to have operational problems and freeze off, the blackouts started.

Mr. Powell, if Texas were 100 percent wind for power generation, what would have happened to the grid?

Mr. POWELL. Well, I don't think Texas or any jurisdiction should be 100 percent any generation. You know, I think in any—I just don't think it would be technically possible for Texas or any State to be 100 percent wind.

Mr. BUCSHON. I think that——

Mr. POWELL. If it was, this would have been a bad event, and I don't think——

Mr. BUCSHON. I mean, it is a hypothetical question, I think proving my point again, that——

Mr. POWELL. Sure.

Mr. BUCSHON [continuing]. We need to continue to pursue an all-of-the-above energy approach, which includes renewables and fossil fuels.

In addition, I guess, homes having no heat, it was reported that electric vehicles saw a dramatic loss of charge, and many charging stations were unavailable. Mr. Powell, how do you—how do we ensure the future of EVs and the reliability of the charging stations are not another way we could leave people without access to their vehicles?

Mr. POWELL. It is a great question, Congressman. I think the unfortunate reality of this and many of the other extreme weather events we have seen, and will likely see more of, is that all parts of our energy system and our energy-dependent systems like transportation are going to have to be hardened for more extreme weather on both sides, for more extreme heat events and extreme cold events.

Unfortunately, these extreme events are hard on all energy systems. They can be hard on batteries, and they can degrade the performance of these vehicles. So we are going to have to invest more in insulating these vehicles and improve technologies that can operate under a wider range of conditions if those are going to be a bigger part of the transportation system in the future.

Unfortunately, it will——

Mr. BUCSHON. I mean, you have probably seen—I think everyone has—major automobile companies announcing they are going to go completely electric in a short, fairly short period of time. And interestingly, you know, I think GM did a demonstration I posted on my social media, and they had an electric car plugged in, and they asked the GM executive where the electricity was coming from. And she replied, "Well, it is coming from the building." And then she said, "Well, it is the local power company providing power to the building." And that wasn't the question. The question was where does the electricity come from.

And it turns out, in this area where they were demonstrating the electrical vehicle, 90 percent of the electrical power was generated from coal. So I just think we need to be open-eyed about this, and all of us, you know, try to be as least ideological and more practical as we can and recognize that we need to continue to advance innovation and technology across the space. You know, wind turbines are going to learn from this. They are not going to freeze up any more, if we get some technological advances. The same thing is true with other forms of power.

So I would encourage all of us to continue to support innovation and technology advances to decrease our carbon emissions, as we have more than any other country in the world, and work towards a lower carbon future.

With that, Mr. Chairman, I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Ms. Schrier.

Ms. Schrier, you are recognized for 5 minutes.

Ms. SCHRIER. Thank you, Mr. Chairman, and thank you to our witnesses.

Dr. Pacala, your report covers a wide range of technologies that need to all be deployed in rapid fashion in order to reach our goals and have diversity and avoid putting all of our eggs in one basket. And I want to ask specifically about hydrogen cells for energy and their potential applications.

Washington State's energy portfolio is 80 percent clean, mostly because of two-thirds of our energy, our electricity, comes from hydropower. And hydropower provides a fantastic, reliable baseload. And sometimes there is oversupply, especially when you add wind and solar. And spilling more water, which, you know, you would like to do, environmentally, actually could further harm salmon

populations. And so there is a lot of interest in capturing and storing that excess, including as hydrogen energy.

And I recently had a really interesting meeting with the Douglas County PUD general manager, Gary Ivory, about the renewable hydrogen demonstration project happening in my district. And last September the Bonneville Environmental Foundation partnered with the county to develop the first hydrogen fueling station for fuel-cell electric vehicles in Washington State. Increasing development of these technologies and storing excess electricity in this way could go a long way toward building a clean energy economy.

The White House has also pointed to green or renewable hydrogen as an area they are interested in. And I know the Department of Energy has been working on this innovation for years.

Your report calls on a rapid scaling of hydrogen technology, stating that we need—that this could create positive synergies. Now, in parts of my district I can't drive 2 minutes without seeing a Tesla, but I have yet to see a hydrogen-cell-powered vehicle. And so I just want to know, where are we with hydrogen innovation? Has it reached a point where it can play a serious role in helping the U.S. meet an interim goal of net zero by 2050? And can you talk about some of these positive synergies?

Dr. PACALA. So, like Rich Powell, I believe that hydrogen is a big piece of the long-term future. But the fact is that hydrogen, as an energy storage device, is still expensive. All right? And it is still expensive relative to other alternatives that we could deploy during the 2020s.

So, during the 2020s, if we expand our net-zero power offerings primarily with wind and solar, while planning for other sources, right, while trying to reduce the very high cost now of nuclear, and while also preparing for $CO_2$ transport technology so that we continue to use decarbonized fossils—if we, as a species, decide to do so, as a Nation decide to do so—then these are ways in which we can reach an 80 percent decarbonized power grid.

And then hydrogen comes in probably later. And it depends on the combined ingenuity of people in the country. Now, I am a real believer in the combined ingenuity. It is one of many technologies that we need to double down, on R&D investments. Yes.

Ms. SCHRIER. Yes, I really appreciate that, because, first, it gives me a perspective on time. But second, starting these kind of pilot projects now is what will pave the way to the 2030s, and potentially having this.

And we have heard a lot about resources, whether they are metals, solar panels that are cheaper now from China, and not wanting to be dependent, that this is just one of the—sort of the layers of redundancy that will help give us that kind of security.

I wanted to ask—and I am not sure which of you is the best to ask—just about other ways of storing excess energy. Because we will get that from wind and solar too. And I wonder if you could just comment—I have got about 40 seconds left—about other ways of storing excess energy.

Dr. PACALA. So I can. Pumped hydro is the way we do it now, but we have exhausted a lot of their—a lot of the sites for that.

Long-term batteries that make fuels like hydrogen and store it is another way to do it. And there are a number of technologies

that look for that. There are some exotic, long-term storage solutions.

Right now, the center of the action on close to deployment or deployable is grid-scale storage in the—sort of the 6-hour range, which is one of the sweet spots. And that is a real commercial opportunity for U.S. firms.

Ms. SCHRIER. Can you tell me more about that, the—oh, we are out of time.

I yield back. Thank you very much.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes Mr. Walberg for 5 minutes.

Mr. WALBERG. Thank you, Mr. Chairman. We all agree on the need for a clean energy future. What we differ on, as this hearing title indicates, is the best path to get there.

As many of my colleagues have already indicated, this administration has dropped an economic bomb onto the Nation's energy sector, threatening hundreds of thousands of jobs and billions in State tax revenues that go toward supporting public schools, fire departments, police stations, and countless other community services.

The Laborers International Union of North America said themselves that canceling the Keystone XL pipeline will result in the loss of 1,000 jobs immediately, and an additional 10,000 jobs over time.

Mr. Powell, in your testimony you state that, according to the International Energy Agency, only 2 of 14 critical power-sector technologies are on track to reduce emissions in the timeframe laid out by President Biden's Executive orders. Further, you state—and I quote—"Requiring further emissions reductions before those technologies are ready poses significant risks to the reliability and affordability of our energy system, and to the millions of workers whose jobs rely on that energy supply."

We have already heard demands that President Biden go further to ban all fossil fuels, shut down additional pipelines, and enact policies inspired by the job-killing Green New Deal. And so, Mr. Camp, thank you for talking about the vital role natural gas plays in Western Pennsylvania. We know natural gas has already played a critical role in reducing emissions in the power sector.

What about heavy industry? Can we continue to meet the demands of steel and cement facilities without natural gas?

Mr. CAMP. Natural gas plays an important role in the heavy industries. You know, I don't specialize in "Can we meet the demands?," but personally, what I see whenever I talk to the individuals who are running these facilities, that they need the natural gas to meet these demands. You know, that is based off their opinion.

You know, I don't think we can cut the fossil fuels completely out. I think we can't abandon them. I think we have to clean them up. But I think this committee alone will work together to do that. It is important that we continue to use those fossil fuels to have that feedstock into these facilities.

You know, as we talk in great lengths about nuclear, you know, Beaver County is home to First Energy—is now Energy Harbor. We do have a nuclear power plant in Beaver County. We had a

coal-fired power plant in Beaver County that closed down in 2019. So, you know, not—as I speak, not just on the natural gas industry, when I say "all energy sectors," that is what I am talking about here, in Beaver County, in Southwestern Pennsylvania.

Mr. WALBERG. All-of-the-above plan. Thank you.

Mr. Powell, according to the U.S. Energy Information Administration, no power sector technology has been responsible for more emission reductions than natural gas over the past decade. We have also moved to become a top exporter of liquefied natural gas, allowing more counties and countries to utilize cleaner fuels. In your testimony you highlight the opportunity of exporting clean U.S. technologies and commodities. How does restricting fossil fuel development align with that line of thinking?

Mr. POWELL. Well, thanks for the question, Congressman. Thanks for your leadership on cleaner fossil technologies and innovation in this space.

I do think there is a real tension there. Exporting liquefied natural gas, for example, is one of the top ways that we can help other economies around the world decarbonize their sectors. Often that liquefied natural gas is going in and it is displacing, oftentimes, critical coal plants, some of the highest emitting plants in the world, or coal for district heating. So liquefied natural gas exports can play a huge role in that global decarbonizing picture. And I don't think that is necessarily being taken into account when folks are talking about restricting particular pieces of U.S. fossil extraction.

Mr. WALBERG. And in my home State—in fact, my own district—America's largest electric utilities, like DTE in my district, have committed to reaching net-zero emissions by 2050.

You also mentioned that zero-emission fuels like hydrogen should play a role in response to climate change. Has your organization looked at how existing infrastructure, such as our natural gas pipeline network, can be utilized to deliver alternative fuels?

Mr. POWELL. Absolutely. I think we should all remember that we have this asset. We have, literally, trillions of dollars of natural gas infrastructure in the ground around this country. We should be trying to find ways to work with that as part of a low-carbon future. And there are so many ways.

We could use that natural gas. We could create hydrogen with it and capture the carbon emissions and put them underground. We could partially run hydrogen alongside natural gas and other low-carbon fuels through the pipelines along the way. We could do a lot with that existing infrastructure. Again, we ought to be focusing on reducing the emissions, not on eliminating the use of the fossil fuels and certainly not on eliminating the use of the fossil fuel infrastructure, which we have invested so dearly in, and which could be a real asset in decarbonizing.

Mr. WALBERG. Thank you, Mr. Chairman. I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Ms. DeGette for 5 minutes.

Ms. DEGETTE. Thank you so much, Mr. Chairman. I am so delighted to join your subcommittee in this Congress. I think that energy policy and, in particular, climate issues are going to be the preeminent issue in this Congress.

And I also—I want to share your concern, the concern of so many on this committee, about what has happened in Texas, which is really a national tragedy. And I will volunteer to put the resources of the Oversight Subcommittee to work in helping us make sure that we get to the bottom of what happened in Texas and working with you to make sure we can have policies that address this.

I just want to ask some questions of the panel about greenhouse gas emissions. And the first thing I want to say—my staff actually wrote a question on this, but I don't think we need a question on it. I think everybody on this panel would agree Americans deserve affordable, reliable electricity. And that is becoming more and more of a challenge, something we need to deal with.

I want to ask the panel this question: Does climate science tell us we need to reduce our greenhouse gas emissions to net zero by no later than 2050, and sooner if possible, to minimize the risk of catastrophic climate events like we are seeing right now?

Let's just go down the panel, if we can.

Ms. Glover?

[Pause.]

Ms. DEGETTE. You have gone on mute. There you go.

Ms. GLOVER. I said, "Congresswoman, I really don't know if scientists are telling you that it has to be net zero by 2050. I"——

Ms. DEGETTE. OK, you don't know.

Ms. GLOVER. I don't have that knowledge.

Ms. DEGETTE. OK. Dr. Pacala?

Dr. PACALA. Yes. So the science is extremely clear that, if you want to limit global climate change to substantially less than 2 degrees, the globe has to get to net zero by 2050.

Ms. DEGETTE. OK, all right.

Dr. PACALA. There is no doubt about that.

Ms. DEGETTE. Thank you.

Mr. Gordon?

Mr. GORDON. Yes, Congresswoman. Again, I am not qualified to answer that question.

Ms. DEGETTE. So you don't know, either.

Mr. Powell?

Mr. POWELL. So I echo Dr. Pacala's point that, globally, we need to make an extremely deep reduction in $CO_2$ emissions if we are to have that impact on the climate.

Ms. DEGETTE. Great. And Mr. Camp?

Mr. CAMP. As Mr. Gordon said, I am not qualified to make that——

Ms. DEGETTE. OK.

Mr. CAMP. But with the—with Dr. Pacala, this hearing we mentioned many times, this is a global issue.

Ms. DEGETTE. Absolutely.

Mr. CAMP. And if we continue to take our fossil fuels——

Ms. DEGETTE. I appreciate that, sir. You are right. The 2018 report of the Intergovernmental Panel on Climate Change says that we need to reduce our global greenhouse gas emissions to zero no later than 2050, and sooner if possible.

Dr. Pacala, I want to ask you if we have the technology today to achieve an ambitious reduction in carbon emissions by 2030

while still providing affordable, reliable electricity for every American?

Dr. PACALA. Yes, we absolutely have the technology to do that.

Ms. DEGETTE. OK. And that is interesting, because what I heard, like, from my utilities is that we have most of the technology. It is that last 10 to 20 percent we just need to incentivize. Would that be accurate, or do you think we could just get there today?

Dr. PACALA. Yes, it is absolutely accurate. So the—most net-zero plans by 2050 call for a 75 percent or 80 percent decarbonized—de-emissioned grid, electricity grid, by 2030. OK?

Ms. DEGETTE. Right.

Dr. PACALA. And so——

Ms. DEGETTE. Right.

Dr. PACALA [continuing]. It is true that the last 20 percent is way harder.

Ms. DEGETTE. Right. But that is why we need to incentivize research and development, from——

Dr. PACALA. Right.

Ms. DEGETTE [continuing]. What I have heard, to get there, because we can't get there without new technology, is that right?

Dr. PACALA. That is right. And also, right now, we get to use, for instance, our abundant natural gas capacity as backup generators to provide the firm source of electricity for when the wind doesn't blow, when the sun doesn't shine. And that gets you down to about 80 percent decarbonized. But then you have got to do something with those sources as well, either decarbonize them, carbon capture and storage, or build more nukes, or build some other—you know, build long-term storage or something, some other form source.

Ms. DEGETTE. Right. So, just for my colleagues, I have got a bill, the Clean Energy Innovation and Deployment Act, which is designed to address this issue by setting up a 3-speed mechanism where the speed to which we try to get to zero is impacted on how fast we can break through with new technology. So I will be talking more about that.

Thanks to our whole panel. I appreciate it.

Thanks again, Mr. Chairman. I yield back.

Mr. RUSH. The gentlelady yields back. Let me just say to the gentlelady that I want to personally welcome you to the subcommittee, and I look forward to working with you over this next—so, again, my personal welcome to you to this subcommittee.

Ms. DEGETTE. Thank you.

Mr. RUSH. The Chair now recognizes Mr. Duncan for 5 minutes.

Mr. DUNCAN. Thank you, Mr. Chairman. Thanks for this hearing. I want to enter into the record an editorial from The Wall Street Journal today. It has a lot of facts in it. It is entitled, "Texas Spins into the Wind," and I would like to enter that into the record.

Mr. RUSH. Hearing no objections, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. DUNCAN. Thank you. I also want to point out—and Ms. DeGette may want to look at this article—but there is a great graphic on there, very difficult to see on there. But let me just tell you that change in power output in the State of Texas from January the 18th until February the 17th, when generation reduced by

almost 20,000 megawatts, that was a 93 percent reduction in wind power output.

At the same time you saw coal increase by 47 percent, and natural gas increase. This is power generation output increased by 450 percent. I don't know that it was necessarily the transmission to the power plants, other than a diversion of some of the natural gas in Texas to meet the needs of powering and heating homes and hospitals and other communities.

You know, Mr. Chairman, in my district we get a lot of our power from nuclear power. Nuclear energy produces a lot of the electricity in the Carolinas. In fact, Duke Energy in the Carolinas has a fleet of 11 nuclear power plants that make up more than 50 percent of the power utility in North Carolina and South Carolina. That fleet of nuclear power plants are responsible for cleaner air where I live. In 2019 alone, this same nuclear fleet generated almost 74 billion kilowatt hours of electricity and avoided the release of more than 52 million tons of carbon dioxide.

I point that out because nuclear energy is the future if we want to lower our carbon emissions in this country. And I am all about next-gen nuclear power, I am all about SMRs and thorium reactors and anything that we can do, Mr. Chairman.

But I wanted to ask Mr. Powell, as you stated in testimony, in order to reduce $CO_2$ emissions as fast as possible we need to modernize the permitting process. Last Congress I introduced a bill to modernize the review of our nuclear power reactor projects, and I plan to reintroduce this bill again in this Congress. I hope some of my colleagues on the other side of the aisle will join me on that. But could you—what do you see as the biggest barrier to rapidly deploying new, clean-energy projects and—whether it is nuclear and other clean technologies, Mr. Powell?

Mr. POWELL. Well, first, thank you, Congressman, for your leadership on nuclear innovation and supporting the existing nuclear fleet, both extremely important. ClearPath was founded in the Carolinas, and we greatly appreciate the remarkable clean energy abundance that that nuclear fleet that Duke maintains provides, along with the clean air and the tax base and all the other great benefits of nuclear.

You know, going forward with nuclear and continuing that, there is a couple of big challenges ahead. The first is modernizing the existing nuclear fleet so that those plants could all go through the second life extensions, and could go from being 60-year plants to 80-year plants.

In the wholesale power markets, the ones that aren't regulated, a lot of those nuclear plants are facing extreme economic stress due to subsidized renewables and extremely low-cost natural gas. There is a number of pieces of legislation that have been introduced in the past Congress that I think could be looked at again this year that would take a stab at preserving those existing nuclear units, using EPA and other authorities to keep those generating, keep those online. I think that is a really important priority.

Then, as we think about the future and the next generation of reactors, obviously there is a big piece about regulatory reform. You have really taken this on at the Nuclear Regulatory Commission. Finding ways to streamline and shorten the timelining to per-

mit new nuclear design is absolutely vital right now. The fastest the NRC could do is about 40 months. And with a lot of licensing activity in front of that to get a new nuclear design license, you can't even start building or financing it before you get that design license. That is a long time——

Mr. DUNCAN. Right.

Mr. POWELL [continuing]. Kind of innovator, right, so finding ways to shorten that down.

And then, once we get the plants actually—the designs licensed, finding ways to then get the siting and the permitting of the specific sites done in a more expeditious manner, while not sacrificing in any way safety in that siting I think is the next big challenge.

Mr. DUNCAN. Absolutely. And I just want to point this out, that in my district alone, replacing the Oconee Nuclear Station, which is a land use of about 2 square miles with solar, would require 107 square miles of land. That is nearly 4 times the size of the City of Greenville, South Carolina. To replace a nuclear power with wind would require over 854 square miles of land. That is more land than the entirety of Anderson County, which is in my congressional district. So we have got to address all these, I believe, in nuclear.

Mr. Chairman, it is a great hearing, I have enjoyed it. And I look forward to continue to listen on the way out. Thanks.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentleman from North Carolina, Mr. Butterfield.

Mr. BUTTERFIELD. Thank you very much, Mr. Chairman, for convening this very important hearing today. And certainly thank you to the witnesses for your testimony. Let me start with Mr. Gordon.

Mr. Gordon, you referenced, I believe, a solar project in my district, a 75 megawatt solar project called Edgecombe Solar. It is in Edgecombe County, North Carolina, which is just a few miles from where I am right now. Let me just commend your company's decision to base this project in my district. This project, along with others across the State, will ensure that North Carolina remains a leader in solar energy deployment. So thank you so very much.

Now, my question is, how can we continue to support the development of the solar industry? And perhaps you could provide some insights into your company's decision to build a solar farm in a rural community so we can learn more about what constitutes an attractive environment for solar and for renewables.

Mr. GORDON. Thank you, Congressman, for the opportunity to answer your question.

I think, first and foremost, you have got to have the right conditions for a solar plant. So, you know, ample sun. But you also need interconnection capacity. You need to be able to connect to the grid at a cost that is affordable, because, you know, high cost to connect can kill a project quickly. And I think, you know, underpinning those 2 things, you need the customers who are willing to buy it. And what we are seeing right now is just a huge interest from Fortune 100 companies to invest in renewable energy.

And so what we are doing is we are trying to work with some of these companies to find locations where they have interest in—you know, in having renewables nearby to act as an energy hedge for them, or to provide renewable attributes to them.

So I think the answer to your question is, you know, complex. There is a lot of things going on. And ultimately, we are also looking for landowners who want a project. You know, we provide significant financial benefits to the landowners who participate. And so it—the whole community is raised.

Mr. BUTTERFIELD. I am glad you are mentioning the land ownership aspect of it, because that is so critically important. I know it is here in my district.

The construction of high voltage, long-distance transmission facilities is highly necessary to meet the needs of the clean-energy transition. Existing utilities, such as electric co-ops and municipally owned utilities, will rely on these transmission facilities for distribution of renewable energy. Mr. Gordon, as high-voltage transmission infrastructure is constructed to integrate growing renewable energy production, how can we make sure the services of existing electric utilities can continue to serve their customers uninterrupted?

Mr. GORDON. So the type of projects that we are proposing basically interconnect with the high-voltage grid at the various locations. They do not disrupt the local service whatsoever. And what they do is, ultimately, provide new resources, new low-cost, renewable resources, to be shipped and delivered to areas of the country that may not have an abundance of geography to site new wind or new solar, such as South Carolina.

Mr. BUTTERFIELD. Yes. Let me take my last minute with Ms. Glover, if I may.

Ms. Glover, while climate change affects everyone, our most vulnerable communities disproportionately bear the brunt of impacts of climate change. This is why environmental justice is a critical part of the CLEAN Future Act. Low-income communities like my community and communities of color are more likely to lack resiliency against the risk of climate change and less likely to have access to sustainable and affordable energy. We have got to fix this thing.

Ms. Glover, from your perspective, what can we do to make sure that low-income communities, communities of color are better prepared for climate change?

Ms. GLOVER. Thank you so much for the question, Mr.—Congressman Butterfield, and for your leadership. You know, I am going to keep repeating my song, which is that I believe energy efficiency is really one of the starting points for this. And it should be the center point of these conversations.

At the end of the day, we want to be able to get to customers, particularly those in low-income, disadvantaged communities, frontline communities, and help them to use less now, and invest in those communities so that they are using less, so that there is more money for them, but also to be able to develop their infrastructure so that it is more resilient. Those 2 things combined, I think, need to happen in the worst of our communities, the communities that are suffering the most.

And I believe that energy efficiency really is an opportunity that is sitting right there and something that we can pull the trigger on fairly quickly and can have some significant impact very quickly, as well.

Mr. BUTTERFIELD. Thank you, Mr. Chairman. I am right on the mark. I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mrs. Lesko for 5 minutes.

Mrs. LESKO. Thank you, Mr. Chairman, and good afternoon to the witnesses and all of the Members.

I agree with Mr. Pallone that we need to try to work together to come up with an energy plan for the future of America. I think it needs to be a commonsense, affordable, reliable, high-quality energy plan.

I have to tell you that I don't think it should copy the California policies, because my utility companies here in Arizona say that at certain times of the year California actually pays Arizona utilities to take their energy off of their hands. And I don't think that is probably a very good plan for the Californians.

I do, Mr. Chairman, want to ask unanimous consent that an article mentioned by Morgan Griffith earlier be entered into the record. It is a New York Times December 6, 2019, article entitled, "Can a Coal Town Reinvest Itself?"

Mr. RUSH. I thought I had, by unanimous consent, already entered that into the record.

Mrs. LESKO. Oh, fantastic. Mr. Griffith had texted me and didn't know if it was done or not. So thank you.

Mr. RUSH. Will the gentlelady—for a moment? Let me just take another stab at it.

Hearing no objections, so ordered, the lady's request for entering into the record of the New York Times article.

[The information appears at the conclusion of the hearing.]

Mrs. LESKO. Thank you, Mr. Chair. I have a question for Mr. Powell.

Mr. Powell, the Center for Negative Carbon Emissions at Arizona State University is currently working on carbon removal technologies, particularly direct air capture, under the direction of Klaus Lackner.

Do you know if—what we can do to increase the efforts and research on that technology and use of that technology? Do you think it is being financed enough?

Mr. POWELL. Thank you so much for that question, Congresswoman, and thank you for your attention to this really important, relatively new technology.

Everyone should remember that, when we say net zero, that means that folks might still be emitting as long as they have a corresponding offset, or something netting out those emissions, and pulling it back out of the atmosphere. And that is what these technologies like direct air capture or broader carbon dioxide removal technologies could do. They could give us a lot of flexibility, and they could also, in the far future, if we decide there is just too much $CO_2$ in the atmosphere, maybe we might decide to pull more out, just as a public service kind of a thing.

And so it is very, very important. A lot of university-scale research is done at this stage. I was very excited to see in the Energy Act of 2020 a major new program to demonstrate these technologies at scale was authorized in that bill. This would be the real start of a big Federal program to actually demonstrate it. There is

a prize concept which would be conducted at the Environmental Protection Agency for breakthrough technologies in this space. And then there would be a more traditional demonstration program at the Department of Energy.

Of course, the authorizing legislation is only the first step. And now your colleagues on the Appropriations Committee actually have to fund that research at DOE and that prize at EPA. And I think significantly more can be done in this space.

A number of utilities who have made net-zero commitments seem to be relying on the existence of a serious amount of this technology 30 or 40 years from now. I know Duke Energy, for example, in some of their modeling has indicated they might like to buy as much as 8 million tons a year. That is a really significant market signal to innovators in this space. But that is a market signal far in the future. So we need to invest in the R&D along the way to make sure that that is actually going to be available when they want to start buying that in the future.

Mrs. LESKO. Well, thank you, Mr. Powell. That sounds like something maybe the Democrats and Republicans can agree upon as part of the energy mix. And so I hope we can.

Mr. Powell, I have another question for you. My understanding is that the Federal Government is required to purchase 7.5 percent of its energy from renewable sources. But right now hydroelectric power isn't included as a renewable energy source. And I know Representative Schrier talked about all the hydroelectric power in her State. Why shouldn't hydroelectric power be included as a renewable energy source? It seems counterintuitive to me. And do you think it should be?

Mr. POWELL. That is a great question. It absolutely should be. And, to take a bigger step back, it is unclear to me why that requirement is only renewable resources. If what we care about is low-carbon energy, I don't see why that wouldn't be a low-carbon requirement for Federal purchasing, not a renewable requirement.

I was actually heartened to see, I believe, one of the Executive orders from the Biden administration actually proposed making that change, that it is going to be a carbon-free procurement as opposed to a renewable procurement. A long way to go, I don't think that has been implemented yet, but I think that is a step in the right direction.

And, absolutely, large and existing hydropower should be part of that mix. It is—right now it is the second-largest renewable resource in this country, and it is by far the most flexible renewable resource in this country. So it certainly should be included in procurements like that.

Mrs. LESKO. Thank you, Mr. Powell.

And Mr. Chairman, I yield back.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes the gentlelady from California, Ms. Matsui, for 5 minutes.

Ms. MATSUI. Thank you, Mr. Chairman. And I am really looking forward to being on this subcommittee. And I also want to thank the witnesses for being here today. This is such an important subject area and I think we can devote a lot of time to it, but I am trying to be as quick as possible.

A clean energy development fueled by California's renewable portfolio standard, or as we call it, RPS, has attracted more than $2 billion in clean energy investments. And the clean energy sector now employs over a half a million workers in the State. Now, Federal tax credits for solar and wind energy have also made these developments possible. And the recent extension of these programs really will continue to fuel investments into clean energy and decarbonization.

Given California's success with RPS, a national clean energy standard, or CES, should be a crucial solution for decarbonization. Dr. Pacala, I would like to ask you about the role a CES can play in driving decarbonization during this decade, the 2020s, and what is a realistic, ambitious clean-energy target for 2030?

[No response.]

Dr. Pacala?

Dr. PACALA. So I should start by representing what is in the report that we just released, and that is that we recommend a clean energy standard that—particularly for electric power—that gets us to 75 percent zero-carbon electricity by 2030, and also a standard for zero-emissions vehicles that gets us to 50 percent of sales for light-duty vehicles by 2030, and also a zero emissions standard, manufacturing standard, for home appliances, particularly home heating but also home cooling.

I want to also just double down on the point that you made, that the position that we are in, where we can do a transition at about the same cost as the energy system that we have had over the last 30 years—actually, a little less than the energy system we have had for the last 30 years—the reason we are in that position is a triumph of human ingenuity, backed by public policy.

So it is precisely the creation, for instance, of markets in wind and solar before they were ready and also, to some extent, the unconventional natural gas by using public policy instruments that created these markets before they were ready that allowed free-market competition to drive their costs down and made them available as alternatives today.

And the clean—the fuel standard in California has been used in exactly that same way. I will note that one of the big companies doing direct air capture is making use of that subsidy to bring that technology into the marketplace, even though it is still pretty commercial otherwise.

Ms. MATSUI. OK. Now I want to get into transportation. The Diesel Emissions Reductions Act bill that I have championed for many years was enacted last Congress. This legislation focused on providing millions of dollars in funding to retrofit polluting diesel engines in medium- and heavy-duty vehicles with cleaner technologies.

Similarly, my home State adopted the Advanced Clean Trucks bill, which requires truck makers to sell cleaner zero-emission trucks in the State. Both initiatives will have significant consequences on reducing greenhouse gas emissions and air pollution for frontline communities.

Dr. Pacala, once again, what are your recommendations for actions to reduce emissions from heavy-duty vehicles in this decade?

Dr. PACALA. So there are——

Ms. MATSUI. Go ahead.

Dr. PACALA. Yes, there are two technologies that can be used to decarbonize heavy vehicles, and they are still in competition, right?

There are some developers that think that you can do this with batteries, even for long haulers, and that we can get charging rates down to low enough levels that you could do long hauling, interstate transport with big trucks. Almost everyone agrees now that, for routes less than 250 miles, which includes a lot of the urban traffic you are talking about that leads to local air pollution, that probably can be done with batteries.

The alternative is hydrogen fuel cells right now. And hydrogen fuel cells represent, you know, still—there is a horse race. I think that, if I had to guess, I am going to guess batteries are going to win, but I wouldn't go to the market on that yet.

Ms. MATSUI. OK, well, I am running out of time, so thank you very much. I yield back. Thank you.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes the gentleman from Indiana, Mr. Pence, for 5 minutes.

[Pause.]

Mr. RUSH. Mr. Pence? Please unmute.

[Pause.]

Mr. RUSH. Mr. Pence, it seems as though you are muted. Mr. Pence, it seems as though you are muted.

[Pause.]

Mr. BURGESS. Mr. Chairman, perhaps we could go to Mr. Armstrong, and we will try to get Mr. Pence on.

Mr. RUSH. The Chair now recognizes Mr. Armstrong for 5 minutes.

Mr. ARMSTRONG. Thank you, Mr. Chairman.

And Mr. Powell, I actually appreciated some of what you talked about, probably because I was the prime sponsor of the FAST Act legislation last session and am going to introduce it again. And I know Ms. Castor is going after me, and I had the ability to serve on the Select Committee on the Climate Crisis with her. And one thing we heard from witnesses from all across the ideological spectrum is the interoperability, and the interoperability of our grid is reliant on infrastructure.

And, regardless of what source of infrastructure that is, the permitting process, primarily in Federal areas has become so duplicative, burdensome, and just simply takes so long that it is very difficult to raise capital for that. So, if you could, just talk about that as part of making sure, regardless of which energy is getting on the grid, that we actually have an ability to do this.

Because I am in North Dakota right now, and we obviously deal with these issues better than Texas. We know winter pretty well. But we have rolling blackouts as well right now, because of the strain on the grid, as a whole, from the Canadian border to the Gulf of Mexico.

Mr. POWELL. Absolutely. So thank you so much for the question, Congressman. Thank you for your leadership on this really important issue.

You know, we can only build clean energy as fast as we can permit it. And it doesn't really matter what your vision of a clean energy future is, whether it is something that is really, really highly

renewable and requires an enormous amount of new transmission, and that kind of linear infrastructure along with a lot of really large land area developments, like very large wind farms or large solar plants, or if it is a vision of the future that has a much more compact, clean energy vision, like a lot of carbon capture plants on existing fossil facilities.

But that probably requires more pipelines running around the country, taking that carbon dioxide away from those power plants. Or, if it is a vision with a lot of hydrogen, that is going to require a lot of new hydrogen pipelines. Like, regardless, we are going to need to build a significant amount of new linear infrastructure in this country, thousands and tens of thousands of miles of this.

I think the Princeton net-zero study that Dr. Pacala was very influential in setting up the meeting has demonstrated that, kind of regardless of which clean energy future, we are going to need an enormous amount of this going forward. And so it just cannot be the case that it takes a decade from the, you know, beginning of attempting to site a project to actually realizing steel in the ground between the NEPA reviews, the environmental impact statements, the traditional air and water permitting processes, and the local, State, and Federal permitting processes along the way.

I am not suggesting that we sacrifice the environmental reviews or the environmental integrity of any of that, but I think we do need to find ways that we can do more things in parallel as opposed to in sequence, and that we can get to yes-and-no answers much more quickly in these processes.

Mr. ARMSTRONG. Yes, and I think actually, I mean, people talk about pipelines, we talk about transmission lines. The hardest thing to permit over a Federal waterway is a highway. I mean, year in and year out, that is what takes longer than everything else.

So, I mean, I will have plenty of time to fight with my colleagues about what sources of energy that are—and we will probably go into it in the next minute and 45 seconds. But I think, realistically, we have to do a better job of protecting the environment, but getting permitting done. Otherwise, first of all, private capital is going to be chased away because the time constraints just take too long. And secondly, it is—I mean, time value of money and energy are really important.

But one of the other things I just wanted to talk about is when we talk about renewables versus other sources of energy, we don't talk about the economics of producing energy well enough. Because in North Dakota we do—about 29 percent of our grid is renewables. But over the last month, when it has been 20 below, it has dropped under 3 percent. And, for a very windy State, it has been unquestionably calm.

So coal and natural gas, between—part of it—and the other thing we don't talk enough about is primacy on the grid, which is where—one of the ways where low natural gas prices are an advantage against coal, but where they really have an advantage against coal is being able to start up and scale down, depending on the amount of energy. And you have seen some of this in Texas in the last 2 days.

So, to oversimplify this in any way, shape, or form—but a coal plant or a natural gas plant has to be economically viable when they are at—when—in North Dakota, they are 70 percent of the grid because we need them when they are 97 percent of the grid. And we don't spend enough time talking about that.

And I can just guarantee you, when we introduce a bill that somehow harms a wind subsidy in North Dakota, the reason every wind lobby is—from across the country flies into North Dakota is not because they care about the environment. It is because it has become incredibly lucrative. And we have done policies where we allow people to sell energy onto the grid for less than it costs us to produce. And then, when we get into these severe weather actions, we run into resiliency problems and we run into reliability problems.

And with that I will yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes the gentlelady from Florida, Ms. Castor, with the aspirational background.

We are all jealous of you, Kathy. You are recognized for 5 minutes.

Ms. CASTOR. Well, thank you, Chairman Rush. This is a very important and timely hearing, and I want to thank our witnesses today, as well.

I am really thinking about all of the folks all across the State of Texas and what they are going through. So we really have a responsibility to work together to ensure that this kind of thing doesn't happen again. The problem is these climate-fueled disasters are coming faster, and they are costing us more. So we have a lot of work to do together on this.

To the witnesses, I wanted to ask you about some of the recommendations that we included last year in the big Select Committee on the Climate Crisis, our Solving the Climate Crisis report. They relate to resiliency in our electricity system and infrastructure.

We recommended that we develop Federal resilience standards for electricity infrastructure, authorizing DOE to identify and evaluate climate-related risks to the electric grid, in partnership with States and local communities in the private sector, and build in the priorities of consumers.

We recommended that the Department of Energy, FERC, and NERC work with the Mitigation Framework Leadership Group to develop resiliency standards so that, when we are federally funding these infrastructure upgrades, they have to come along with appropriate standards.

We also recommended improving planning and cost allocation for transmission lines, something that you all have discussed a little bit already, and helping States harden their physical grid infrastructure and improve maintenance to make the grid more resilient.

Now, when we are talking about the modernization and expansion of the grid, the macrogrid in America, I would think that it would be wise, if we are making those kind of Federal investments, that they have to be paired with these kind of resiliency priorities.

I want to ask you all if you agree. And do you highlight one over the other?

First, Dr. Pacala.

Dr. PACALA. I can be quick. I do believe that we need resiliency requirements as we develop the grid. Even if we didn't develop the grid to be more decarbonized, we need resiliency measures, additional resiliency measures.

Ms. CASTOR. Mr. Powell?

Mr. POWELL. Absolutely, Congresswoman. But one thing I will note is I think storage could play a big role in this, if we thought of storage as a transmission asset alongside a distribution asset, and we have more ability to move energy and time, as opposed to just in space. I think that could be a really powerful part of this, as well, and could increase resilience.

Ms. CASTOR. Yes, and I think folks agree on that. And when we are looking at the economic recovery package, we want to do more on storage. I mean, my friends from the natural gas areas, remember, it was Federal investments that led to the expansion of natural gas. And now it is time to mitigate the damage that climate change is doing and help put the R&D into those cleaner sources of energy.

Mr. Gordon, what do you think about these important resiliency requirements, having the Congress authorize new requirements directing the Federal Department of Energy to do so, as we expand and modernize the grid across the country?

Mr. GORDON. Thank you, Congressman Castor. I think it is a great idea. We are—we would be fully supportive of that.

And just to clarify, I think you may have said that "if the Federal Government is investing in a lot of the transmission infrastructure." And I think—I am not sure if that was the intent, but the transmission system, by and large, is owned by private companies today. And it is a patchwork grid that wasn't really designed for the future that we have to plan for.

And so what we do really need to do is make sure that the transmission-owning utilities are working in concert with each other, both regionally and interregionally, to make sure that electrons can flow seamlessly long distances in order to make sure that everyone has a higher degree of resiliency in the grid.

Ms. CASTOR. Well, I think we envisioned significant Federal cooperation and investment and modernization and upgrading of the grid, and that has got to come in partnership with private utilities, public utilities, and the rest. And it would seem that we are on the cusp now, coming out of the COVID pandemic—hopefully, soon—and the economic turmoil that it has wrought, that this can be a source of hundreds of thousands of good-paying jobs in infrastructure and construction.

And Dr. Pacala, I think the Academies—in your report you focused a little bit on this. What is the potential here?

Mr. RUSH. The gentlelady's time is up.

Ms. CASTOR. We will take that for the record.

Mr. RUSH. All right.

Ms. CASTOR. Thank you very much——

Mr. RUSH. The gentlelady yields back. The Chair now recognizes Mr. Pence, who has returned on screen.

Mr. Pence, you are recognized for 5 minutes.

Mr. PENCE. Thank you, Mr. Chair. Can you hear me now? Thank you, Chair Rush and Republican Leader Burgess, for holding this hearing today. And thanks to the witnesses for your insight on decarbonization in the U.S. energy industry.

Like many of my colleagues on this committee, I support an all-of-the-above approach to our energy supply and power generation. Access to abundant, reliable energy sources is beneficial for the customer, the economy, and for our national security and safety, as we are, unfortunately, seeing so drastically in Texas in the last few days.

I agree with my friends across the aisle that renewables should play an important role in the future of our energy supply. Indiana's sixth district is doing its part to implement innovative clean energy technologies.

North Vernon, Indiana, was the first city government in the State to be entirely powered by solar energy. The street lights, buildings, traffic signals are all powered by locally sourced solar energy.

Cummins Engine Company—just mentioned the over-the-road diesel emissions—is located in my hometown in Columbus, Indiana. It is an international leader in heavy-duty electric engines. And, in 2020 alone, Cummins won 5 Department of Energy awards, the most of any company, to advance production of fuel cell technologies. So, Doctor, I hope that one wins out.

And, in the State of Indiana, wind energy production has doubled over the past decade, accounting for 6 percent of energy produced in Indiana. Hoosiers do not have a top-down Federal mandate to thank for this progress. This progress is attributed to improved economic costs and a free-market response to the growing demand for diverse energy production.

It is in our best interest to support both the efforts to expand renewable energy capacity and access to fossil fuels like natural gas and coal. They provide robust baseload energy we need for a regional electric grid.

As Mr. Camp mentions in his testimony, natural gas plays a critical role in local economic development, emissions reduction, and lower consumer utility bills. It is also a driver for good-paying manufacturing jobs that use natural gas for feedstock in the production process of plastics and chemicals in everyday consumer goods in the manufacturing, which is so important to the State of Indiana. We need a robust network of pipelines to extend those benefits to parts of the country that do not have locally sourced supplies of natural gas.

Before coming to Congress, I personally shipped through pipelines, rail, and trucking companies. I know firsthand that nothing is safer for the environment and human lives than the pipelines that move reliable sources of energy to every corner of our country. If we are serious about maintaining a reliable energy source and competitiveness, low prices for consumers, then a diverse energy supply is paramount.

Mr. Powell, running along the Ohio River in Madison, Indiana, the Clifty Creek Power Plant burns coal for electricity generation, producing enough energy to power a city of 1 million people. Since

the plant was constructed in the 1950s, the Clifty Creek Power Plant has invested more than $1 billion in environmental upgrades and efficiencies.

Congress passed several provisions in the omnibus bill relating to clean coal innovation, including the 45Q tax credit extension for carbon capture, as well as demonstration programs to explore alternative uses for coal. Mr. Powell, can you speak to the importance of these provisions, and how the Biden administration can approach the implementation in accordance with congressional intent?

Mr. POWELL. Absolutely. Thanks so much, Congressman, thank you for your attention to these issues, this important support for carbon capture technology.

For facilities like the one you are discussing, I think the important thing now is, first, demonstrating that we can bring down the cost of coal carbon capture technology. So that is the first thing that DOE needs to do. Right now 45Q isn't quite enough to probably justify putting carbon capture on those facilities. We need to bring the price down a little further.

And so the demonstration program set up at DOE will now authorize public-private partnerships to do more demonstrations on facilities like yours to capture those emissions in cost share with private-sector players and with private-sector utilities. So I think that is the first thing.

And then, once we have brought the cost down further to where it is more economic, 45Q hopefully will be able to take over. We may need to think about further extensions of 45Q in the future to continue helping support that technology and that deployment.

Mr. PENCE. Thank you, I yield back.

Mr. RUSH. The gentleman yields back.

Mr. Pacala, you asked that you be excused at 2:45. Do you still need to be excused from the hearing?

Dr. PACALA. Well, I do have a National Academies webinar with 3,000 people signed up that starts at 3:00, and they can soldier on without me if I am needed. But if not, then I am happy to make that gig.

Mr. RUSH. So if—we would love for you to continue as a witness, but you have to make the call. Do you need to be excused?

Dr. PACALA. Yes, that would be best.

Mr. RUSH. Well, we thank you, Mr. Pacala, for your time. You have really made this hearing worthwhile, very interesting, and we certainly appreciate all your contributions to this area.

Dr. PACALA. I want to thank you, Chairman Rush, and every member of the committee for your service in the Nation's interest. There is no more important issue today than the one that you are in charge of. So thank you.

Mr. RUSH. All right, very good. You are excused. And now the Chair recognizes the gentleman from Vermont for 5 minutes for questioning.

Mr. Welch, you are recognized for 5 minutes.

Mr. WELCH. Thank you. Thank you very much, Mr. Chairman.

First of all, I want to say one of the best experiences I had in Congress was going to a coal mine in West-by-God Virginia with David McKinley. And Vermont is not coal country, but I got to tell

you I really admired those hardworking coal miners who kept the lights on in our barns and schools for so long.

And I want to say to Mr. Camp I really admire the hardworking folks that you are here representing. So whatever it is we do, there has to be enormous respect paid to people who have been, really, the pioneers and the hard workers in keeping our lights on, keeping our economy going.

But having—there is also something that Mr.—I think Mr. Powell said: Disruption is happening. And many of our major utilities have adopted zero-emission goals. So whether it is market forces, whether it is business changes, whether it is the awareness of climate change and carbon emissions playing a big role in that, change is here.

And I think the challenge for us is to come up with pragmatic policies that are all-of-the-above approach to addressing the changes that we need. But as we do it, never forget the people who have contributed. And we have to acknowledge that there is some disruption, and we have got to mitigate that for communities that are affected.

One of the approaches that makes a lot of sense for me is energy efficiency. And Ms. Glover, I want to ask you—congratulations on your position, I really appreciate your leadership, and—of the Alliance. But we have some bipartisan bills in this legislature, in this committee: the Main Street Efficiency Act, and the HOPE for HOMES legislation. Could you comment on, A, efficiency and, B, why those 2 pieces of legislation would be helpful?

Ms. GLOVER. Excuse me, I didn't realize I was muted. I apologize. Thank you, Congressman, for your leadership and for that question.

You know, the Main Street Efficiency Act is particularly important to us, and we really do appreciate, you know, your leading on that, because it does allow small businesses to have a place in this conversation, and they have a role that they can play. And, as we talk about economic recovery for our country and the importance of small business, we believe that the Main Street Efficiency Act and giving grants not only to small businesses and particularly those in distressed communities and minority-owned businesses so that they can better improve the efficiency of their own spaces, whether that is building efficiency and/or maybe even manufacturing processes, but at the same time supporting small businesses to be able to do that work is a double win.

Additionally, we also believe that investments in homes and retrofits so that they are more efficient is also a double win. It is a win in that it allows people to save money, it allows us to save energy in our use on the grid and builds resilience, but it also can be a really big economic driver. The cost to enter the efficiency spaces of small business, it is a low barrier. It is not like other areas, other sectors of the industry. And so anything that we can do to not only encourage small businesses and residents to take advantage of these opportunities to participate, as well as take advantage of what it provides is a really good——

Mr. WELCH. That is great, thank you. Because that—it is local control, business control, homeowner control, community control, community jobs.

Let me ask Mr. Gordon. The administration has a goal of clean energy by 2035. Representative Clarke and I have introduced a renewable energy standard which would have as a goal 55 percent renewable by 2030. We have heard how absolutely important it is for our generation folks to have some reliability. How would a 10-year renewable energy standard combined with a clean energy standard allow for certainty of the electrical generator community? And how would that help us with a clean energy economy?

Mr. GORDON. Thank you, Congressman Welch, for that question.

I think, as you point out, business certainty is huge for major infrastructure investments. And so having a 10-year program, whether it is a clean energy standard or a renewable energy standard, gives us the certainty we need to know that customers are going to be buying for that period of time, at a minimum.

And normally what happens, as soon as they start buying a little, they start buying a little bit more, because the economics are so positive for them and for their customers. And so I think just giving a little nudge to the market through programs like this really gets the ball moving.

And I think, you know, what we have seen is massive interest, you know, over the last 5 years from, historically, the biggest coal utilities in the country: the American Electric Powers, for instance, they are going big on wind right now. So all it takes is a nudge. You get the policy direction set, you give the certainty to the investors and the developers because these projects take 5 to 7 years to develop, and you have got to get them onto the grid, which can take even more time and more money.

So we need that long horizon in order to make those type of investments.

Mr. WELCH. Thank you very much.

Thank you, Mr. Chairman. I yield back.

Mr. RUSH. The gentleman yields back. The Chair now recognizes Mr. Schrader for 5 minutes. I don't see any additional Republican Members—I am sorry.

Mr. Palmer, you are recognized for 5 minutes.

Mr. PALMER. Thank you, Mr. Chairman. I am sitting way out here to your right, so it may have made me hard to see. I yield to the gentleman from Texas, Mr. Burgess, for—may consume.

Mr. BURGESS. I thank the gentleman for yielding, and of course Mr. Palmer here to the right of all of us, so that is no great surprise.

So Mr. Powell, you are still here. Let me ask you a question. I tried to ask you one earlier, and it got taken by another witness. But that is OK. I got a good answer, so it gave me something to work on. But you talked about the 45Q tax credit. Are you familiar with Petra Nova Coal Plant in Houston, and the fact that it has been closed since September because it could not meet the operating costs, or the operating costs were—exceeded any ability for it to meet those because of the reduction in energy prices that occurred with the COVID pandemic?

So could you speak to that issue? Right now it just seems criminal that that plant is shuttered with the State so badly needing electricity. And granted, it is in the southern part of the State, but every little bit helps right now. But could you speak to that?

Mr. POWELL. Sure. Absolutely, Congressman. And it certainly does seem tragic at the moment that, you know, not just a coal-fired power plant but a coal-fired power plant operating with very low emissions is not running, you know, at this very moment of kind of energy scarcity in the State.

You know, to take a big step back on Petra Nova, I think we should all remember that was a demonstration project, and it worked as intended, so it clearly demonstrated host combustion carbon capture on a coal-fired power plant. [Audio malfunction.] It has worked very well at sequestering more than 2 million tons, it put it safely underground into an—used it for—recovery.

Overall, the economics of the project worked, even in the absence of [audio malfunction]. It wasn't able to capture those 45Q benefits. It was able to capture some of the revenues from the enhanced oil recovery project that it was associated with. But, unfortunately, when, you know, the COVID pandemic hit, oil prices crashed and all gas prices crashed, as well, in Texas, and the gas-fired production is so expensive it just no longer made sense to run that plant.

So you know, I think it worked very well as a technical demonstration. And now we need to go forward with the next generation of combustion capture to bring that price down a little bit further. And then, those would also be—45Q—it probably would be a lot closer to an economic operation if you were to, say, do a Petra Nova——

Mr. BURGESS. Right. Well, when we were working on one of the coronavirus response packages last summer that didn't actually get passed into law, I worked with Senator Cornyn here in Texas to get extension of the 45Q tax credit, and I also worked with Mr. Crenshaw to get that extended to natural gas-generating facilities.

But it seems to me that, having the stability of that—I mean, that credit is going to expire. So it makes it harder to plan a big capital-intensive project like that if the tax credit is going to evaporate. So it just seems to me—and again, maybe we will get a chance to revisit this with one of the coronavirus response things. We haven't so far had any ability for bipartisan input. But Mr. Cornyn and I—or Senator Cornyn and I—our contribution last summer was to extend this 45Q tax credit to provide perhaps a little bit more stability for major projects like this.

And I just think that is such an important part of this, and we can't lose sight of it. We have got the technology. We are doing what everyone asked us to do: produce electricity with coal with zero—near-zero emissions and, as you correctly point out, the enhanced oil field recovery on the other side of it. It really was a win-win-win proposition. And again, right now, tragically, it is shuttered and not contributing to the very necessary baseload of electricity in Texas.

So just in general, and the question that I had asked earlier that kind of got taken up by another witness, but just in general, your thoughts on decarbonization, renewables, resiliency of the grid—in short, could you summarize that?

Mr. POWELL. Absolutely. I think—let's take the Texas example. I think what we have seen very clearly is that we need a more resilient grid with a mix of resources.

I think there are a number of highly resilient, advanced technologies that could help in situations like this, and they could help companies' grids all over the country when they are going to be dealing with situations like this [audio malfunction] carbon capture, that is enhanced geothermal, and that is energy storage, so that we can take the great low-cost energy from wind and solar, and then we can move it around through time, right, because that is a more variable energy source. So I think technology can be a big answer in all of this.

But the real key is that we need a broad portfolio, a really resilient mix. We don't want to have all our eggs in any one or a few baskets in this. We need a lot of options, especially because, if we are going to have different parts —we are going to be [audio malfunction] extreme weather.

Mr. BURGESS. Great answer, I appreciate that.

Mr. Chairman, if I may, I would—I do need to point out that one of the hazards of an interconnected grid is that problems can spread more rapidly. And we need to bear that in mind, as well.

And I will yield back.

Mr. RUSH. The acting ranking member yields back. The Chair now recognizes Mr. Schrader for 5 minutes.

Mr. SCHRADER. Thank you very much, Mr. Chairman. I really appreciate this hearing. It is certainly timely, and I agree with folks that this is going to be, hopefully, one of the signature efforts of this particular Congress, as we get, hopefully, on the other side of this COVID epidemic.

And my heart goes out to the folks in Texas and that part of the Midwest and South that are really getting hit by this terrible freezing cold weather. But I will point out to everybody my district has also, unfortunately, been in the throes of a once-in-a-century ice storm in the mid-Willamette Valley here in Oregon, and it has put hundreds of thousands of folks out of power. I got my power back yesterday, 5 days without heat, water, you know, just the ability to do pretty much anything. My fireplace came in handy. But it showcases and headlines, I think, some of the problems that we face out here.

Ours in the Pacific Northwest wasn't the result of frozen pipelines, but it was downed power lines with the trees. It points out, I think, we need to do a serious vegetative management and pursue some of the new Federal policies this Congress and previous Congresses have put in place over the last several years to effectively harden our grid, if you will, just by minimizing some of the power problems that we are going to have due to overhead power lines.

I just would say also—I think it goes for every Member on this panel—I want to thank all the line crews. The efforts that these men and women have put in going 24/7, 18-hour shifts—certainly in my mid-Willamette Valley, and I am sure it is true down in Texas, too—that they have done everything they can, trying to get Oregonians and Texans back online. So I really want to call that out, and appreciate their work.

I guess I question—well, a comment. I just agree with Congressman Welch and the work that Ms. Glover's power alliance is doing. I think that is critical. Energy efficiency is probably the least ex-

pensive, most efficient—no pun intended—way to get reduction in carbon emissions and compliance with all our folks out there.

But I was going to ask Mr. Gordon if he could talk—with the transmission line problems that we are having, the pipeline problems—could you talk a little bit about what does it mean to harden the grid, how do you have redundancy, what role putting power lines underground plays, and how economical all that is?

Everyone wants to talk about building another plant or doing more renewable, but there is a certain amount of just getting the transmission redundancy, I assume, that needs to occur. Could you comment on that?

Mr. GORDON. Thank you, Congressman Schrader. Yes, it is absolutely the case. What we need to harden the grid will be more high-voltage transmission lines so that, if one line trips off or is taken out by a tree, that there is redundancy in the system, which obviously improves the resiliency of the grid and hardens the grid. So, I mean, absolutely, that is imperative.

As you might know, there is not a lot of public support for new transmission lines, so it is a tough one. You know, it is going to be the Achilles heel of making this transition happen, because what really needs to happen is more of these lines in order to harden the grid. Burying the lines is an option in some cases. The costs are higher, as well. So that has to be taken into consideration, of course.

So there is no one easy solution, from a cost standpoint. But I think the solution from a technical standpoint is fairly clear.

Mr. SCHRADER. I appreciate that. Maybe a role of Congress could be to incentivize some of the landowners to allow some of these transmission lines to go over or under their properties.

Mr. Powell, what is the proper balance? We talked a little bit about our role in the United States and other governments, about global—you know, globally balancing out, what is America's role, and how do we engage others to do their fair share?

Mr. POWELL. Thanks very much for the question, Congressman, and thanks for your leadership on the energy innovation topic, broadly.

It is a delicate balance. You know, when we think about some of these very aggressive goals, even some of the voluntary goals that have been made in the United States, the net-zero goals, we do have to acknowledge those things are going to come with a cost, in all likelihood. And, you know, there may be near-term opportunities for cost savings, but it probably will mean more cost in the future. And that is why innovation is so important, because it can help drive down the costs of compliance. So hopefully we don't lose too much to American competitiveness and jobs during that period.

And, of course, if we don't drive down the costs, then we are not going to have the things to export to the rest of the world that it will take so many other—you know, Nigeria, Indonesia, the rapidly developing world, they don't have the rich resources that the United States does. They are making their decisions about building up their economies almost entirely on the basis of the lowest-cost, nearest-term opportunities. So, unless we give them better opportunities to decarbonize their grids, as well, they are very unlikely to take them on.

So I think it is a delicate balance, and it really highlights the need for innovation to drive down costs and improve performance.

Mr. SCHRADER. Thank you very much. I hope American innovation and technology can contribute to that solution.

And I yield back, Mr. Chairman. Thank you.

Mr. RUSH. The gentleman yields back. I seem to have lost my visual, but can you hear me?

Can you hear me?

VOICE. Yes, Mr. Chairman, loud and clear.

Mr. RUSH. All right, Ms. Kuster, you are recognized for 5 minutes.

Ms. KUSTER. Thank you very much, Mr. Chairman, and I wanted to, at the outset, insert into the record, if I could, two articles: the first from the Texas Tribune, "Texas largely relies on natural gas for power. It wasn't ready for the extreme cold"; and the second, the New York Times article entitled "How to Prevent the Next Texas Power Breakdown." So I would seek permission to insert those into the record.

Mr. RUSH. Hearing no objections, so ordered.

[The information appears at the conclusion of the hearing.]

Ms. KUSTER. Thank you, Chairman Rush and Acting Ranking Member Burgess, for holding this important hearing today. I am excited to be returning to the Energy Subcommittee and continuing our work across the aisle to advance policies to tackle climate change and advance clean energy solutions.

I believe that the Federal Government must take bold action to invest in clean energy to achieve net-zero carbon emissions because it is good for our health, it is good for the planet, and it will create millions of good-paying green jobs.

As a recent National Academy of Sciences report found, the transition to net zero could provide quality jobs and economic benefits for American workers. One form of carbon-free energy that is ripe for expansion is hydropower. A 2016 DOE report outlined U.S. hydropower production could grow up to 150 gigawatts in 2050, producing enough carbon-free energy to power 36 million homes. We don't need to build new dams to achieve this goal. The Federal Energy Regulatory Energy Commission has already identified hundreds of dams, including 4 in my district, that could be safely retrofitted to generate hydropower.

Mr. Gordon, my first question is for you. Would retrofitting, rehabilitating, and removing dams create quality jobs and help to decarbonize the energy system?

Mr. GORDON. I am sorry, Congressman Kuster, can you repeat the question?

Ms. KUSTER. Sure. Would retrofitting, rehabilitating, and removing dams create quality jobs and help to decarbonize the energy system?

Mr. GORDON. So our company does not operate in the hydro sector, so I am not sure I am qualified to answer that question.

Ms. KUSTER. OK. Is there anyone else on the panel that wants to take a crack at that? If not, I will move on.

Mr. POWELL. I would be happy to, Congresswoman.

Ms. KUSTER. Sure.

Mr. POWELL. Thank you for your attention to this issue. We have got an enormous potential in retrofitting nonpower dams in this country, literally thousands of potential opportunities for that. And I think there was just an important announcement between the National Hydro Association and American Rivers, where basically the conservation community and the hydropower community are coming together with some joint proposals about places where perhaps older or nonused dams could be removed and other nonpower dams could be powered up, and so we could have a real win-win on conservation and producing more clean electricity. I think that there is an enormous opportunity there.

Ms. KUSTER. Terrific. Well, I am a big fan of that approach, and I am a—I know well Dan Reicher, formerly of the Department of Energy, who was involved in that negotiation. So thank you for bringing it up.

What I am interested in is, while I am a strong supporter of taking steps to reach net-zero emissions, I believe we should also pursue negative-emission technologies that remove carbon directly from the atmosphere. And my time is short, so I am going back to Mr. Gordon, but if someone else would like to respond, can you speak to the role that negative-emissions technologies have to play to help the planet achieve net-zero emissions?

Mr. GORDON. Congressman Kuster, again, I am sorry, I am not informed on that topic——

Ms. KUSTER. All right. Anyone else want to take a stab at that?

Mr. POWELL. I am happy to also add, Congresswoman Kuster, and I apologize for the siren behind me here. But negative-emission technologies, I think, could play an enormous role in this space. Most of the models of the future of decarbonized energy systems show that we will need to rely on, you know, perhaps around the world, billions of tons of this negative-emission technology. That could take a number of forms. That could take the form of mechanical devices, which capture things directly from the atmosphere. That could take the form of better forestry and soil management practices, where foresters and farmers could be compensated for pulling this out of the atmosphere. It could even take the form of ocean approaches, where we either grow more plants in the ocean or do things to the ocean so that they become more of a sink for carbon dioxide.

A ton of innovation is needed in this space. DOE is just getting started, and the broader Federal energy innovation apparatus is just getting started. The private sector is also leading the way. You have seen major commitments from Microsoft and Amazon and a number of other major technology producers that are really investing deeply in this space, as well. So I think it is a space with a lot of movement.

It is very early days, and it remains very expensive. Currently we need to focus on bringing the cost far, far down so it could be a real part of the mix.

Ms. KUSTER. Great. Thank you, Mr. Powell. My time is up, and I will yield back. Thank you for your expertise.

Mr. RUSH. I thank the gentlelady for yielding back. The Chair's screen is frozen, and my time—my clock is frozen, also. So—but the

audio is—I can hear you. The audio is working fine. So the Chair now recognizes Ms. Barragán for 5 minutes.

And Ms. Barragán, you are recognized for 5 minutes.

Ms. BARRAGÁN. Thank you, Chairman Rush, for this important hearing on solutions to reach a 100 percent clean-energy economy. We have seen the deadly cost associated with the fossil fuel industry through extreme weather events influenced by climate change. Whether it is record wildfires in California or a polar vortex in Texas, we cannot drill, mine, or frack our way out of the climate crisis.

Instead, we need a massive investment in clean energy, energy efficiency, and battery storage combined with modernizing our grid for this century's challenges. By prioritizing these investments in environmental justice communities, we can have a transformational impact on our economy and our climate.

Mr. Chair, I would like to submit for the record a February 16, 2021 article from The New York Times entitled, "Texas Blackouts Hit Minority Neighborhoods Especially Hard."

Mr. RUSH. So ordered.

[The information appears at the conclusion of the hearing.]

Ms. BARRAGÁN. Thank you, Mr. Chair.

Ms. Glover, I would like to start with you. It is critical for there to be racial equity in the new jobs created from our transition to clean energy. In California, Latinos make up 34.4 percent of California's workforce yet only 21.8 percent of the energy efficiency industry. Black workers are 9.8 percent of the workforce yet only make up 7.3 percent of the energy efficiency industry. How can the energy efficiency industry do more to prioritize minorities for training and support to enable them to obtain employment in energy efficiency business?

Ms. GLOVER. Thank you, Congresswoman, for that question, and I appreciate your leadership.

You know, through the summer the Alliance and the members of our coalition really started to talk very deeply about equity and the concerns of underrepresented communities, and how we could do better. And we adopted a set of principles that would guide us not only in our advocacy positions, but also we are working to support our companies and those that are part of our coalition.

They are all really focused on trying to figure out how do they better attract people of color to their business, how do they reach out to them better, do a better job of that, identify those types of opportunities that people would be interested in and encourage them to participate.

But additionally, we are looking at who our partners should be who are already in these communities, who can really provide us the kind of guidance and direction that we need. And I would suggest that, you know, the entire industry in some way is thinking about these problems and trying to figure it out. But we do need the help of leaders as yourself—such as yourself—as well as others in our communities to help us do the right thing the right way.

And what I mean by that is address the concerns of the community in a way that they see them, and also make sure that we are encouraging investment in those communities so that, as you stated, they are also getting, not just jobs—I think jobs and for people

to be employed is a great thing—but we have lots of entrepreneurial minds in our communities and people who have the ability to grow great businesses in terms of energy efficiency, and we want them to be a part of this industry and use that talent so that we can spread the work that we do throughout the country——

Ms. BARRAGÁN. Thank you.

Ms. GLOVER [continuing]. Quite frankly.

Ms. BARRAGÁN. Thank you so much, Ms. Glover.

Mr. Gordon, when I listen to my colleagues on the Republican side, they repeatedly talk about electricity prices being a consequence of the transition to a cleaner, healthier energy future. However, over the past 10 years the cost of wind power has dropped by 70 percent, solar power costs are down by 90 percent, and lithium ion batteries are—for energy storage and electric vehicles—are down by 85 percent.

Is the argument that clean energy is too expensive based in reality or outdated?

Mr. GORDON. Thank you for your question, Congresswoman. I think that is a very good question, and you are right to state the facts. The cost of new wind, new solar, new battery storage have declined significantly over the last 10 years. And so, when you are comparing, you know, the building of a new gas plant versus a new wind plant versus a new solar plant, wind and solar are competitive with both of those. And if you look at the stats, there is not a single coal plant being built in the United States in the contiguous 48 right now.

On the other hand, you have significant builds in wind and solar. It is because the costs have come down so much that the utilities who own both renewables, nuclear, coal, gas, they see the future is very—that is very clear to them, and it is going to be dominated by renewables. And so they are just making that move right now because of the costs.

Ms. BARRAGÁN. Well, thank you for that. One thing we don't talk enough about is the cost of the impact on health and negative health impacts. And with that, Mr. Chairman, I yield back.

Mr. RUSH. The gentlelady yields back. I just want to remind Members I am having a technology problem. My screen is frozen, my clock is frozen. My audio is working just fine, so I am going to ask Members—you know, I can't see the clock, so please be mindful of the fact that, when your time is up, bring your questions to a conclusion.

The Chair now recognizes for 5 minutes the gentleman from Virginia, Mr. McEachin, for 5 minutes.

[Pause.]

Mr. RUSH. Mr. McEachin?

[Pause.]

Mr. RUSH. The Chair now recognizes the gentlelady from Delaware, Ms. Blunt Rochester, for 5 minutes.

Ms. BLUNT ROCHESTER. Thank you so much, Mr. Chairman, for calling this important hearing. And I want to thank the witnesses, not only for your testimony but for your perseverance.

I hear every day from my constituents in Delaware about the impacts of climate change that are—that they are already facing, whether it is the rising sea levels that flood our beaches, the

changing seasons impacting our farmers in Delaware, or the extreme heat that endangers our most vulnerable citizens.

This week's extreme weather event in Texas and parts of the Midwest has highlighted the importance of investing in energy resilience. We need to work together to create a more climate-resilient energy system. We need to be better prepared for future emergencies to better protect our constituents, which is why I introduced the Open Back Better Act last year and why I plan to reintroduce it in the upcoming weeks.

As we start to rebuild our economy from the ongoing public health pandemic, we need to be intentional. The Open Back Better Act invests in retrofits to ensure that our Nation's critical infrastructure, such as hospitals, libraries, and community centers, are safer, cleaner, more energy efficient, and more resilient against future threats while creating good-paying jobs and prioritizing those communities hardest hit by the COVID–19 pandemic. These upgrades are critical to low-wealth communities and communities of color, which are so often disproportionately burdened by the impacts of public health emergencies and natural disasters.

My questions are for Ms. Glover.

First, Ms. Glover, I want to thank you and the coalition for all of your hard work, and also your leadership and support for the Open Back Better Act. As you referenced in your written testimony, the Open Back Better Act helps to retrofit mission-critical buildings throughout the country. Can you please expand on why these efforts are so important, especially to low-wealth communities and communities of color?

And how do we ensure that resiliency efforts include all communities?

Ms. GLOVER. Sure. Thank you so much, Congresswoman, for the question and for your leadership on this issue.

You know, I think, as we start to think about buildings in particular and the importance that they place, a lot of the conversation that we have had over the last 6 months around equity is really focused on underinvestment or noninvestment. And so it is really important for those communities that are the most disadvantaged that we start investing in them first.

And retrofitting buildings is a great way to do that, and an important way to do that, one, for those communities, particularly when we are talking about public buildings, being able to save money for localities on their energy costs—and they can redirect those funds to other things that they have to take care of, is one thing that this would do.

Secondly, as you mentioned, the opportunity for jobs is a big one, right? And we are talking about not just a job on one building, but we are talking about giving people skills that they can carry on to do that work in all kinds of ways. And we are not talking about just college education jobs, but also blue jobs, green jobs, however you would like to describe them. And we are talking about giving people skills that are going to allow them to sustain themselves and their family over the long haul.

And thirdly, I think, is an opportunity to give a demonstration to the community at large about why efficiency is important, what it can do for you. People get to see it in ways that they may not—

even if they can't see behind the walls, they see the effective impact of that work in their schools, in their mayor's offices, et cetera, and their hospitals.

And so I think, you know, for all of those reasons, this work is critically important, and we have an opportunity to do it now. And if we are going to transition, we need to take care of these communities first, and we need to do it now.

Ms. BLUNT ROCHESTER. Excellent. Can you also tell us how Congress can help alleviate any real or even perceived risks for businesses and industries as we accelerate transition to a clean energy economy?

Ms. GLOVER. I think the—what Congress can do is to think about what businesses are really needing now and address those needs. And that means hearing from people.

A lot of what we learned with how we were trying to help small business, particularly out of the pandemic, what we learned sometimes is that the rush to put money out there sometimes doesn't hit the people that you want. And so I appreciate all of your deliberative efforts to make sure that what you are putting out into the market in terms of funding is very specific and is going to hit the communities and intended—that you intend.

And I just think that, in terms of energy efficiency, as we said, 99 percent of the energy efficiency job—99 percent of the jobs—well, no, all the jobs happen in 99 percent of the counties across this country. That means we are all impacted by it, and we should do something with that.

Ms. BLUNT ROCHESTER. Thank you so much, and I yield back the balance of my time. Thank you.

Mr. RUSH. The gentlelady yields back. The Chair now recognizes Mr. O'Halleran for 5 minutes.

Mr. O'HALLERAN. Thank you, Mr. Chairman, and the panel, and also the Members on the committee for the outstanding discussion today. It was a broad view of what the discussion is going to be for the next year, number of years.

The energy industry has changed significantly in the last decade, as we all know. Electricity from coal has declined, our Nation has become energy independent, and renewable energy technologies have put our Nation on the path to continued carbon emission restrictions—reductions, I am sorry.

My district is facing the brunt of the transition away from coal. As major plants continue to close, workers are laid off, and local economies are hurt. It is essential that new Federal policies provide equality and opportunity for rural communities that are too often left behind. As the Biden administration pursues its robust climate agenda, I look forward to putting forward bipartisan climate proposals that support innovation and energy security.

I will soon be introducing comprehensive legislation, the New Promise Act, to put impacted coal communities in the driver's seat, with economic development support for their economies and workers, mitigate the tax revenue losses, major plant closures that cost those—cause local economies to have impact, empowers workers, and more, including job training.

Dr. Powell—or Mr. Powell, I am sorry—I appreciate your testimony highlighting the need for pragmatic policies to support im-

pacted communities and workers in the energy transition. Part of my legislation will authorize grant funding for communities to respond and repurpose coal-fired facilities for new energy production, manufacturing, and other proposal purposes. Could you comment on how this and other policy solutions could reduce the strain on assets and create real employment?

Mr. POWELL. Thank you so much, Congressman. Thank you for your support of USE IT Act and so much other legislation that has tried to bring forward carbon capture and these other important technologies. Thank you for the update in title, as well. I didn't get quite that far, but I will take it here.

You know, I think that policy that tries to take advantage again of the existing infrastructure, as we discussed with Congressman Armstrong, has a lot of real merit. I mean, it is an absolute shame that units like the Navajo Generating Station that have all of the interconnects, probably a lot of boilers and other potential things that could be put back to use, aren't being taken advantage of right now.

I would say the highest and best use for facilities like that are as demonstration sites for carbon capture technology. So, you know, continuing the existing use of those sites and continuing the existing use of the fossil fuel assets, we know we need to crack that technology if we are going to resolve global emissions. We know we need to demonstrate that somewhere. Why shouldn't we prioritize disadvantaged communities?

And if it is not carbon capture technology, I do think that there is a lot of other things that could be done with those units and assets. For example, advanced nuclear technologies might be one thing that you could put into repower an existing fossil generating plant like that. Low-carbon hydrogen also might be something that you could bring in, whether that is produced from fossil fuels or carbon capture or produced from renewable resources, it might be something that you could bring in to revitalize those facilities and reuse those assets.

So I think that prioritizing communities that are facing this transition and prioritizing using those existing assets is the way to do this that both has the least impact on communities and potentially is the most cost-effective way to do it, because you are using the existing assets.

Mr. O'HALLERAN. Thank you, Mr. Powell.

Mr. Gordon, a recent report stated that utility-scale energy storage installations will exceed 10 gigawatts by 2021. I was proud to see my legislation signed into law last year, which the committee voted for also, which will provide technical assistance, identify barriers and financial resources from DOE to utilities serving rural communities.

Could you discuss the importance of new energy storage technology being considered with transmission resource planning? Thank you.

Mr. GORDON. Thank you, Congressman. Yes. And, in fact, in your own district we have over 1,000 megawatts of combined solar and energy storage projects in development. So we are working with utilities in the state to address, you know, the—their resource adequacy needs after they replace or decide not to build new fossil gen-

eration. So we are already in your district working right now to build significant amounts of projects.

Mr. O'HALLERAN. Thank you very much. And I yield.

Thank you, Mr. Chairman.

Mr. RUSH. The gentleman yields back. And with that, this concludes the witness questions-and-answers phase of the subcommittee.

And I certainly want to thank each of witnesses for your participation in today's hearing. You have made this hearing a very, very meaningful and successful hearing. I want to also thank all the Members for your fine questions that you asked of the witnesses, and the witnesses for your answering these questions.

So, again, I want to thank our witnesses for your participation, and the witnesses are excused.

I want to remind Members that, pursuant to committee rules, that they have 10 business days to submit additional questions for the record to be answered by the witnesses who have appeared. I ask each witness to respond promptly to any such question that you may receive.

And now I have a unanimous consent request to enter into the record the following documents. And the staff has agreed that, due to the high volume of documents for the record, the minority and the majority staff have come to an agreement on the completeness of this list. And I will ask now that we enter these records and these documents into the record, rather, en bloc.

And without objection, so ordered.

[The information appears at the conclusion of the hearing.[1]]

Mr. RUSH. At this time, the subcommittee stands——

Mr. BURGESS. Mr. Chairman? Mr. Chairman? Wait, this is Burgess. Would you yield for another unanimous consent request?

Mr. RUSH. Oh, yes. I yield to Mr. Burgess.

Mr. BURGESS. I just wanted to ask unanimous consent that an article from E&E News discussing the Petra Nova plant that I talked about in Houston from September of 2020—I will have my staff get that to you, and I would ask unanimous consent to include that in the documents in the record, as well.

Mr. RUSH. Hearing no objection, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. RUSH. We will now—and without objection now, the subcommittee is adjourned.

[Whereupon, at 3:38 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

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[1] A Department of Energy report submitted for the record has been retained in committee files and is available at https://docs.house.gov/meetings/IF/IF03/20210218/111210/HHRG-117-IF03-20210218-SD014.pdf.

February 17, 2021

The Honorable Bobby Rush
Chairman
Energy Subcommittee
Committee on Energy and Commerce
U.S. House of Representatives
Washington, D.C. 20515

The Honorable Fred Upton
Ranking Member
Energy Subcommittee
Committee on Energy and Commerce
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman Rush and Ranking Member Upton:

Our trade associations represent America's retail fuel community. More than ninety percent of retail sales of motor fuel in the United States occur at our members' outlets. On behalf of this diverse and forward-thinking industry, we are eager to work with you and your respective teams to help improve the environmental characteristics of transportation energy in the United States. We would like to work with you to collaborate on policies that will spur improvement and change to the transportation sector.

The most expeditious and economical way to achieve environmental advancements in transportation energy technology is through market-oriented, consumer-focused policies that encourage our membership to offer more alternatives. Fuel retailers have demonstrated in recent years that they are prepared to invest in any transportation energy technology that their customers desire. With the right alignment of policy incentives, the private sector is best equipped to facilitate a faster, more widespread, and cost-effective transition to alternatives – including electricity – in the coming years.

As discussed further below, policies that adhere to the following principles will create new jobs, accelerate the deployment of advanced alternative fuel infrastructure and vehicles, benefit consumers through a competitive and robust marketplace and drive massive economic investment and improvements in air quality:

- Science should be the foundation for transportation climate policies.
- Establish performance goals without mandating specific technologies to allow for the benefits of innovation and technology development.
- Develop competitive market incentives to ensure a level playing field and provide long-term consumer benefits.
- Harness existing infrastructure to help commercialize new technology, maximize diverse investments, and achieve near-term and long-term emission reduction goals.
- Set consistent, uniform national policy so that (i) the market has certainty to help it invest, and (ii) state policies do not create inconsistent or counterproductive measures.

- Ensure fair treatment so that all households are not forced to subsidize alternative energy users.

**Science should be the foundation for transportation climate policies**

Any effort to improve transportation energy's emissions characteristics requires an accurate accounting of the lifecycle carbon intensity associated with particular fuels and technologies. This analysis should include everything from acquisition of natural resources, engine and battery manufacturing, tailpipe emissions, and vehicle end-of-life consequences. It should also be regularly updated so that policy is nimble enough to adjust to efforts to innovate and improve the environmental characteristics of different alternatives. Additionally, every sector of the economy should assume a burden of reducing carbon emissions that is proportionate to its share of nationwide emissions.

**Policy should set performance goals without mandating specific technologies to allow for the benefits of innovation and technology development**

While it may be tempting to prematurely pick winners and losers from an energy technology standpoint, sound policy must be grounded in science and recognize that the state of technology can change rapidly. Incentives to invest in alternative fuel technologies should be tied to those technologies' lifecycle environmental attributes rather than the underlying technology itself.

No one solution will decarbonize transportation energy. Policies should incentivize multiple technologies. What policymakers think is the best solution today may be surpassed by subsequent ingenuity and innovation. Sound policy should not stifle innovation by mandating specific fuel solutions. Instead, policy should set performance goals and let the market – guided by consumers – innovate to find the best way to meet those goals.

Retailers' experience is valuable in this respect because they bring a technology-agnostic perspective with an underlying attention and loyalty to consumer preferences and low prices.

**Develop competitive market incentives to ensure a level playing field and provide long-term consumer benefits**

Fuel retailers today are best positioned to provide alternative sources of transportation energy because they have a keen understanding of consumer preferences and tendencies. Refueling stations are strategically located throughout the country where refueling demand is greatest, competing with one another on price, speed, and quality of service. Those sites include disability accessible restrooms and parking lots, food and beverage options, vehicle service and repair centers, and even showers and other amenities for professional drivers. Consumers demand all of this, regardless of the type of fuel their vehicle consumes.

Existing alternative fuel incentives – such as the Renewable Fuel Standard and biofuel blending and alternative fuel infrastructure tax credits – have allowed retailers to offer less expensive, lower carbon fuels to their customers, while also supporting investments in renewable fuel production. Regardless of how one may feel about ethanol and biodiesel, the *incentives* Congress established have been successful given the amount of petroleum-based fuel that has been displaced by these renewable fuels since 2005.

These benefits can be replicated for new technologies if policymakers adopt the same market-oriented and consumer-focused perspective. Policy mechanisms worth considering include:

- Ensuring credit regimes and/or tax incentives make alternative fuel less expensive for the end user, thereby providing a stable economic case for upstream investment.

- Permitting all EV charging station owners to generate a profit by selling electricity to EV owners without being subject to regulation as a utility. This allowance is essential if fuel retailers are to have any incentive to invest in EV charging technology.

- Adopting uniform retail pricing measurements (*e.g.*, dollars per kilowatt-hour) and requirements for consumer-friendly price disclosures.

Conversely, policies that at first blush appear to be quick and easy solutions tend to have the unintended consequence of undermining retailers' incentives to invest capital in alternative fuels. This inevitably hinders the growth and expansion of alternative transportation energy. Examples of these counterproductive policies include:

- *Allowing EV charging infrastructure at Interstate rest areas* – Not only would this discourage off-highway fuel retailers from investing in charging infrastructure, but it will signal to prospective EV drivers that they will need to refuel at often desolate, poorly maintained state-run rest areas rather than the off-highway travel centers, convenience and fuel retailers with all of the amenities that drivers have come to expect.

- *Forcing ratepayers to underwrite electric utilities' investment in EV chargers or to subsidize the cost of electricity that charges electric vehicles* – Where this occurs, the utilities are operating in a guaranteed rate of return environment without putting a single dollar at risk. Retailers cannot compete with electric utilities in this environment. While there is good reason for ratepayers underwriting the cost of the grid and other upgrades, there is no public policy rationale why utilities should be given a leg up over private actors who wish to enter the market for chargers that consumers use to power their vehicles. Utilities' ongoing pursuit of this uncompetitive arrangement is the single greatest deterrent to fuel retailers investing in EV charging infrastructure.

- *Prohibiting fuel retailers from selling electricity to individual consumers* – Certain states prohibit the sale of electricity (*i.e.*, fuel) to individual consumers except by price-regulated utilities. This discourages additional deployment of such infrastructure. EV charging station owners must be permitted to generate a profit by selling electricity to EV drivers if they are to have any incentive to invest in the technology.

- *Permitting utilities that own EV charging stations to charge other EV station owners higher rates for power than the internal transfer price they charge their own operations* – A prohibition on such practices is the only way to provide a level playing field and ensure competitive pricing for individual consumers.

**Harness existing infrastructure to help commercialize new technology, maximize diverse investments, and achieve near-term and long-term emission reduction goals.**

It is exponentially less expensive to leverage existing infrastructure than create entirely new supply chains and infrastructure. To the extent environmental objectives can be achieved by harnessing existing infrastructure – including removing hurdles to bringing alternative fuels to market – customers will more seamlessly gravitate to new types of fuels and vehicles. American companies have spent more than sixty years building out a refueling infrastructure system that optimizes logistics and maximizes customer

benefits. Deployment of new technology that complements this infrastructure will (all else being equal) be less expensive and thus more likely to generate consumer loyalty.

In just the past decade, there has been extraordinary growth in consumption of biofuels such as ethanol and biodiesel, as well as other low carbon fuels such as renewable natural gas, compressed natural gas, renewable diesel, and biobutanol. These are all liquid fuels that are mostly compatible with existing infrastructure that was originally developed for hydrocarbons. With all of these fuels, industry has responded to policy signals by allocating capital toward bringing the fuels to market. Retailers then sell the fuels to consumers for less money than the fuels that were being displaced. This has created enormous environmental benefits in a relatively short period of time. We can build upon current policies to leverage existing infrastructure and achieve meaningful environmental benefits as we work toward reaching our longer-term aspirations.

**Set consistent, uniform national policy so that (i) the market has certainty to help it invest and (ii) state policies do not create inconsistent or counterproductive incentives**

Federal policy should be designed to lower the cost of alternatives fuels to make those sources of transportation energy more competitive with petroleum-based fuels. This is the only way to ensure that consumers will gravitate toward low carbon technologies. Although some state incentive programs adopt this approach, others have vacillated between different approaches in a way that does not allow private market participants to plan long-term investments in alternatives. Such inconsistent policies are ultimately self-defeating, and that approach should be avoided.

**Ensure fair treatment so that all households are not forced to subsidize alternative energy users.**

Fundamental tenets of fairness dictate that users of transportation energy, including alternative energy sources, pay for that energy and related infrastructure. Unfortunately, this is not occurring today in two ways:

First, when utilities rate-base their EV infrastructure investments, it raises the monthly utility bills for all of a particular rate class, even though the benefits are confined to a small group of users. It is patently unfair and inequitable for policymakers to force most households to subsidize the refueling costs for EV drivers. Vehicle owners should pay the costs of powering their own vehicles in order to create a market system that will keep energy prices down and avoid regressive charges.

Second, it is imperative that highway infrastructure funding comes from all highway users, and not just those that rely on a particular technology. Our country's infrastructure has been woefully underfunded for decades. Our associations strongly support the Biden Administration's desire to remediate that and bring our roads, bridges, and broader transportation system into the 21st Century. Any user fee to generate increased revenue, however, must capture all vehicles that use the roads.

* * * *

In the current policymaking landscape, it is tempting to paint a picture of how we want the world to look in ten, twenty, or thirty years without focusing on the steps needed to get from here to there in a way that establishes a sustainable market that will benefit consumers and the environment. Fuel retailers want to assist in this endeavor and urge you not to allow long-term aspirations to distract you from building on existing policies and infrastructure to achieve tangible, real-world progress.

All of our associations believe that national, consumer-focused, and market-oriented climate policy is achievable. We appreciate President Joe Biden's goal of pursuing pragmatic policies so that we can come

out of the COVID-19 pandemic ready to hit the ground running toward a sustainable future for our nation. On behalf of the approximately 125,000 retail fuel locations in the United States, we are eager to work with you to achieve what we fundamentally believe are mutually compatible objectives.

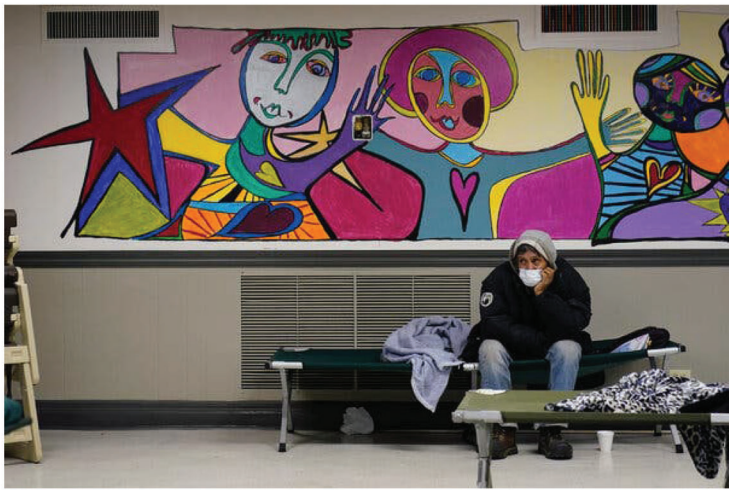
Sincerely,

National Association of Convenience Stores (NACS)
National Association of Truckstop Operators (NATSO)
Society of Independent Gasoline Marketers of America (SIGMA)

cc: Members of the Committee on Energy and Commerce Energy Subcommittee

# *Texas Blackouts Hit Minority Neighborhoods Especially Hard*

As the freak winter storm raged, historically marginalized communities were among the first to face power outages, experts say.



A makeshift warming shelter at the Travis Park Methodist Church in San Antonio, Texas, on Tuesday. Eric Gay/Associated Press

By James Dobbins and Hiroko Tabuchi

Published Feb. 16, 2021 Updated Feb. 18, 2021, 5:24 a.m. ET

SAN ANTONIO, Texas — When the lights went out Monday night in the Alazán-Apache housing project in San Antonio — which stands in one of the city's poorest ZIP codes — the traffic signals in the neighborhood flickered off and storekeepers pulled down their shutters.

For residents, there was little left to do but huddle under blankets and hope that their children wouldn't fall ill.

"I need to take my kids somewhere to keep them warm. I don't know where," said Ricardo Cruz, 42, who lives at the Alazán-Apache Courts with his wife and five children, between 5 and 13 years old, and who has been without electricity since 7 p.m. Monday.

While the rolling blackouts in Texas have left some 4 million residents without power in brutally cold weather, experts and community groups say

that many marginalized communities were the first to be hit with power outages, and if history serves as a guide, could be among the last to be reconnected. This is particularly perilous, they say, given that low-income households can lack the financial resources to flee to safety or to rebound after the disruption.

Experts worry, in particular, that rising energy prices amid surging demand will leave many families in the lurch, unable to pay their utility bills next month and triggering utility cutoffs at a time when they are at their most vulnerable. In Texas' deregulated electricity market, prices can fluctuate with demand, leading to a potential jump in electric bills for poorer households that already spend a disproportionate amount of income on utilities.

"Whether it's flooding from severe weather events like hurricanes or it's something like this severe cold, the history of our response to disasters is that these communities are hit first and have to suffer the longest," said Robert Bullard, a professor at Texas Southern University and an expert on wealth and racial disparities related to the environment.

"These are communities that have already been hit hardest with Covid," he said. "They're the households working two minimum wage jobs, the essential workers who don't get paid if they don't go to work."

In Houston, local environmental groups said that neighborhoods like Acres Homes, a predominantly Black and Latino neighborhood in the northwest of the city, were among the first to lose power. "The pipes are freezing. They're out of water and electricity," said Ana Parras, co-executive director of Texas Environmental Justice Advocacy Services, or Tejas, a community group that serves local communities of color.

Many of the city's hardest-hit communities already have poor infrastructure. "The houses there don't have much insulation," she said.

Electric service trucks in Fort Worth, Texas, on Tuesday. Ron Jenkins/Getty Images

Research has also shown that in Houston and elsewhere, lower-income, minority communities tend to live closer to industrial sites and be more exposed to pollution, a concern as the freezing weather shut down large refineries and other industrial sites.

Large industrial complexes tend to release bursts of pollutants into the air when they shut down and again when they restart. In the days before and after Hurricane Harvey in 2017, Houston's network of petrochemical plants and refineries released millions of pounds of pollutants, raising health concerns in nearby communities. And electricity outages mean that many air-monitoring stations are likely to be down.

"It's a very sad situation," Ms. Parras said, considering that "we live in the energy capital of the world."

In San Antonio, some residents turned to their cars as a source of warmth. In the driveway of a single-family house off a West Side street, Jesus Garcia sat in his car running the engine to stay warm and charge his cellphone.

The 78-year-old lives on the other side of the neighborhood, but his house went dark two days ago. So he came to his friend's place to stay. But her power went out, too, and the roads were too dangerous to drive home last night.

So he stayed a second night, unsure when, exactly, he would return home. "They got plenty of people to fix all this stuff, but I don't know what's going on," he said with a shrug.

At a 7-Eleven gas station on the edge of the West Side, one of the few gas stations open, cars lined the street to purchase fuel. Inside, most of the snacks and bottled water were gone. And the store's pipes were frozen.

Under Interstate 37, less than a mile from downtown, about 20 tents protected some of the city's most vulnerable residents, the homeless, from the deadly cold. They stood in groups around camp fires fueled by wood from a Christian ministry across the street.

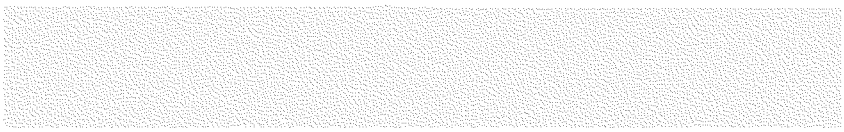
But a burst pipe meant that the ministry couldn't offer the showers that it usually does. A Baptist church nearby was setting up a temporary shelter.

Desiree Lee Garcia Curry, 37, said she would sleep in the tent city after losing a room at a hotel. A few nights ago, she slept under a tarp as ice accumulated on the ground.

"The hotel let us stay for a full day but then threw me and my roommate out," she said. "I lost half my stuff."

Greg Woodard has a tent here, too. Five days ago, when the polar vortex descended on South Texas, the 39-year-old considered taking shelter at another church nearby. But he wasn't allowed to bring his books. He studies at the Alamo City Barber College. "I decided to take my chances out in the cold," he said.

James Dobbins reported from San Antonio, and Hiroko Tabuchi from New York.



SYRACUSE UNIVERSITY ENGINEERING & COMPUTER SCIENCE

Harvard T.H. Chan School of Public Health
Center for Climate, Health, and the
Global Environment

February 18, 2021

To: Chairman Bobby Rush, Ranking Member Fred Upton and members of the Energy Subcommittee of the Energy and Commerce Committee of the U.S. House of Representatives

Re: Subcommittee Hearing on A Smarter Investment: Pathways to a Clean Energy Future

President Joseph Biden has set a goal of achieving a carbon-free electricity sector by 2035 and net-zero greenhouse gas emissions economy-wide by 2050 and the CLEAN Future Act includes a clean energy standard and a goal of net-zero carbon emissions from the power sector by 2050.

Our Clean Energy Futures (CEF) project shows that several clean energy policies, including clean energy standards, carbon prices, and a national cap and trade policy can achieve low or zero carbon emissions in the electricity sector by 2040 to 2050 and provide major health gains at modest costs.

We summarize the key research findings of the CEF project here and append supplemental information for your reference. We are available to provide a briefing to the committee on the results from this extensive research.

**About Clean Energy Futures (CEF)**

The CEF project quantifies the carbon emissions, costs, air quality, and health outcomes of different policies to reduce carbon dioxide ($CO_2$) emissions from the U.S. electricity.

The CEF team is analyzing 12 leading policy options including (1) clean electricity standards, (2) national cap and trade policies, (3) carbon prices in the electricity sector, and (4) rules under section 111(d) of the Clean Air Act.

Each electricity sector policy is compared to a no-policy reference case (business as usual, BAU) to estimate changes in: (1) carbon dioxide emissions; (2) electricity system generation sources and system costs; (3) co-pollutant emissions of sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$), and mercury; (4) air quality, including fine particulate matter ($PM_{2.5}$) and ozone; and (5) air quality-related human and ecosystem health outcomes.

**Key Findings**

*Reaching Zero Emissions in the Electricity Sector is Achievable at Modest Costs*

Several clean energy policies, including clean energy standards, carbon prices, and a national cap and trade policy can achieve low or zero carbon emissions in the electricity sector by 2040 to 2050 with existing technology at a cost of about 15% above baseline. Moreover, the strongest policies deliver 20% more benefits than the moderate policies at only 6% higher costs.

Civil and Environmental Engineering | 151 Link Hall | (P) 315.443.3434 | (F) 315.443.1243 | Syracuse, NY 13244

*Clean Energy Delivers Climate and Health Benefits That Far Outweigh Policy Costs*

All of the policies that we examined deliver climate benefits that exceed policy costs. In addition, all policies considered, except the Affordable Clean Energy rule, decrease sulfur dioxide and nitrogen oxide emissions resulting in substantial additional health benefits associated with improvements in air quality. Virtually the entire coterminous U.S. is projected to experience better air quality. Improvements are most striking in the eastern U.S., particularly in areas experiencing chronically impaired air quality. For the most ambitous policies, such as a 100% Clean Energy Standard by 2040, our projections suggest that over 11,000 premature deaths could be avoided annually from decreases in air pollution by 2030.

*Policy Design Determines Timing, Cost, and Benefits of Clean Energy*

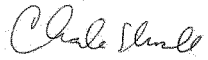
- For Clean Energy Standards, the timeline for achieving 100% clean energy exerts a larger impact on future energy generation and emissions trajectories than which carbon intensity benchmark is used and whether partial crediting is allowed, when banking is limited.
- Policies that drive down coal generation can achieve large reductions in sulfur dioxide, nitrogen oxide and mercury emissions, decreasing atmospheric concentrations of fine particulate matter ($PM_{2.5}$) and ozone, and providing considerable health benefits.
- Policies with stringent targets and timelines without banking reach the zero- or near-zero emissions the earliest.
- Emissions banking can lower costs and, together with a stringent policy target, achieve early emissions reductions and larger cumulative benefits for carbon dioxide and co-pollutants. It can also extend the use of fossil fuels further into the future.
- If small generating units (<25W) are not covered and run unconstrained, they can drive up emissions of nitrogen oxides when a stringent standard is applied to larger covered sources.

**Next Steps**

The Clean Energy Futures project is expanding on our current work to produce maps of future carbon emissions reductions, air quality, and health benefits. We also plan to conduct a distributional analysis of the health benefits by race/ethnicity and income and to analyze electricity sector effects under a scenario of high electrification of the transportation sector.

We are available to answer questions or brief the committee on our findings.

Yours truly,



Charles T. Driscoll, Jr, PhD, NAE
University Professor of Environmental Systems Engineering

Kathleen S. Lambert
Senior Advisor
Harvard Chan C-CHANGE

**Clean Energy Futures Collaborators**

The CEF project is a multi-institutional research initiative with experts from Syracuse University; Center for Climate, Health and the Global Environment at the Harvard TH Chan School of Public Health; Resources for the Futures; and Georgia Institute of Technology.

- Charles Driscoll, Jr. – University Professor of Environmental Systems and Distinguished Professor of Civil & Environmental Engineering, Syracuse University
- Kathy Fallon Lambert – Senior Advisor, Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health
- Jonathan Buonocore – Research Scientist, Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health
- Dallas Burtraw – Darius Gaskins Senior Fellow, Resources for the Future
- Maya Domeshek – Research Associate, Resources for the Future
- Amelia Keyes – Research Associate, Resources for the Future, JD candidate Harvard Law School
- Qasim Mehdi – PhD candidate, Syracuse University
- Armistead (Ted) Russell – Regents Professor, Georgia Institute of Technology
- Huizhong Shen – Postdoctoral Fellow, Georgia Institute of Technology
- Peter Wilcoxen – Professor, Director of the Center of Environmental Policy and Administration, Maxwell School, Syracuse University
- Petros Vasilakos - Postdoctoral Fellow, Georgia Institute of Technology

**Supplemental Information from the Clean Energy Futures Research Project**

Table 1. The Clean Energy Futures project compares the 12 electricity sector policies shown below to a no-policy reference scenario. The colors in the table denote low, moderate, and high ambition policies.

| Policy Type | Code | Description |
|---|---|---|
| Reference case | BAU | Business as usual, no policy |
| Section 111 rules | ACE | Affordable Clean Energy – assumed 4.5% HRI for affected units |
| | CPP20 | Updated Clean Power Plan - achieves 65% CO2 reduction from 2005 levels by 2035 |
| Clean Energy Standard | CES40 | 100% clean in 2040, 0.82 metric tons/MWh, partial crediting, total generation, no banking |
| | CES40-B | 100% clean in 2040, 0.82 metric tons/MWh, partial crediting, total generation, banking allowed |
| | CES50-H | 100% clean in 2050, high carbon intensity benchmark (0.82 metric tons/MWh), total generation, banking allowed until 2040 |
| | CES50-L | 100% clean in 2050, low carbon intensity benchmark (0.46 metric tons/MWh), total generation, banking allowed until 2040 |
| Cap and Trade | CAP | Net 0 emissions in 2040, offsets allowed but no banking |
| | CAP-B | Net 0 emissions in 2040, banking allowed |
| Carbon Price | CP-25 | Carbon price $25/ton rising at 5% per year |
| | CP-25u | Like CP-25 but units below 25 MW "unconstrained" (not held to BAU capacity factors) |
| | CP-50 | Carbon price $50/ton rising at 5% per year |
| | CP-50u | Like CP-50 but units below 25 MW "unconstrained" (not held to BAU capacity factors) |

Figure 1. Projected total carbon dioxide emissions from the U.S. power sector under a set of policy cases from 2020 to 2050.

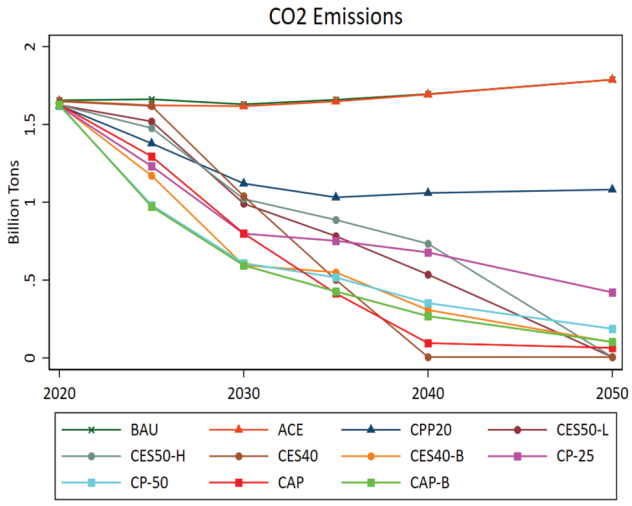



Figure 2. Comparison of estimated net present value system costs (green bars), climate benefits calculated using the social cost of carbon (orange bars), and health benefits associated from improved air quality due to lower sulfur dioxide and nitrogen oxide emissions (blue and red bars).

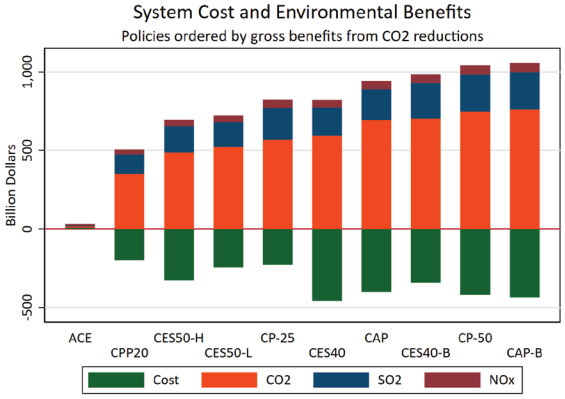


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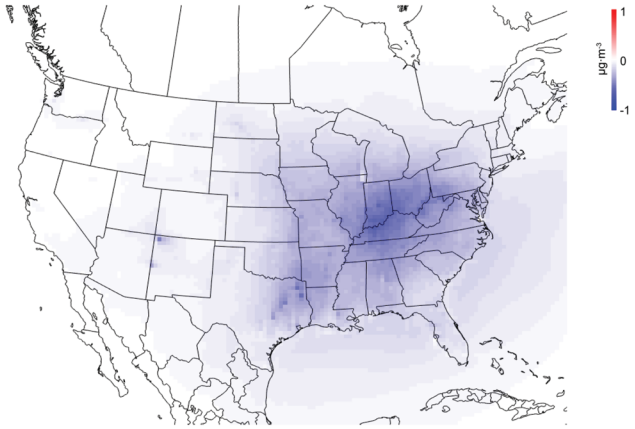
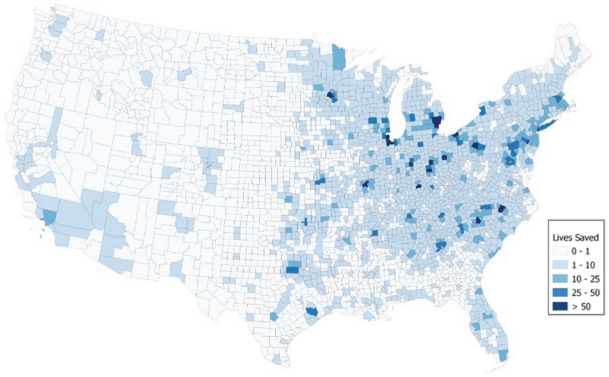
Figure 3. Projected change in air quality (a) and premature deaths (b) avoided under a Clean Energy Standard with banking (CES40-B). Similar results are also available for the other policy scenarios.

3a. Estimated change in fine particulate matter ($PM_{2.5}$) concentrations for the CES40-B policy in 2030 (annual average of 24-h averages)




3b. Estimated premature deaths avoided from reductions in fine particulate matter ($PM_{2.5}$) and ozone concentrations for the CES40-B policy in 2030. Annual total lives saved = 11,200.



**Modeling References**

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The New York Times

# A Plan to Future-Proof the Texas Power Grid

The state's massive blackouts are the result of a failure to insure against extreme weather.

**By Jesse Jenkins**
Dr. Jenkins is an assistant professor and an energy systems engineer at Princeton University.

Feb. 18, 2021, 5:00 a.m. ET

As the power crisis in Texas stretches into its fifth day, the blame game is well underway.

Frozen wind turbines, unsubstantiated allegations of nefarious power plant outages, the state's libertarian approach to electricity markets and its deliberately isolated power grid have all been targets of pundits and politicians quick on the takes but light on the facts.

The truth is, there is plenty of blame to go around. That gives easy fodder for instant experts trying to confirm their priors. But the failure to prepare for this extreme cold is systemic, and the millions of Texans enduring deadly cold and extreme discomfort deserve a closer look at what went wrong, and what to do about it. The lessons can help Americans prepare for the range of extreme weather that a changing climate will bring.

Texans aren't accustomed to temperatures in the teens. Neither is the state's energy infrastructure, which failed this week as record-breaking cold drove skyrocketing heating demand and widespread failures of power plants, gas pipelines and wells.

Homes and buildings in Texas are built to stay cool during summer heat, not to weather an Arctic freeze, which means they have less insulation than buildings in colder climates. The result: As temperatures fall, Texas' energy demand rises more quickly than in some other states.

On Sunday, demand for electricity hit a winter record, at 69,150 megawatts, and by Monday morning, more than 30,000 megawatts of power went offline. These plant outages represented twice the level that the Electric Reliability Council of Texas, or ERCOT, considers an "extreme generator outage" in its scenario planning.

Faced with greater demand and diminished generation capacity, the grid operator ordered transmission utilities to start disconnecting millions of customers. Days later, many of them have yet to regain power.

Texas is unique among states for having its own electrical grid. The grid operator, ERCOT, must balance supply and demand for electricity. If demand exceeds supply, generators strain to meet the greater load and plants automatically disconnect to avoid damaging overworked generators, triggering a cascade of shutdowns that can blackout the entire state. A grid operator's primary job is to avoid this outcome.

What caused so many power plants to fail? The same frigid temperatures that sent demand soaring.

Every source of power generation — wind turbines, natural gas plants and nuclear reactors — has been hammered by the winter storm. But Texans rely on natural gas for two-thirds of their winter electricity supply, and failures across Texas' natural gas system are the biggest cause of current outages.

While pundits and politicians pounced on early reports of wind turbines icing up, renewable energy outages are the least significant factor in the blackouts, according to a senior director for the Texas grid operator. Wind and solar provide valuable energy throughout the year. But grid operators know not to count on these resources for much output during tough conditions, and these energy sources represent just 11 percent of Texas' winter capacity needs. In short, wind and solar are reliably unreliable.

Two-fifths of the generating capacity of Texas' thermal plants (a category that includes natural gas, coal and nuclear plants) has been offline since Sunday night, accounting for the bulk of supply shortfalls. Texans were counting on these plants to be there, and they failed.

The problems start out in the Permian Basin, where gas wells and gathering lines have frozen, and pumps that are used to lift gas from the ground lack electricity to operate; this has cut gas field production in half. At least one nuclear reactor near Houston also went offline Monday when a safety sensor froze; it was restarted Tuesday night.

It is possible to weatherize energy infrastructure to protect against these outcomes. After all, more extreme weather conditions are a regular part of life in many parts of the Midwest and New England.

Pipelines can be buried deeper to insulate against the ground's cold surface. When gas supplies are disrupted, dual fuel power plants can switch from gas to petroleum stored on site. Wind turbines can be equipped with heaters to keep blades free of ice. Sensors, valves and coolant intakes can be protected against freezing. Long-distance power lines can connect to other regions' power systems and draw from their supplies during times of need.

All of this is possible but costly.

Preparing for extreme events is like buying home or health insurance: it costs you every year and you hope you'll never use it. But when a crisis strikes, paying the premiums can look like the perfect decision in hindsight.

The problem, of course, is that we have to use foresight, not hindsight, to identify the kinds of crises that we wish to protect against.

Texas is well prepared for peaks in demand driven by summer heat waves. These happen often enough that it's obviously worth investing to mitigate the risks. Planning for rarer events is more difficult.

The calculus should come down to both the frequency of such events and, when they do occur, the severity of their impacts. A once-in-a-decade cold snap that causes a few hours of rolling blackouts, as occurred in 2011, may be tolerable. But several days without heat during below-freezing temperatures are not.

When the power returns, a thorough inquiry can determine what steps could have been taken to protect Texas' electric and gas systems from such failures. Texans will have to determine just how much insurance is worth taking out.

Texas' crisis also raises important questions for energy system operators and infrastructure planners across the country, as extreme cold is not the only weather threat we face. While scientists are still analyzing whether these polar vortex cold snaps are related to climate change, we do know that climate change increases the frequency of extreme heat waves, droughts, wildfires, rain and coastal flooding. Those extreme events test our systems to the breaking point, as they have in Texas this week.

The changing climate means the past is no longer a guide to the future. The entire country must get much better at preparing for — and insuring against — the unexpected.

Jesse Jenkins (@JesseJenkins) is an assistant professor and energy systems engineer at Princeton University.

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Water Outages
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WINTER STORM 2021

# Texas largely relies on natural gas for power. It wasn't ready for the extreme cold.

Texas largely relies on natural gas — especially during times of high demand — to power the state. Experts say natural gas infrastructure, from pumping it out of the ground to the plants in city centers, was unprepared for the plunging temperatures brought by the winter storm.

BY ERIN DOUGLAS FEB. 16, 2021 5 PM

The Blanco Vista neighborhood of San Marcos is blanketed with snow after a massive winter weather system caused power outages across Texas. The outages during this storm far exceeded what the Electric Reliability Council of Texas predicted for an extreme winter event. The forecast for peak demand was 67 gigawatts; peak usage during the storm was more than 69 gigawatts on Sunday. Jordan Vonderhaar for The Texas Tribune

**Winter Storm 2021**

*As Texas faced record-low temperatures this February and snow and ice made roads impassable, the state's electric grid operator lost control of the power supply, leaving millions without access to electricity. As the blackouts extended from hours to days, top state lawmakers called for investigations into the Electric Reliability Council of Texas, and Texans demanded accountability for the disaster. We have compiled a list of resources for Texans who are seeking help, or places to get warm.* MORE IN THIS SERIES



Failures across Texas' natural gas operations and supply chains due to extreme

temperatures are the most significant cause of the power crisis that has left millions of Texans without heat and electricity during the winter storm sweeping the U.S.

From frozen natural gas wells to frozen wind turbines, all sources of power generation have faced difficulties during the winter storm. But Texans largely rely on natural gas for power and heat generation, especially during peak usage, experts said.

Officials for the Electric Reliability Council of Texas, which manages most of Texas' grid, said the primary cause of the outages Tuesday appeared to be the state's natural gas providers. Many are not designed to withstand such low temperatures on equipment or during production.

**February Winter Storm 2021**

**How can I stay warm? How can I help others?**

**I've been without power for more than a day. Why are people calling these rolling outages?**

**Wait, we have our own power grid? Why?**

**I read online that wind turbines are the reason we lost power. Is that true?**

SEE MORE COVERAGE

By some estimates, nearly half of the state's natural gas production has screeched to a halt due to the extremely low temperatures, while freezing components at natural gas-fired power plants have forced some operators to shut down.

"Texas is a gas state," said Michael Webber, an energy resources professor at the University of Texas at Austin. While he said all of Texas' energy sources share blame for the power crisis — at least one nuclear power plant has partially shut down, most notably — the natural gas industry is producing significantly less power than normal.

"Gas is failing in the most spectacular fashion right now," Webber said.

More than half of ERCOT's winter generating capacity, largely powered by natural gas, was offline due to the storm, an estimated 45 gigawatts, according to Dan

Woodfin, a senior director at ERCOT.

The outages during this storm far exceeded what ERCOT had predicted in November for an extreme winter event. The forecast for peak demand was 67 gigawatts; peak usage during the storm was more than 69 gigawatts Sunday.

It's estimated that about 80% of the grid's capacity, or 67 gigawatts, could be generated by natural gas, coal and some nuclear power. Only 7% of ERCOT's forecasted winter capacity, or 6 gigawatts, was expected to come from various wind power sources across the state.

Woodfin said Tuesday that 16 gigawatts of renewable energy generation, mostly wind generation, are offline and that 30 gigawatts of thermal sources, which include gas, coal and nuclear energy, are offline.

"It appears that a lot of the generation that has gone offline today has been primarily due to issues on the natural gas system," Woodfin said during a Tuesday call with reporters.

Production of natural gas in the state has plunged, making it difficult for power plants to get the fuel necessary to run the plants. Natural gas power plants usually don't have very much fuel storage on site, experts said. Instead, the plants rely on the constant flow of natural gas from pipelines that run across the state from areas like the Permian Basin in West Texas to major demand centers like Houston and Dallas.

In early February, Texas operators were producing about 24 billion cubic feet per day, according to an estimate by S&P Global Platts. But on Monday, Texas production plummeted to a fraction of that: Operators in the state produced somewhere between 12 billion and 17 billion cubic feet per day.

The systems that get gas from the earth aren't properly built for cold weather. Operators in West Texas' Permian Basin, one of the most productive oil fields in the world, are particularly struggling to bring natural gas to the surface, analysts said, as cold weather and snow close wells or cause power outages that prevent pumping the fossil fuels from the ground.

"Gathering lines freeze, and the wells get so cold that they can't produce," said Parker Fawcett, a natural gas analyst for S&P Global Platts. "And pumps use electricity, so they're not even able to lift that gas and liquid, because there's no power to produce."

Texas does not have as much storage capacity as other states, experts said, because the resource-laden state can easily pull it from the ground when it's needed — usually.

Of the storage that the state does have, the resources are somewhat difficult to get to. Luke Jackson, another natural gas analyst for S&P Global Platts, said that physically withdrawing stored natural gas is slower than the immediate, ready supply of lines from production and is insufficient to make up for the dramatic declines in production.

Some power plants were already offline before the crisis began, adding to the problems, experts said. ERCOT anticipated 4 gigawatts of maintenance outages during the winter. Power plants in Texas usually do maintenance and updates to their plants during the typically mild winter months in preparation for the extreme electricity and power demand during the summer. That, too, is straining the grid's supply.

Another winter problem: heating homes and hospitals by burning natural gas.

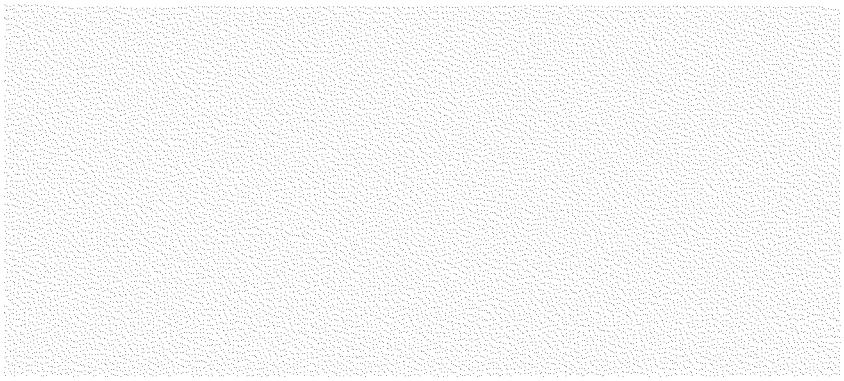
"In the summer, you don't have as much direct burning of natural gas," said Daniel

Cohan, an associate professor of civil and environmental engineering at Rice University, pointing out that during peak usage in the summer months, the demand is all for electricity.

The last time the state experienced a major freeze like this was a decade ago, in 2011. At that time, too, natural gas generation experienced difficulties — had ERCOT not reduced load through the rolling blackouts implemented during that storm, it would have resulted in widespread blackouts throughout the entire region, a federal report on the storm warned.

It is possible to "winterize" natural gas power plants, natural gas production and wind turbines, experts said, which prevents such major interruptions in other states with more regular extreme winter weather. But even after upgrades were made after the 2011 winter storm, many Texas power generators have still not made all the investments necessary to prevent these sorts of disruptions happening to the equipment, experts said.

ERCOT directors also said that the storm this week took a turn in the early morning hours of Monday, when extremely low temperatures forced many more generators offline than ERCOT had anticipated.



"It appeared that the winterization we were doing was working, but this weather was more extreme than [past storms]," Woodfin said. "The loss of generation during the morning of Monday, after midnight, was really the part that made this a more extreme event than we had planned."

Upgrading equipment to withstand extremely low temperatures and other changes, such as providing incentives for customers to conserve power or upgrade to smart appliances, could help avoid disasters like this one, said Le Xie, a professor of electrical and computer engineering at Texas A&M University and assistant director of energy digitization at A&M's Energy Institute.

"We used to not worry too much about such extreme cold weather in places like Texas, but we probably need to get ready for more in the future," Xie said. With climate change, he said, "We're going to have more extreme weather conditions throughout the country."

*Jolie McCullough contributed reporting.*



**RELATED NEWS**

**Gov. Greg Abbott, other top Texas officials call for resignations and**

*Beaver County Times*

## Beaver County sees economic growth amid cracker construction

With construction of the Shell Chemicals ethane cracker plant in Potter Township taking shape, Beaver County is poised as a regional leader in the petrochemical industry. [BCT file]

By Chrissy Suttles

Posted Jan 8, 2020 at 4:09 PM

Construction of Shell Chemicals' ethane cracker plant made Beaver County a leader in economic growth two years ago, new data reveals.

Construction of Shell Chemicals' ethane cracker plant made Beaver County a leader in economic growth two years ago, new data reveals.

Federal Bureau of Economic Analysis estimates released last month show Beaver County had the region's highest year-over-year gross domestic product growth in 2018. Economists use GDP to measure the size and economic health of a region.

"It's a measure of value added," said Chris Briem, an analyst with the University of Pittsburgh's Center for Social and Urban Research. "Beaver County shot out as having this very rapid growth because of the tremendous number of construction jobs at the cracker plant."

While all seven counties in southwestern Pennsylvania generated growth in 2018, annual rates varied — ranging from 0.6 percent in Armstrong to 6 percent in Beaver. Allegheny County produces more than $96 billion in GDP annually, according to the bureau, or 63 percent of the region's total.

Beaver County's growth was primarily in the construction industry; roughly $400 million of net growth represented a 62.5 percent surge in what the industry generated in 2017. That year, the county saw a 3.2 percent spike — good news considering Beaver's 1.4 percent decline in 2016.

Shell Chemicals began constructing the petrochemical complex in Potter Township late 2017.

Now, roughly 6,500 pipe fitters, electricians and welders are on site, a number that has gradually increased over time. It's unclear how 2019's growth will stack up as the site nears completion.

"Much of the work is done," Michael Marr, Shell Chemicals' business integration lead, told The Times in December. "Now we are tying the various larger structures together."

Once open sometime this year, it will support about 600 permanent, full-time jobs. The company expects to produce more than a million tons of plastic each year at the facility, spurring an interest in Appalachian petrochemical production.

Briem said it's unlikely this level of growth will last post-construction when thousands of temporary employees leave the county for other opportunities.

"The estimated employment numbers are 600 jobs at the plant," he said. "There's some value to that, but I don't think it's on the same scale. The chemical industry, in general, has a fairly high output for workers so you might see a jump beyond employment, but it's a relatively small number."

Other industries experiencing growth in Beaver County included transportation, information and manufacturing. This, plus construction, greatly offset a steep decline in utility, agriculture and similar industries.

"The big question now is whether the existence of the cracker will spur any other development or manufacturing facilities in the region," Briem said.

*The Shell Pennsylvania Petrochemicals Complex near Pittsburgh will employ 1,000 electricians for more than a year, making it one of the largest projects in the IBEW.*

# $6.5 Billion Pa. Cracking Plant Puts a Region to Work

**August 8, 2019**

$200M Agreement Brings Jobs, Stability in Pennsylvania

Job-Rich Pennsylvania Pipeline Moves Closer to Completion

Job-Rich Pennsylvania Pipeline Moves Closer to Completion

**One of the largest projects in the IBEW is finally underway north of Pittsburgh.**

After years of rumors, planning, permitting and approval, the Shell Pennsylvania Chemical project on the banks of the Ohio River in Beaver Cou[illegible]aking shape.



The $6.5 billion project will take the bountiful natural gas from the Marcellus and Utica shales and pump out trillions of tiny, transparent [illegible]uilding block of countless consumer and industrial products.

At the moment, Beaver Local 712 has more than 350 members on site, but by the start of next year, peak demand for our members will reach 1,000 and continue at that level for more than 12 months.

"We haven't had a job this big since the Beaver Valley nuclear plant 40 years ago," said Local 712 Business Manager Frank E. Telesz Jr.

The plant is the first of its kind outside of the Gulf Coast and is only possible because of the meteoric growth of U.S. natural gas production since horizontal fracturing — better known as fracking — was introduced just over a decade ago. Twenty years ago, next to no natural gas was produced in the Ohio River Valley. Today, it accounts for nearly 30% of the national supply.

If it were a country, the region including parts of Ohio, Pennsylvania and West Virginia would be the third-largest producer of natural gas in the world behind the rest of the U.S. and Russia.

The scale of the project is unprecedented in the area, and uses one of the world's largest cranes at nearly 700 fett tall, it can lift 3,500 tons.

And unlike the Gulf Coast, where most cracking plants are today, it is less than a day's drive to nearly all the companies that use polyethylene beads to pump out car parts, medical equipment, consumer goods, food containers, sporting goods and much, much more.

And there are no hurricanes.

"This is the kind of job the IBEW was built for. We are the only place to find that many skilled wiremen and apprentices to do it right, do it safely and do it on budget," said Construction and Maintenance Department Director Mike Richard.

Local 712 has only about 450 members and, like many locals, nearly everyone is working.

There is both a need and an opportunity for travelers, Telesz said.

"They are running staggered daylight shifts and started a second turn," Telesz said.

The contractors are especially eager, he said, for veterans (12% of the current workforce) and women (15%).

"Most of the petrochemical plants on the Gulf Coast have been built, at least in part, nonunion. We have been pitching Shell on the value of working with the IBEW. Now is our time to deliver on that promise," he said.

The scale of the project is nearly unprecedented. Just during pre-work, Shell built two heavy haul bridges, relocated a portion of a highway and moved 7.2 million cubic yards of dirt.

The Horsehead zinc smelter on the site was demolished and the concrete from its foundation was recycled into a 200-foot retaining wall.

The heart of the plant is the "cracker," which heats the natural gas liquid ethane to nearly 2,000 degrees, strips off hydrogen atoms and breaks it down into a smaller molecule, ethylene. The ethylene is then cooled in the 4-million pound quenching tower that was recently installed by one of the largest cranes in the country, known as the "Mother of All Cranes."

The ethylene is then strung back together in long chains as either high- or low-density pellets, and this single plant will churn out billions of pounds each year.

early next year, there will be 6,000 construction workers from all trades across the site.

The Ohio Valley is one of the richest natural gas resources in the world and the Shell plant is expected to be the beginning of a petrochemical boom in the region worth more than $100 billion.

In operation, Shell said there will be 600 full-time jobs.

However massive the Shell project is, it is likely only the beginning. Natural gas production from the more than 13,000 wells in the region will have risen 700% between 2013 and 2023.

Thousands of feet below the Ohio River is the Marcellus Shale, the second-largest natural gas field in the world. Hundreds of feet below that is an equally valuable natural as deposit known as the Utica shale.

Even better, the rocks are loaded with natural gas liquids — ethane, propane and their chemical cousins — that are mingled in the more common methane heating gas. Those liquids are the building blocks of what could become a petrochemical powerhouse.

"Ethane is to the chemical industry what flour is to bakers," said Steven Hedrick, chief executive of the Mid-Atlantic Technology, Research & Innovation Center at a recent energy conference.

MATRIC estimates that there could be as many as 25,000 permanent jobs in plastics and related manufacturing just in this region.

A study sponsored by a regional development company found that the Ohio Valley could support up to four more ethane cracking plants equal in size or larger than the Pennsylvania plant.

"We could become the new Gulf Coast," Telesz said.

In March 2018, then-Ohio Gov. John Kasich announced a stepped-up investment commitment by Thailand's PTT Global Chemical and South Korea-based Daelim Industrial Co. Ltd. for a proposed cracking plant in Belmont County, in the heart of Utica's "wet" shale gas area. Community leaders are hoping for a positive decision by the end of this year on a project that could be worth up to $10 billion. The company has already spent more than $150 million on engineering and design work for the project, and a final decision is expected sometime this year.

Then, in November 2017, China Energy Investment Corporation and West Virginia officials signed a memorandum of understanding outlining a staggering $84 billion investment commitment in natural gas industries that would span two decades.

"It is hard to even fathom what that amount of investment in this region would mean," said Third District Business Development International Representative Ed Hill Jr. "There is nothing to compare it to."

However, in the shadow of the trade war launched by the Trump Administration, the Chinese conglomerate's first visit to the region was canceled last summer.

"I would take it more as a sign of the potential value of the resources in this region rather than, say, clearing space on my calendar to get a job," said Hill said.

In his annual report to Congress last year, Energy Secretary Rick Perry recommended that a new ethane storage and distribution hub be built in the region, further cementing the region's new reality as a near-permanent jobs center in the U.S.

"I have not been as excited about a prospective project with anything I've done [illegible]ding in Texas, as I am about this," Perry said in an interview with the Washington Examiner.



[illegible]body knows how many and what kind of jobs are available on the Gulf Coast. I want people to understand that the game is changing," Hill said.

In fact, the Pennsylvania petrochemical plant was one of the very first projects targeted by the Business Development Department nearly a half decade ago. Local 712 is the home local of Hill's late father, former International President Edwin D. Hill.

"Lives will be changed and careers will be made with all the work we are going to see in this region for people who have seen hard times and need a break," Hill said. "There is now real opportunity for people here."

Polyethylene beads are the building block of countless consumer and industrial products and the Shell plant will produce trillions every year.


Expand Navigation



# Pipelines Are Key to the Keystone State's Future, Let's Not Mess It Up

Posted on **December 31, 2017** by **Natural Gas Now Guest Blogger**

**James T. Kunz, Jr.**
*Business Manager, International Union of Operating Engineers, Local 66*

***Pipelines are the infrastructure needed to realize Pennsylvania's economic future, say the Operating Engineers and they ask the Commonwealth not mess its up.***

Pipelines must adhere to strict state and federal regulation throughout construction, testing and infrastructure replacement to ensure system integrity. According to data

collected by the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, the natural gas delivery system is the safest form of energy delivery in the country.

The Marcellus and Utica shale formations provide great opportunities for Pennsylvania. But the full benefits will not be attained if we do not build the pipelines needed to transport resources to market. A number of key infrastructure projects have been proposed or are in construction right now across the state, and many of our members are on the job today.

— Typical view of existing Pennsylvania pipeline. Would you know it was there but for the marker?

But, unnecessary regulatory actions, beyond what is normally required, are causing increased delays and environmental risk. One example is a recent agreement among Sunoco, the Department of Environmental Protection and environmental groups that is causing horizontal directional drilling to start and stop, start and stop — something industry experts agree has the potential for greater harm.

Uncertainty around Pennsylvania's regulatory policies is hampering development of pipeline infrastructure and hindering our ability to realize the gain from these projects.

**Editor's Note:** Mr. Kunz has it exactly correct. Pipelines are the lifeblood of our future economic activity here in Pennsylvania. They supply construction jobs for union workers, they supply much needed economic development in the rural areas of the commonwealth and they delivery energy security, low energy prices and cleaner air to urban areas.

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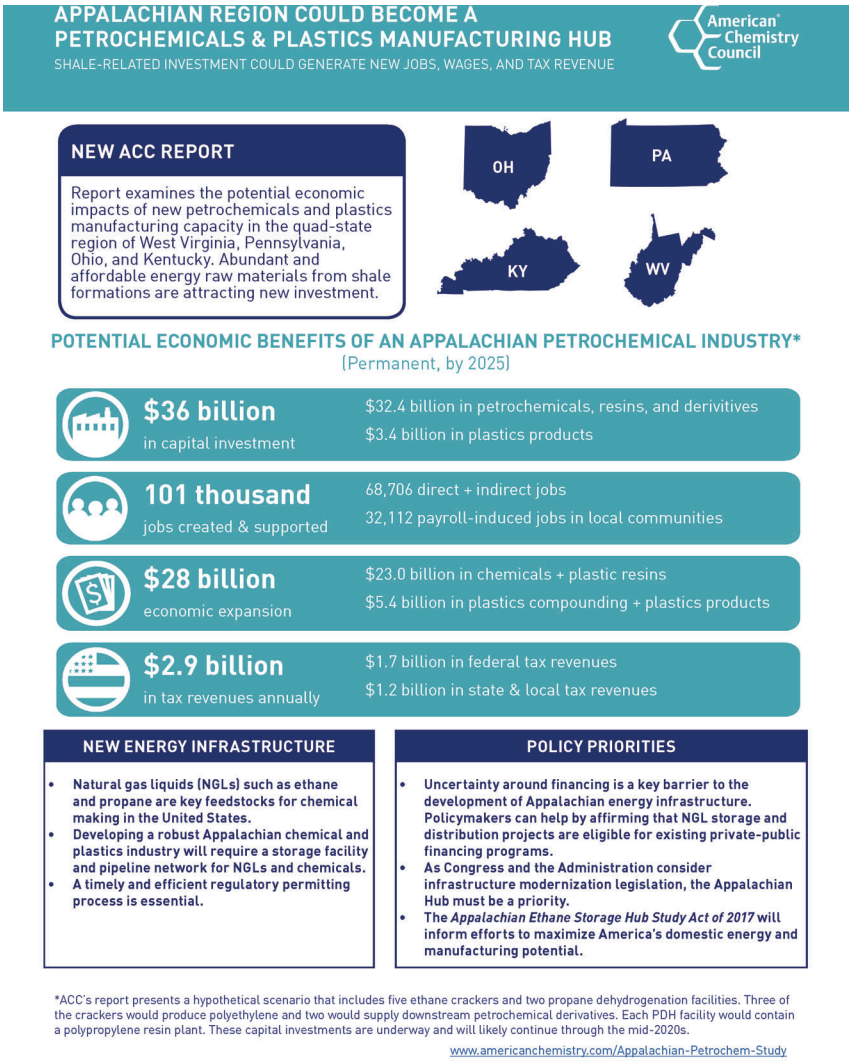

APPALACHIAN REGION COULD BECOME A PETROCHEMICALS & PLASTICS MANUFACTURING HUB
SHALE-RELATED INVESTMENT COULD GENERATE NEW JOBS, WAGES, AND TAX REVENUE
American Chemistry Council
NEW ACC REPORT
Report examines the potential economic impacts of new petrochemicals and plastics manufacturing capacity in the quad-state region of West Virginia, Pennsylvania, Ohio, and Kentucky. Abundant and affordable energy raw materials from shale formations are attracting new investment.
OH
PA
KY
WV
POTENTIAL ECONOMIC BENEFITS OF AN APPALACHIAN PETROCHEMICAL INDUSTRY*
(Permanent, by 2025)
$36 billion
in capital investment
$32.4 billion in petrochemicals, resins, and derivitives
$3.4 billion in plastics products
101 thousand
jobs created & supported
68,706 direct + indirect jobs
32,112 payroll-induced jobs in local communities
$28 billion
economic expansion
$23.0 billion in chemicals + plastic resins
$5.4 billion in plastics compounding + plastics products
$2.9 billion
in tax revenues annually
$1.7 billion in federal tax revenues
$1.2 billion in state & local tax revenues
NEW ENERGY INFRASTRUCTURE
• Natural gas liquids (NGLs) such as ethane and propane are key feedstocks for chemical making in the United States.
• Developing a robust Appalachian chemical and plastics industry will require a storage facility and pipeline network for NGLs and chemicals.
• A timely and efficient regulatory permitting process is essential.
POLICY PRIORITIES
• Uncertainty around financing is a key barrier to the development of Appalachian energy infrastructure. Policymakers can help by affirming that NGL storage and distribution projects are eligible for existing private-public financing programs.
• As Congress and the Administration consider infrastructure modernization legislation, the Appalachian Hub must be a priority.
• The Appalachian Ethane Storage Hub Study Act of 2017 will inform efforts to maximize America's domestic energy and manufacturing potential.
*ACC's report presents a hypothetical scenario that includes five ethane crackers and two propane dehydrogenation facilities. Three of the crackers would produce polyethylene and two would supply downstream petrochemical derivatives. Each PDH facility would contain a polypropylene resin plant. These capital investments are underway and will likely continue through the mid-2020s.
www.americanchemistry.com/Appalachian-Petrochem-Study

ENDORSED Tri-State Shale Coalition

## *What is a storage hub?*

A storage hub is a single or set of, storage locations for raw material hydrocarbons such as ethane and butane. It can also include manufactured chemical intermediates such as ethylene. These storage locations are typically below ground in salt domes, natural gas caverns, or other non-porous formations.

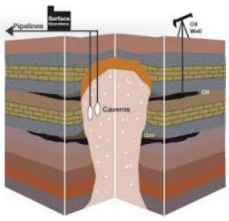
A storage hub includes a backbone of pipelines from source locations to key manufacturing locations plus associated monitoring equipment and appropriate pumps or compressors to move the materials. Some hydrocarbons, especially methane (or natural gas) and crude oil can also be connected to a large country or continent wide pipeline system.

Most storage hubs act purely as a materials storage and transportation network. However, some also act as or include financial exchange structures with price-setting based on local or regional supply and demand. The materials all meet standard specifications.

## *How does it work?*

Producers of hydrocarbons or chemicals link to the pipeline system and flow their material to the storage locations. Consumers of these materials similarly link to the pipeline

system and withdraw materials. This flow of materials is governed by contracts.




Third parties independently monitor and report on flows and storage levels. They also assay the materials to ensure that standard specifications are met. Finally, they are tasked with the smooth operation of the storage hub, which includes both routine maintenance and long-term capital maintenance and needs.

Fees are collected for storage, input and withdrawal of materials. These fees include two components: the on-going payments to third parties to keep the operations running and a payback portion for the large capital outlays needed to establish the storage hub.

A governing body of stakeholders overseas the performance and negotiates the fees for third parties. They make decisions regarding changes in the operation of the storage hub. Changes to capital payback portion can also be made by this governing body.

### *Is the storage hub a new concept?*

No, it has been around for decades and successfully implemented globally in many locations. It is considered standard practice in the petrochemical industry.

The largest example is the Mont Belvieu storage hub on the U.S. Gulf Coast. Other prominent global examples can be found in Rotterdam, Netherlands and Al Jubali Saudi Arabia. There are many others globaly, most of which have been in opearation for decades.

### *What are the benefits of a storage hub?*

The benefits are multiple and have a considerable and long term impact on the region, as demonstrated by existing global storage hubs in fostering petrochemical investment and growth.

The storage hub is essentially a pooled resource of raw materials, overall capital

outlays are dramatically reduced for any single producer or consumer. Both cost and risk is spread among a number of stakeholders.

If a financial exchange structure or system is included, then more transparent and market efficient pricing provides an added benefit producing a level playing field available to all.

However, the largest economic impact is simply the increase in attractiveness of the region to additional — and very large — investments along with potentially hundreds or thousands of high-paying, STEM (Science, Technology, Engineering and Mathematics) jobs. These include investments and jobs in upstream, midstream and downstream facilities.

American Chemistry Council Study on Appalachain Storage Hub Benefits LINK

### *Petrochemical Industry Investments*

If the storage hub includes petrochemical building blocks such as ethylene from regional cracker facilities, then it opens up the region to the many consumers of ethylene (more than 20 distinct chemical processes) that are too small by themselves to invest in an ethane cracker. By consuming ethylene, they, in turn, create additional demand for ethylene which could lead to ethane cracker expansions or additional crackers. This in turn, causes increased demand for ethane from natural gas producers and midstream companies.

These additional capital investments not only bring large numbers of jobs but also increased taxes for the region to grow. It should be noted that each petrochemical manufacturing job historically creates additional 2 to 5 in direct jobs in the community.

PA IHS Markit Study on the Basins potential to support additional petrochemical investment LINK

Shale Crescent IHS Markit Study on the economics of the Basin versus Gulf Coast LINK

### *Strategic security?*

Security, and thus reduced risk, is an important component as well. The storage hub features underground storage and transportation, widely accepted as much safer and more secure than above ground storage and transport. In addition, producers of these materials have access to a larger connected customer base while consumers of these materials have access to multiple suppliers, minimizing the impact of any single interruption in the demand or supply chain.

Creation of another large storage hub in the U.S. geographically distant from the Mont Belvieu hub provides strategic security on a national level. The geographically distant hub would lead to the formation of a petrochemical complex in that location. Thus providing both storage and production separation and thus increased security from any single event. An event could be an act of god such as the hurricane Katrina, which caused shutdown of most of the Gulf Coast petrochemical complexes and resulting nationwide shortages. Events could also be man-made such as terrorism. A geographically separate storage hub and petrochemical base in the Appalachian basin provides strategic security.

Strategic security was the motivator for the US Government investment in the Mont Belvieu hub in the 1950s, and expansion to include the strategic petroleum reserve in the 1970s. It was also the driver for the Philadelphia Storage Hub started in the late 1960s as a cold war era icon as the hub was carved from granite formations and is reputed to be able to withstand an H bomb within 50ft without damage.

### *Where would be built?*

That is still to be determined and depends heavily on local geology. Underground storage sits typically impermeable underground salt domes will need to be evaluated. Many such sites exists, their suitability and capacity are unknown.


One proposal is essentially to follow the existing Appalachian basin chemical footprint and run along the Ohio River between West Virginia and Ohio, with small side branches. Which covers nearly the same distance as the Mont Belvieu Hub. Leading to the name 'Mont Belvieu along the Ohio river'. Extensions along the Ohio River to Kentucky and Indiana petrochemical complexes have also been contemplated.

Benedum Study on Geological Formations LINK

Raw materials and energy for chemical production are economically advantaged with production in the Basin, versus other global and even US Gulf Coast locations. This potentially leads to $36 billion in new chemicals and plastics industry investments. From this perspective, the sizeable investments needed for an Appalachian Storage Hub are justified and the game changing nature of a hub confirmed.

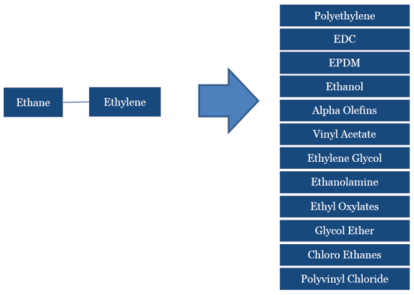
### *Chemical Intermediates, what is the relationship to the storage hub?*

The regional focus has been on attracting large global scale ethane crackers, which is understandable considering the $5 billion investment in one plant. These ethane crackers, convert ethane into ethylene and in a separate step polymerize ethylene into polyethylene, the final product which is shipped to plastics processors.

Ethylene, the chemical intermediate in these plants is also a useful intermediate to produce a number of other chemical products, some of which are outlined in the graphic.

The chemical company with the ethane cracker has expertise in the technologies for that process and in marketing the end use polyethylene. They rarely produce any of these other ethylene based products. Instead they are produced by other chemical companies. As we have seen in the US Gulf Coast and other others with a high concentration of petrochemical investment a win-win cycle is created.

The cracker plant owner can at modest cost increase the output of ethylene and thus increase scale and spread overhead and non raw material costs over a larger output, increasing profitability. The ethylene consuming chemical company gains access to ethylene without an investment and knowledge of the technologies. They also gain ethylene at close to producer costs from a plant that is far larger in scale than their demands required.




This results in two new investments, the increase in cracker capacity to produce ethylene and the new ethylene consuming plant. The investment of these ethylene consuming plants can vary from quarter of a billion dollars to several billion for world scale units. Since the region has the lowest

ethane costs globally, and local demand for these downstream ethylene based products, they are economically advantaged and local production will be the most profitable option.

### *What could be stored in the storage hub?*

Other hubs have a wide range of raw materials from crude oil to chemical intermediates. For the unique case of an Appalachian Storage Hub, the key raw materials for the chemical industry -- ethane and propane are high on the list. Chemical intermediates ethylene and propylene and chlorine -- the high volume building blocks are also candidates. Beyond that market demands will dictate.

Contact Us

# Gas pipelines represent prosperity

## The Marcellus Shale is bringing good jobs and cleaner air to Pennsylvania

DAVID SPIGELMYER AND JAMES KUNZ

SEP 5, 2016 | 12:00 AM

We often read and hear about the need to expand natural gas pipelines and associated infrastructure. From Mariner East to PennEast to Atlantic Sunrise and many more, state and federal regulators are weighing the approval of thousands of miles of critical energy infrastructure.

central question — why? Why is natural gas infrastructure so important for the commonwealth?

Natural gas pipelines — which Pennsylvania's hardworking and highly skilled building trade union members safely construct — are the cornerstone to realizing shale's economic and environmental benefits. What's more, this infrastructure is unquestionably the safest way to transport energy, as 99.999 percent of crude oil and petroleum products delivered by pipeline reach their destination safely, according to a new report.



Providing an economic shot in the arm when we needed it most, the historic energy revolution that took off right across Appalachia is breathing much-needed life into union halls and creating new opportunities for local laborers who are well-trained and take enormous pride in the work they're privileged to do. This game-changing opportunity — enabled by strong, sustainable natural gas production — is helping to spur new apprentice programs to train the next generation of skilled workers to build future shale-driven

MENU

partnership among our region's building trades unions, energy producers and pipeline companies is worth taking stock in and celebrating.

And as the industry continues to mature, demand for a nimble, ready-to-execute local labor force is growing.

Consider the Mariner East II project, which represents a $3 billion infrastructure investment which is expected to create nearly 30,000 jobs — many of which require the precision and expertise of construction trade union members. At the same time, these energy projects are spurring a regional manufacturing renaissance — an industrial rebirth that's generating new job-creating construction, development and expansions.



Take the recently announced Shell ethane cracker project in Beaver County, for example. This project, which represents the largest investment made in Pennsylvania since World War II, is expected to create 6,000 construction jobs and support 600

What's playing out before us right now represents a classic American success, or turnaround, story — and it's one that we should all be proud of and grateful for.

For hardworking, middle-class families throughout the commonwealth, pipelines are delivering significant energy savings that give strained household budgets a little extra, and much-needed, room. America's emergence as a global energy production leader has helped lower the cost of living and reduce household energy costs by as much as 25 percent for homes relying on natural gas, according to recent federal data.

With natural gas, we no longer are forced to choose between growing our economy or improving our environment. Thankfully, we can have both. As Department of Environmental Protection Secretary Patrick McDonnell recently said, Pennsylvania's air quality "continues to improve," reflecting the benefits of producing and using more clean-burning natural gas that's safely developed right here at home. These significant air-quality benefits are being realized at the national level, too, as America has reduced its carbon emissions more than any other nation, thanks in large part to greater natural gas production and its use in electric power generation.

Safely developing and modernizing Pennsylvania's natural gas infrastructure network — made possible by local laborers and an industry that shares the commitment for a more prosperous future — will ensure that our air will continue to improve, that job opportunities will be there for those seeking work and that our nation will further reduce its dependence on unstable and often unfriendly regions of the world to meet our growing energy

MENU

progress is set into motion and is generating jobs for future generations.

*David Spigelmyer is president of the Marcellus Shale Coalition. James Kunz is business manager for International Union of Operating Engineers Local 66.*

*First Published September 5, 2016, 12:00am*

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https://www.wsj.com/articles/texas-spins-into-the-wind-11613605698

OPINION | REVIEW & OUTLOOK

# *Texas Spins Into the Wind*

An electricity grid that relies on renewables also needs nuclear or coal power.

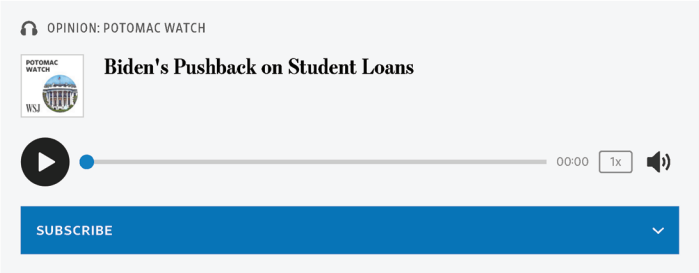
By The Editorial Board
Updated Feb. 17, 2021 9:39 pm ET


A sign states that a Fiesta Mart is closed because of a power outage in Austin, Feb. 17.
PHOTO: MONTINIQUE MONROE/GETTY IMAGES

**Listen to this article**
5 minutes

While millions of Texans remain without power for a third day, the wind industry and its advocates are spinning a fable that gas, coal and nuclear plants—not their frozen turbines—are to blame. PolitiFact proclaims "Natural gas, not wind turbines, main driver of Texas power shortage." Climate-change conformity is hard for the media to resist, but we don't mind. So here are the facts to cut through the spin.

Texas energy regulators were already warning of rolling blackouts late last week as temperatures in western Texas plunged into the 20s, causing wind turbines to freeze. Natural gas and coal-fired plants ramped up to cover the wind power shortfall as demand for electricity increased with falling temperatures.




Some readers have questioned our reporting Wednesday ("The Political Making of a Texas Power Outage") that wind's share of electricity generation in Texas plunged to 8% from 42%. How can that be, they wonder, when the Electric Reliability Council of Texas (Ercot) has reported that it *counts* on wind to meet only 10% of its *winter capacity*.

Ercot's disclosure is slippery. Start with the term "capacity," which means potential maximum output. This is different than actual power generation. Texas has a total winter capacity of about 83,000 megawatts (MW) including all power sources. Total power demand and generation, however, at their peak are usually only around 57,000 MW. Regulators build slack into the system.

Texas has about 30,000 MW of wind *capacity*, but winds aren't constant or predictable. Winds this past month have generated between about 600 and 22,500 MW. Regulators don't count on wind to provide much more than 10% or so of the grid's total capacity since they can't command turbines to increase power like they can coal and gas plants.

Wind turbines at times this month have generated more than half of the Texas power *generation*, though this is only about a quarter of the system's power capacity. Last week wind generation plunged as demand surged. Fossil-fuel generation increased and covered the supply gap. Thus between the mornings of Feb. 7 and Feb. 11, wind as a share of the

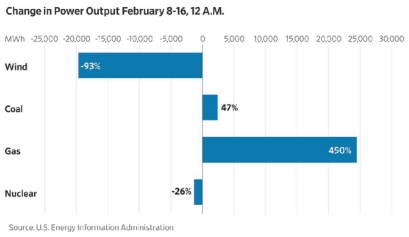
state's electricity fell to 8% from 42%, according to the Energy Information Administration (EIA).

Gas-fired plants produced 43,800 MW of power Sunday night and coal plants chipped in 10,800 MW—about two to three times what they usually generate at their peak on any given winter day—after wind power had largely vanished. In other words, gas and coal plants held up in the frosty conditions far better than wind turbines did.

It wasn't until temperatures plunged into the single digits early Monday morning that some conventional power plants including nuclear started to have problems, which was the same time that demand surged for heating. Gas plants also ran low on fuel as pipelines froze and more was diverted for heating.

"It appears that a lot of the generation that has gone offline today has been primarily due to issues on the natural gas system," Electric Reliability Council of Texas senior director Dan Woodfin said Tuesday. The wind industry and its friends are citing this statement as exoneration. But note he used the word "today." Most wind power had already dropped offline last week.

Gas generation fell by about one-third between late Sunday night and Tuesday, but even then was running two to three times higher than usual before the Arctic blast. Gas power nearly made up for the shortfall in wind, though it wasn't enough to cover surging demand.




Between 12 a.m. on Feb. 8 and Feb. 16, wind power plunged 93% while coal increased 47% and gas 450%, according to the EIA. Yet the renewable industry and its media

mouthpieces are tarring gas, coal and nuclear because they didn't operate at 100% of their expected potential during the Arctic blast even though wind turbines failed nearly 100%.

The policy point here is that an electricity grid that depends increasingly on subsidized but unreliable wind and solar needs baseload power to weather surges in demand. Natural gas is crucial but it also isn't as reliable as nuclear and coal power.

Politicians and regulators don't want to admit this because they have been taking nuclear and coal plants offline to please the lords of climate change. But the public pays the price when blackouts occur because climate obeisance has made the grid too fragile. We've warned about this for years, and here we are.

*Correction: An earlier edition misstated the total winter power capacity and typical demand and generation in Texas.*

*Appeared in the February 18, 2021, print edition.*

https://www.wsj.com/articles/a-deep-green-freeze-11613411002

OPINION | REVIEW & OUTLOOK

# *A Deep Green Freeze*

Power shortages show the folly of eliminating natural gas—and coal.

By The Editorial Board
Updated Feb. 15, 2021 2:09 pm ET

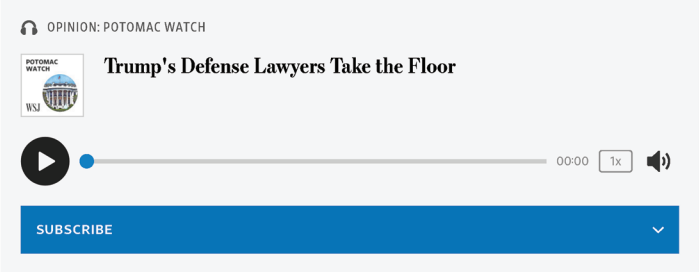
Oil rigs are seen in a icy landscape near Interstate 20 in Odessa,Texas, Feb. 12.
PHOTO: JACOB FORD/ASSOCIATED PRESS

**Listen to this article**
5 minutes

Gas and power prices have spiked across the central U.S. while Texas regulators ordered rolling blackouts Monday as an Arctic blast has frozen wind turbines. Herein is the paradox of the left's climate agenda: The less we use fossil fuels, the more we need them.

A mix of ice and snow swept across the country this weekend as temperatures plunged below zero in the upper Midwest and into the teens in Houston. Cold snaps happen—the U.S. also experienced a Polar Vortex in 2019—as do heat waves. Yet the power grid is

becoming less reliable due to growing reliance on wind and solar, which can't provide power 24 hours a day, seven days a week.




While Texas is normally awash in gas and oil, the Electric Reliability Council of Texas, which oversees the state's wholesale power market, urged residents this weekend to conserve power to avoid power outages. Regulators rationed gas for commercial and industrial uses to ensure fuel for power plants and household heating.

Texas's energy emergency could last all week as the weather is forecast to remain frigid. "My understanding is, the wind turbines are all frozen," Public Utility Commission Chairman DeAnn Walker said Friday. "We are working already to try and ensure we have enough power but it's taken a lot of coordination."



Blame a perfect storm of bad government policies, timing and weather. Coal and nuclear are the most reliable sources of power. But competition from heavily subsidized wind power and inexpensive natural gas, combined with stricter emissions regulation, has caused coal's share of Texas's electricity to plunge by more than half in a decade to 18%.

Wind's share has tripled to about 25% since 2010 and accounted for 42% of power last week before the freeze set in. About half of Texans rely on electric pumps for heating, which liberals want to mandate everywhere. But the pumps use a lot of power in frigid weather. So while wind turbines were freezing, demand for power was surging.

Gas-fired power plants ramped up, but the Arctic freeze increased demand for gas across the country. Producers couldn't easily increase supply since a third of rigs across the country were taken out of production during the pandemic amid lower energy demand. Some gas wells and pipelines in Texas and Oklahoma also shut down in frosty conditions.

Enormous new demand coupled with constrained supply caused natural gas spot prices to spike to nearly $600 per million British thermal units in the central U.S. from about $3 a couple weeks ago. Future wholesale power prices in Texas for early this week soared to $9,000 per megawatt hour from a seasonal average of $25.

Prices jumped in the Midwest too, though less dramatically because there are more coal and nuclear plants. Illinois and Michigan have more gas storage than Texas, which exports much of its shale gas to other states and, increasingly, around the world in liquefied form.

Europe and Asia are also importing more fossil fuels for heat and power this winter. U.S. LNG exports increased 25% year-over-year in December while prices tripled in northern Asian spot markets and doubled in Europe. Germany's public broadcasting recently reported that "Germany's green energies strained by winter." The report noted that power is "currently coming mainly from coal, and the power plants in Lausitz" are now "running at full capacity."

Coal still accounts for 60% of China's energy, and imports tripled in December. China has some 250 gigawatts of coal-fired plants under development, enough to power all of Germany. Unlike Democrats in the U.S., Chinese leaders understand that fossil fuels are needed to support intermittent renewables. "Power shortages and incredibly high spot

gas prices this winter are reminding governments, businesses and consumers of the importance of coal," a Wood Mackenzie consultant told Reuters recently.

California progressives long ago banished coal. But a heat wave last summer strained the state's power grid as wind flagged and solar ebbed in the evenings. After imposing rolling blackouts, grid regulators resorted to importing coal power from Utah and running diesel emergency generators.

Liberals claim that prices of renewables and fossil fuels are now comparable, which may be true due to subsidies, but they are no free lunch, as this week's energy emergency shows. The Biden Administration's plan to banish fossil fuels is a greater existential threat to Americans than climate change.

*Appeared in the February 16, 2021, print edition.*

TLP:WHITE

U.S. DEPARTMENT OF ENERGY | Office of Cybersecurity, Energy Security, and Emergency Response

# Extreme Cold & Winter Weather | Update #1

**REPORT TIME & DATE:** 12:00 PM EST| Tuesday, February 16, 2021
**REPORT DISTRIBUTION:** Public

## EXECUTIVE SUMMARY

An arctic air mass is impacting the Central United States, bringing snow, ice, and extreme cold temperatures from the Canadian border as far south as Texas, causing record winter power demand and impacting power generation, including natural gas and wind facilities. The Electric Reliability Council of Texas (ERCOT), the Southwest Power Pool (SPP), and the Midcontinent Independent System Operator (MISO) have implemented controlled power outages across portions of their systems to manage load. The arctic air mass is expected to continue impacting the region through the remainder of the week and additional winter weather is forecast in Texas on Wednesday.

**Electricity Sector Summary**

- As of 10:30 AM EST, February 16, ERCOT and SPP have declared Energy Emergency Alert (EEA) Level 3 due to operating reserves falling below the required minimum as high demands related to ongoing severe winter weather event exceeded available generation capacity. Generation resources are strained due to cold weather tripping units, natural gas supply curtailments, and wind power generation outages. ERCOT, SPP, and MISO have instructed utilities to shed firm load and implement controlled outages. Controlled outages could continue throughout the day.
    - As of 10:45 AM EST, there were approximately 4.89 million power outages across Texas, Louisiana, and Oklahoma, with 4.5 million outages in Texas.
    - Although a substantial number of customers are out of power due to the controlled power outages, some customers are without power in Texas and Louisiana due to damaged infrastructure from the ongoing winter weather.

**Natural Gas Sector Summary**

- As of February 16, gas production in the U.S. South Central Region was down approximately 6.3 billion cubic feet per day (Bcf/d) due to wellhead freeze-offs and natural gas processing plant outages caused by extreme cold. These outages represent approximately 30% of U.S. South Central output and approximately 7% of total U.S. gas production. Although production losses due to freeze-offs are temporary, output takes time to return to normal levels and the cumulative reduction over several days could be substantial.
- Gas suppliers are responding to high demands and gas production outages by withdrawing gas from storage. As of February 16, gas storage draws in the U.S. South Central region are up approximately 10 Bcf/d (100%) compared to pre-event withdrawals.

**Petroleum Sector Summary**

- As of February 16, approximately 3.6 million bcf/d of refining capacity was reported offline in the U.S. Gulf Coast region as refiners have shut down refineries either due to the cold weather directly or due to power outages. These refinery outages account for approximately 36% of total U.S. Gulf Coast refining capacity and approximately 19% of total U.S. refining capacity.

## DOE ACTIONS

- DOE is coordinating with industry, interagency, and state partners to provide situational awareness and support restoration efforts.
- DOE is holding daily calls with electricity and oil and natural gas partners and is in regular contact with the North American Electric Reliability Corporation.
- The DOE Power Marketing Administrations are working with customers, reliability coordinators, and balancing authorities to support reliability within their service territories.
- Following a formal petition from ERCOT on February 14, the Acting Secretary of Energy issued an emergency order pursuant to section 202(c) of the Federal Power Act to authorize the dispatch of additional generation units in the ERCOT region to help ensure reliability. This allows ERCOT to dispatch generation units they deem necessary to meet electricity demand from February 14 through February 19, 2021 even if they are in exceedance of limits for sulfur dioxide, nitrogen oxide, mercury, and carbon monoxide emissions, as well as wastewater release limits. The order and additional information can found at: https://www.energy.gov/oe/downloads/federal-power-act-section-202c-ercot-february-2021.

## ELECTRICITY SECTOR

**POWER OUTAGES**

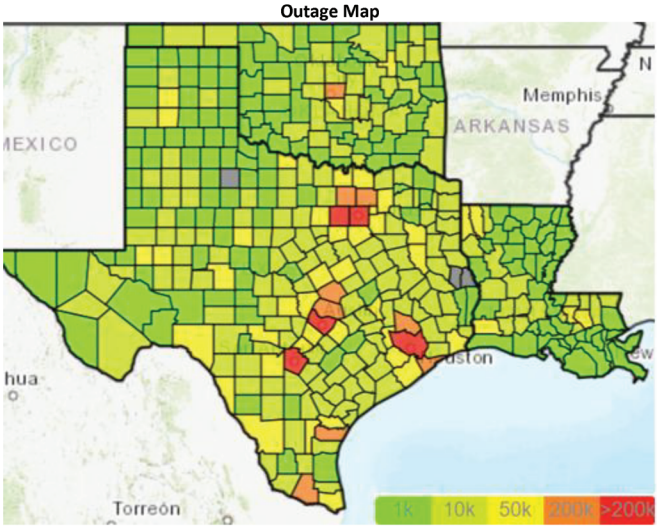
- As of 10:45 AM EST, there were approximately 4.89 million power outages across Texas, Louisiana, and Oklahoma, with 4.5 million outages in Texas.
- Oregon has also experienced a severe winter storm causing widespread outages, totaling 223,098 as of 10:45 AM EST.

**Extreme Cold Customer Power Outages**
*as of 10:45 AM EST 02/16/2021*

| State | Current Outages | % of State Without Power |
|---|---|---|
| Texas* | 4,511,638 | 27% |
| Louisiana | 164,525 | 2% |
| Oklahoma | 211,496 | <1% |
| Total | 4,887,659 | - |

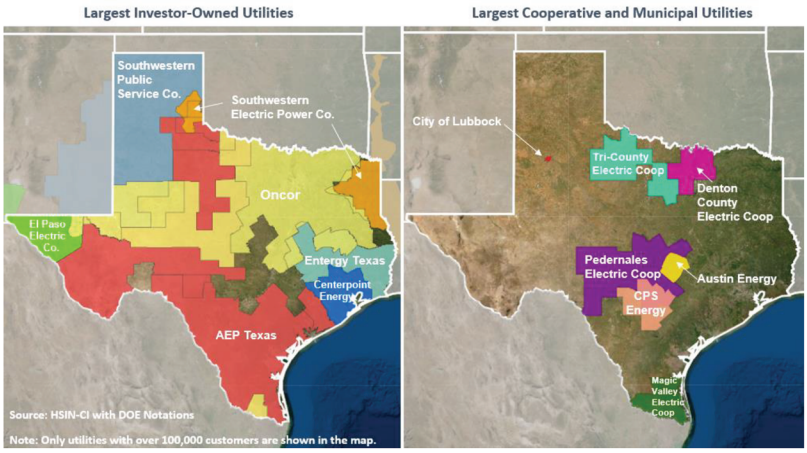
*Some outages due to winter storms, rather than controlled power outages.

**Outage Map**




**ELECTRICITY OVERVIEW**

- High demands related to ongoing extreme cold winter weather in the ERCOT, SPP, and MISO territories exceeded available generation capacity on February 15. At 2:25 AM EST on February 15, ERCOT declared an EEA 3and instructed utilities across ERCOT's territory to shed firm load and implement controlled outages. MISO also instructed Entergy Texas to shed firm load in MISO's Western (Texas) Load Pocket. SPP declared EEA 3 at 7:15 AM EST on February 16, signaling that operating reserves are below the required minimum. SPP implemented a load shed and cut electricity exports.
- In addition to high-demand, the cold temperatures have caused natural gas well "freeze-offs," curtailing the availability of natural gas in some locations. Additionally, an ice storm late last week and continuing winter weather have limited wind generation due to icing on the turbines. Solar generation has also been limited due due to heavy cloud cover. Weather impacts have also been reported at other generation facilities.
- Although a substantial number of customers are out of power due to the controlled power outages, some of the customers are without power in Texas and Louisiana due to damaged infrastructure related to the winter weather.



**REGIONAL DETAILS**

| ERCOT |
| --- |
| **OVERVIEW**<br>• At 2:25 AM EST on February 15, ERCOT declared an EEA 3 and instructed utilities within ERCOT's service area in Texas to shed firm load and implement controlled outages due to generation inadequacy.<br>  ○ Prior to declaring an EEA 3 and implementing load shed, ERCOT declared an EEA 1 at 1:17 AM EST and an EEA 2 at 2:12 AM EST due to the loss of several generation units.<br>• ERCOT anticipates generators to return to service and renewable output to increase on February 16. ERCOT anticipates that customer outages will decrease throughout the day.<br>• Reduced supply of natural gas due to well "freeze offs," lower-than-normal solar generation due to heavy cloud cover, and limited wind generation due to icing on the turbines have further constrained electricity generation.<br>• On the evening of February 14, the Acting Secretary of Energy issued an emergency order pursuant to section 202(c) of the Federal Power Act to authorize the dispatch of additional generation units in the ERCOT region to help ensure reliability. This allows ERCOT to dispatch generation units they deem necessary to meet electricity demand from February 14 through February 19, 2021 even if they are in exceedance of limits for sulfur dioxide, nitrogen oxide, mercury, and carbon monoxide emissions, as well as wastewater release limits.<br>• ERCOT is the independent system operator for the state of Texas, serving about 26 million people and about 90% of the state's electric load. ERCOT operates largely independently from the rest of country and is not subject to federal oversight.<br><br>**DEMAND FORECAST**<br>• The current-day forecast peak is 58,266 MW as of 9:15 AM EST.<br>• The day-ahead forecast peak for February 17 is 75,056 MW, even higher than the forecast peak on February 16. |

## MISO

**OVERVIEW**

- Due to extreme winter weather and temperature, generation and transmission failures have occurred in the Entergy Texas Western Load Pocket of MISO. To alleviate transmission overloads, interruptible load was shed.
- MISO declared a Maximum Generation Emergency Event Step 2c effective February 15 at 6 PM EST through February 15 at 10 PM EST for the South Region. Local balancing authorities are asked to issue public appeals to reduce demand and should prepare to shed load due to forced generation outages and extreme cold temperatures. North/Central Regions are in Maximum Generation 1b.
- Utilities in additional states began shedding load on the evening of February 15.
- MISO's Cold Weather Alert is in effect through February 17. Temperatures are expected to be as low as 0 degrees F and operators should expect to be contacted about fuel restrictions.
- MISO is the independent system operator and regional transmission organization for much of the Midwest, with 15 U.S. member states, including a small portion of Texas not covered by ERCOT.

## SPP

**OVERVIEW**

- SPP declared an EEA 3 effective at 6:15 AM EST on February 16 for the entire balancing authority area, which was followed by load-shed.
- SPP is forecasting a morning peak of above 44.6 GW around 10 AM EST on February 16, higher than the peak load of 43.661 MW on February 15.
- SPP had previously declared an EEA Level 2 beginning at 8:22 AM EST on February 15, an EEA Level 1 at 6 AM EST on February 15, and a period of conservative operations at 1 AM EST on February 9.
- SPP experienced some generator outages on the morning of February 15 that contributed to local loading issues in addition to reducing supply needed to serve load.
- Electricity prices within the SPP service areas are at the top of the range.
- SPP has 14 member states in the central and western U.S. and performs contract reliability coordination services in three additional states.

## NATURAL GAS SECTOR

**NATURAL GAS SUMMARY**

Extreme cold temperatures have led to sharp increases in gas demands for home heating and electricity generation across much of the Central U.S. At the same time, the cold has led to supply disruptions caused by well freeze-offs and natural gas processing plant outages in several producing areas in the U.S. South Central region (TX, OK, KS, LA, AR, MS, AL), which typically accounts for approximately 20-25% of total U.S. gas production.

**NATURAL GAS PRODUCTION**

- Wellhead freeze-offs have caused producers to cut back natural gas production in the South Central United States, including in the Permian Basin in Texas and New Mexico, the Cana Woodford in Oklahoma, and the Denver-Julesburg in Colorado. Over the past weekend the Permian Basin saw temperatures overnight as low as 0 degrees F.
- As of February 16, Texas gas production was estimated at 15.7 billion cubic feet per day (Bcf/d), down approximately 30% from pre-event average.
- Although production losses due to freeze-offs are temporary, output takes time to return to normal levels, and the cumulative reduction over several days could be substantial.

**NATURAL GAS PROCESSING PLANTS**

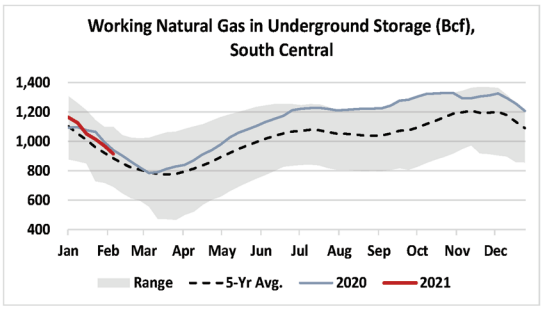
- Some natural gas processing plants across Texas have reportedly shut down due to freezing conditions. This has forced the shut-in of some natural gas production.

**NATURAL GAS STORAGE**

- Suppliers are compensating for lost output and responding to the surge in gas demand by withdrawing gas from storage facilities.
- Draws from gas storage facilities in the U.S. South Central region have increased sharply during the cold weather event, doubling to about 20 Bcf/d from about 10 Bcf/d pre-event.

**NATURAL GAS STOCKS**

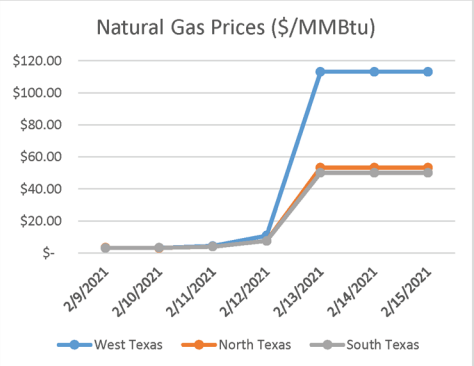
- Natural gas stocks in the U.S. South Central region stood at 915 Bcf/d on February 5, 4.3% above the five-year average for this time of year.
- According to EIA's Form 191 data, Texas has 30 active natural gas storage facilities.




South Central includes Alabama, Arkansas, Kansas, Louisiana, Mississippi, Oklahoma, and Texas

**NATURAL GAS PRICES**

- Natural gas prices have increased across Texas with spot prices increasing above $100/MMBtu in several markets. Price increases have been seen across the entire Midcontinent as demands due to cold weather have strained supply and resulted in price spikes.




**NATURAL GAS UTILITIES**

- On February 12, the Texas Railroad Commission issued an emergency order temporarily prioritizing natural gas deliveries to natural gas utilities for residences, hospitals, schools, churches, and other human needs customers.

## PERTROLEUM SECTOR

**PETROLEUM SECTOR SUMMARY**

Extreme cold temperatures and power outages have forced operators to shut down refineries in the U.S. Gulf Coast region. Additionally, extreme cold temperatures and well freeze-offs have led to production outages in producing areas.

**PORTS**

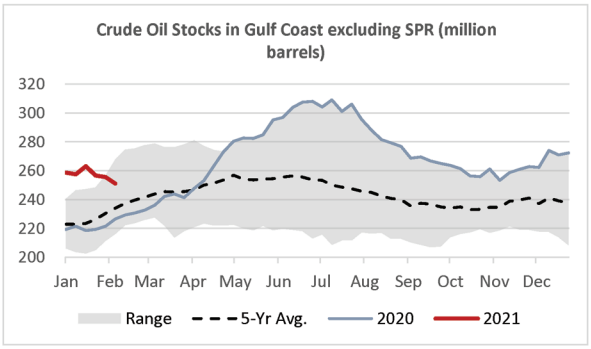
- Operations in the Houston Ship Channel have been reduced due to freeze offs impacting refineries and terminals. On February 16, there were 13 vessels waiting to depart the channel with 18 ships in queue to come into the waterway.

**REFINERIES**

- There are approximately 3.6 million bcf/dof refinery capacity outages due to the severe cold along the Texas Coast, or about 36% of PADD 3 refinery capacity, and 20% of U.S. refinery capacity.

**OIL STOCKS**

- Crude oil stocks in the Gulf Coast (PADD 3) averaged 251 million barrels for the week ending February 5, 7.2% above the five-year average for this time of year.



## EMERGENCY DECLARATIONS & WAIVERS

**EMERGENCY DECLARATIONS**

To provide vital supplies and transportation services to a disaster area in the United States, emergency declarations may be issued by the President, Governors of States, or the Federal Motor Carrier Safety Administration (FMCSA). These declarations trigger the temporary suspension of certain Federal safety regulations, including Hours of Service for motor carriers and drivers engaged in specific aspects of the emergency relief effort. See 49 CFR 390.23 for the actual emergency regulation.

| Emergency Declarations and HOS Waivers *as of 1:00 PM EDT 02/15/2021* | | | | |
|---|---|---|---|---|
| State/Territory | Details | Effective Dates | | Status |
| | | Start | End | |
| Virginia | State of Emergency | 2/11 | 3/13 | Active |
| Oregon | State of Emergency | 2/13 | 2/20 | Active |
| Kentucky | Kentucky Transportation Cabinet Declaration of Emergency- Assistance for power restoration and delivery of gasoline, propane, and diesel fuels | 2/11 | 2/21 | Active |
| Mississippi | State of Emergency | 2/14 | 2/21 | Active |
| Alabama | State of Emergency | 2/14 | Continuing | Active |
| Louisiana | State of Emergency | 2/11 | Continuing | Active |
| Oklahoma | State of Emergency | 2/12 | Continuing | Active |
| Texas | Texas Department of Public Safety Emergency Notice – Assistance for delivery of Propane and Home Heating Oils | 2/10 | 2/15 | Active |
| | Federal Emergency Declaration | 2/11 | Continuing | Active |
| | State Disaster Declaration | 2/12 | Continuing | Active |

Sources: State government, White House, and FMCSA websites.

TLP:WHITE

U.S. DEPARTMENT OF ENERGY | Office of Cybersecurity, Energy Security, and Emergency Response

# Extreme Cold & Winter Weather | Update #2

**REPORT TIME & DATE:** 12:00 PM EST| Wednesday, February 17, 2021
**REPORT DISTRIBUTION:** Public

## EXECUTIVE SUMMARY

An arctic air mass is impacting the Central United States, bringing snow, ice, and extreme cold temperatures from the Canadian border as far south as Texas, causing record winter power demand and impacting power generation. The Electric Reliability Council of Texas (ERCOT) has directed utilities to implement controlled power outages across Texas to manage load since early Monday. The Southwest Power Pool (SPP), and the Midcontinent Independent System Operator (MISO) also implemented controlled outages on Monday and Tuesday. The arctic air mass is expected to continue impacting the region through the remainder of the week, and additional winter weather is forecast in Texas on Wednesday.

**Electricity Sector Summary**

- As of 10:30 AM EST, February 17, the Energy Emergency Alert (EEA) Level 3 for ERCOT remains in place due to operating reserves falling below the required minimum as high demands related to ongoing severe winter weather event exceeded available generation capacity. Generation resources are strained due to cold weather tripping units, natural gas supply curtailments and some wind power generation outages. ERCOT has instructed utilities to shed firm load and implement controlled outages. Controlled (rotating) outages could continue throughout the day.
    - As of 9:30 AM EST, there were at least 3.4 million power outages across Texas and Louisiana, with 3.3 million outages in Texas. This is down from more than 4 million customers without power on the afternoon of February 16.
    - ERCOT directed member utilities to restore an additional 600,000 customers overnight, in addition to the 400,000 customers restored on the afternoon of February 16.
    - Although a substantial number of customers are out due to the controlled power outages, some of the customers are without power in Texas and Louisiana due to damaged infrastructure from the ongoing winter weather.
- SPP has restored its controlled outages and downgraded its status to EEA Level 2, and MISO has issued a Maximum Generation Alert through 11 PM EST, February 17.

**Natural Gas Sector Summary**

- Extreme cold temperatures have led to sharp increases in gas demands for home heating and electricity generation across much of the Central United States. At the same time, the cold has led to well freeze-offs and natural gas processing plant outages that have caused supply disruptions in several producing areas, especially in the U.S. South Central region (TX, OK, KS, LA, AR, MS, AL), which typically accounts for approximately 20-25% of total U.S. gas production.

**Petroleum Sector Summary**

- As of February 17, there is approximately 3.3 million barrels per day (b/d) of capacity, equal to about 18% of total U.S. refinery capacity. Reported impacts are primarily concentrated in the Texas Gulf Coast region.

## DOE ACTIONS

**DOE ENERGY RESPONSE ORGANIZATION (ERO):** ACTIVATED: Enhanced Watch

- DOE is coordinating with industry, interagency, and state partners to provide situational awareness and support restoration efforts.
- DOE is holding daily unity of effort calls with electricity and oil and natural gas partners and is in regular contact with the North American Electric Reliability Corporation.
- Following a formal petition from ERCOT on February 14, the Acting Secretary of Energy issued an emergency order pursuant to section 202(c) of the Federal Power Act to authorize the dispatch of additional generation units in the ERCOT region to help ensure reliability. This allows ERCOT to dispatch generation units they deem necessary to meet electricity demand from February 14 through February 19, 2021 even if they are in exceedance of limits for sulfur dioxide, nitrogen oxide, mercury, and carbon monoxide emissions, as well as wastewater release limits. A copy of the order and additional information can found at: https://www.energy.gov/oe/downloads/federal-power-act-section-202c-ercot-february-2021.

## ELECTRICITY SECTOR

**POWER OUTAGES**

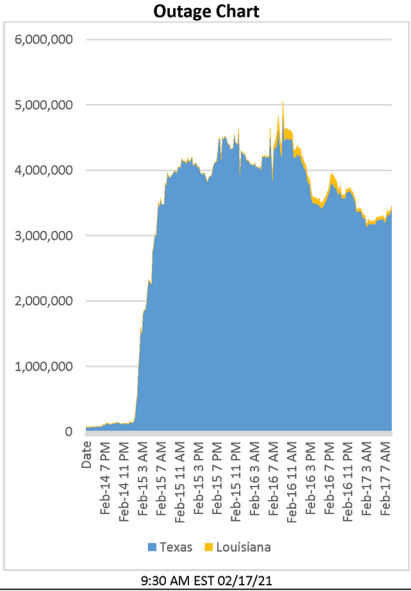
- As of 9:30 AM EST, there were at least 3.39 million power outages across Texas and Louisiana, including 3.34 million outages in Texas.
- In addition, there are 157,679 customers out in Oregon as of 9:30 AM EST due to a winter storm, which affected the region over the weekend.

**Texas and Louisiana Customer Power Outages**
*as of 9:30 AM EST 02/17/2021*

| State | Current Outages | % of State Without Power | Peak Outages | % Restored from Peak |
|---|---|---|---|---|
| Texas* | 3,341,984 | 28% | 4,893,204 | 32% |
| Louisiana | 45,706 | 2% | 211,496 | 78% |
| Total | 3,387,690 | - | - | - |

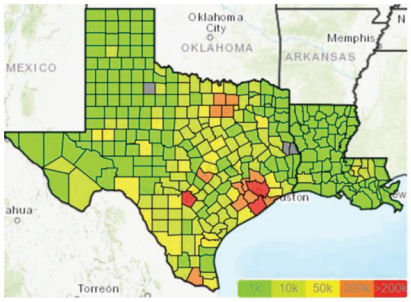
*Total outages, including both controlled outages and storm-related outages. Outage information for Pedernales Electric is unavailable as of 9:45 AM EST on February 17 and is not included in the Texas total.

**Outage Chart**




9:30 AM EST 02/17/21

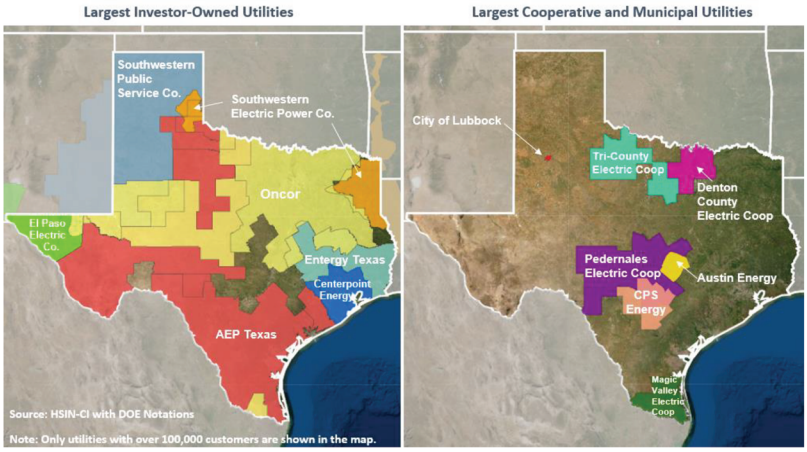
**Outage Map**




9:30 AM EST 02/17/21

**ELECTRICITY OVERVIEW**

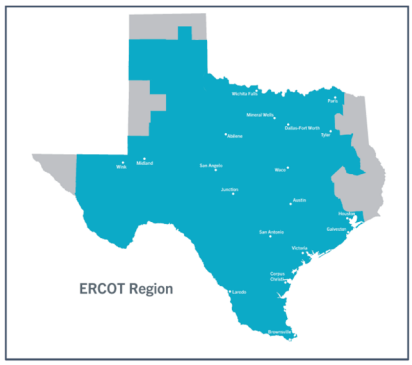
- **ERCOT:** As of 9:30 AM EST on February 17, ERCOT remains in EEA Level 3.
- **SPP:** As of 6:30 PM EST on February 16, SPP declared an EEA Level 2, in which members companies are asked to issue public conservation appeals. The alert will remain in effect until further notice. SPP currently has enough online generating capacity to meet system-wide demand.
- **MISO:** As of 9:30 AM EST on February 17, MISO had terminated EEAs and issued a Maximum Generation Alert for its South Region through 11 PM EST.



**REGIONAL DETAILS**

## ERCOT

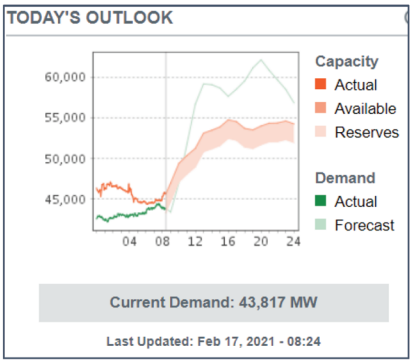
**OVERVIEW**




- ERCOT announced at 9:30 AM EST on February 17 that although some generation returned to service overnight, 14,000 MW of load shed is still needed, in part due to lost east DC-tie imports due to the conditions in the Midwest.
- ERCOT remains in EEA Level 3, which it first implemented at 2:25 AM EST on February 15. At that time, ERCOT instructed utilities within ERCOT's service area in Texas to shed firm load and implement controlled outages due to generation inadequacy.
- ERCOT is the independent system operator for the state of Texas, serving about 26 million people and about 90% of the state's electric load. ERCOT operates largely independently from the rest of country and is not subject to federal oversight.

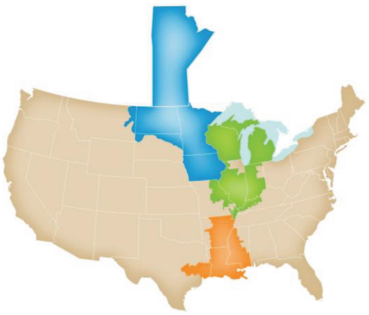
**GENERATION**

- Curtailed supply of natural gas due to well freeze offs, and reduced wind generation due to icing on the turbines have constrained electricity supply.
- On the evening of February 14, the Acting Secretary of Energy issued an emergency order pursuant to section 202(c) of the Federal Power Act to authorize the dispatch of additional generation units in the ERCOT region to help ensure reliability. This allows ERCOT to dispatch generation units they deem necessary to meet electricity demand from February 14-19, 2021 even if exceed limits for sulfur dioxide, nitrogen oxide, mercury, and carbon monoxide emissions, as well as wastewater release limits.



## MISO

**OVERVIEW**

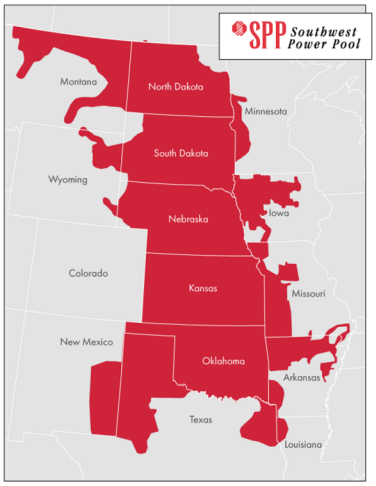


- Due to extreme winter weather and temperature, generation and transmission failures have occurred in the Western Load Pocket of MISO. To alleviate transmission overloads, MISO directed Entergy Texas to perform interruptible load shed on February 15 and additional load shed was required on February 16.
- MISO terminated directive for member utilities in the South Region to implement periodic power outages at 11 PM EST February 16.
- MISO issued a Maximum Generation Alert from February 17 at 2 AM EST until 11 PM EST for its South Region.
- MISO's Cold Weather Alert is in effect through February 17. Temperatures are expected to be near 0.
- MISO is the independent system operator and regional transmission organization for much of the Midwest, with 15 U.S. member states, including a small portion of Texas not covered by ERCOT.

## SPP

**OVERVIEW**

- At 7:30 PM EST, February 16, SPP declared an EEA Level 2. An EEA Level 2 required SPP to direct its member companies to issue public conservation appeals. The alert will remain in effect until further notice.
- SPP's forecasts anticipate that due to high load and persistent cold weather, it is likely its system will fluctuate between EEA levels over the next 48 hours.
- SPP previously declared the EEA Level 3 on February 16 for the entire balancing authority area and issued load-shed instruction for capacity deficiency.
- SPP has 14 member states in the central and western U.S. and performs contract reliability coordination services in three additional states.



## NATURAL GAS SECTOR

**NATURAL GAS SUMMARY**

Extreme cold temperatures have led to sharp increases in gas demands for home heating and electricity generation across much of the Central United States. At the same time, the cold has led to well freeze-offs and natural gas processing plant outages that have caused supply disruptions in several producing areas, especially in the U.S. South Central region (TX, OK, KS, LA, AR, MS, AL), which typically accounts for approximately 20-25% of total U.S. gas production.

**NATURAL GAS PRODUCTION**

- Wellhead freeze-offs have caused producers to cut back natural gas production in the South Central United States, including in the Permian Basin in Texas and New Mexico, the Cana

Woodford in Oklahoma, and the Denver-Julesburg in Colorado. Over the past weekend the Permian Basin saw temperatures overnight as low as 0 degrees F.

- Although production losses due to freeze-offs are temporary, output takes time to return to normal levels, and the cumulative reduction over several days could be substantial.

**NATURAL GAS PROCESSING PLANTS**

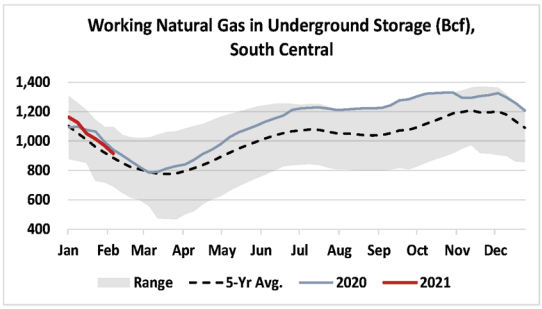
- Some natural gas processing plants and compressor stations across Texas have reportedly shut-in due to weather conditions.

**NATURAL GAS STORAGE**

- Suppliers are compensating for lost output and responding to the surge in gas demand and prices by withdrawing gas from storage facilities.
- This week ending February 19 is projected to have the largest withdrawal from storage in the history of the South Central Region.

**NATURAL GAS STOCKS**

- Natural gas stocks in the U.S. South Central region stood at 915 Bcf on February 5, 4.3% above the five-year average for this time of year.
- According to EIA's Form 191 data, Texas has 30 active natural gas storage facilities.




South Central includes Alabama, Arkansas, Kansas, Louisiana, Mississippi, Oklahoma, and Texas

**NATURAL GAS PIPELINES**

- Natural gas pipelines across the affected area have implemented severe/winter weather procedures and many lines have issued operational flow orders (OFO).

**NATURAL GAS UTILITIES**

- On February 12, the Texas Railroad Commission (TRC) issued an emergency order temporarily prioritizing natural gas deliveries to natural gas utilities for residences, hospitals, schools, churches, and other human needs customers.

**LNG TERMINALS**

- Texas Governor Greg Abbott has asked LNG export terminals to dial back operations.

## PERTROLEUM SECTOR

**PETROLEUM SECTOR SUMMARY**

Extreme cold temperatures and power outages have forced operators to shut down refineries in the U.S. Gulf Coast region. Additionally, extreme cold temperatures and well freeze-offs have led to production outages in producing areas.

**REFINERIES**

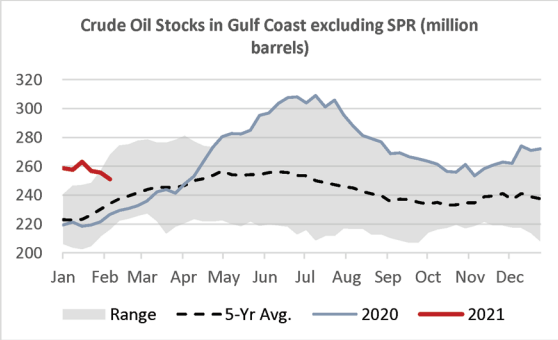
- As of February 17, refinery shutdowns, rate reductions, or process unit outages have been reported at refineries representing approximately 4.2 million barrels per day (b/d) of refinery capacity. The most severe impacts have been reported in the Texas Gulf Coast region.

**PORTS**

- Operations in the Houston Ship Channel have been reduced due to freeze offs impacting refineries and terminals. On February 16, there were 13 vessels waiting to depart the channel with 18 ships in queue to come into the waterway.

**OIL STOCKS**

- Crude oil stocks in the Gulf Coast (PADD 3) averaged 251 million barrels for the week ending February 5, 7.2% above the five-year average for this time of year.



## EMERGENCY DECLARATIONS & WAIVERS

**EMERGENCY DECLARATIONS**

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| Emergency Declarations and HOS Waivers *as of 3:30 PM EST 02/16/2021* | | | | |
|---|---|---|---|---|
| State/Territory | Details | Effective Dates | | Status |
| | | Start | End | |
| Tennessee | Executive Order by the Governor- Energy Emergency | 2/16 | 2/26 | Active |
| Kentucky | Kentucky Transportation Cabinet Declaration of Emergency- Assistance for power restoration and delivery of gasoline, propane, and diesel fuels | 2/11 | 2/21 | Active |
| Mississippi | State of Emergency | 2/14 | 2/21 | Active |
| Alabama | State of Emergency | 2/14 | Continuing | Active |
| Louisiana | Emergency Order- Implementation of Emergency Gas Shortage Plan | 2/15 | 2/20 | Active |
| | State of Emergency | 2/11 | 3/12 | Active |
| Oklahoma | State of Emergency | 2/12 | Continuing | Active |
| Texas | Texas Department of Public Safety Emergency Notice – Assistance for delivery of Propane and Home Heating Oils | 2/10 | 2/15 | Active |
| | Federal Emergency Declaration | 2/11 | Continuing | Active |
| | State Disaster Declaration | 2/12 | Continuing | Active |

Sources: State government, White House, and Federal Motor Carrier Safety Administration websites.

The New York Times

# Can a Coal Town Reinvent Itself?

A coal town in southwestern Virginia has been trying for years. Hope is running thin.

By Eduardo Porter

Dec. 6, 2019

GRUNDY, Va. — Jay Rife surveys the landscape — hundreds of flat, grassy acres reclaimed from a spent mountaintop mine once operated by the Paramont Coal Company. A few handsome homes stand on one end of the project. An 80,000-square-foot shell, to house some future manufacturing operation, is being built on another. For the intrepid, there are trails for all-terrain vehicles. There's an R.V. park. The whole site has been wired for broadband. Elk have been imported from Kentucky for tourists to look at.

Buchanan County, where Grundy sits, has spent $35 million to $40 million on the development, called Southern Gap, some seven miles from town along U.S. 460. Mr. Rife, the head of the county's Industrial Development Authority, says the project "is going to be the salvation of Buchanan County."

Few places have had as many shots at deliverance. None, so far, have succeeded in stemming Grundy's inexorable decline.

This corner of southwestern Virginia has long sought alternatives to coal as a source of sustenance. The Appalachian School of Law, which opened in the 1990s in the shell of Grundy Junior High School, was heralded as a new economic engine, lubricated — of course — with taxpayer funds. So was the Appalachian College of Pharmacy, founded in 2003 some 20 minutes down the road in Oakwood. County officials considered a dental school, but figured it was too expensive. They still get grumpy about the optometry school, on which they spent $250,000 in feasibility studies only for it to open across the state line in Pikeville, Ky. Then there is downtown Grundy itself, much of which was moved up the hill to avoid periodic floodwaters from the Levisa Fork, a tributary of the Big Sandy River.

The old town of Grundy through a second-story window of Walmart, which opened in 2011. Julia Rendleman for The New York Times


Walmart anchors Grundy's new commercial center, which sits on an elevated platform built by the Army Corps. Julia Rendleman for The New York Times

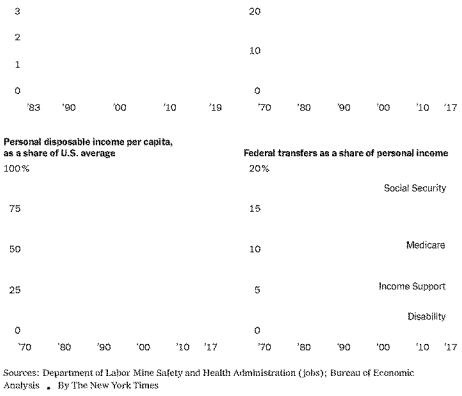
Virginia estimates that the relocation and flood-proofing projects, started almost 20 years ago, cost $170 million in federal and state funds, more than $170,000 for every woman, man and child living in town today. The Army Corps of Engineers shaved off the flank of a mountain across the river to create an elevated platform on which the new commercial district would sit. Virginia's Department of Transportation bulldozed much of the old downtown and routed U.S. 460 through it, built on top of a levee protecting what was left of Grundy's old center. Finally, in 2011, Walmart opened a superstore to anchor the new site, perched somewhat oddly above a two-story, publicly funded parking lot.

Today, a Subway and a Taco Bell are there, too, alongside a restaurant called El Sombrero, run by the only Mexican immigrants in town. There are a Shoe Sensation, a Verizon outlet and a Double Kwik gas station. Still, the effort does not quite amount to a reinvention. The economic engine is still the one that carried this corner of Appalachia through the 20th century. "We are a one-industry community, and that's coal," Mr. Rife said. A few steps from Walmart, an office of Welmore Energy, a coal-producing subsidiary of the Ukrainian steel conglomerate Metinvest, serves as a reminder of that dominance.

**Buchanan's Plight**

**BUCHANAN COUNTY, VA.**

| **Coal mining jobs** | | **Population** |
|---|---|---|
| 6 thousand jobs | QUARTERLY | 40 thousand |
| 5 | | |
| | | 30 |
| 4 | | |




Sources: Department of Labor Mine Safety and Health Administration (jobs); Bureau of Economic Analysis ■ By The New York Times

And that, today, is a problem. At the peak of coal's fortunes in the 1970s, more than 35,000 people lived in Buchanan. Over 5,000 worked in the mines. Mr. Rife remembers downtown sidewalks in Grundy, the county seat, packed with thousands of people on weekend shopping expeditions. Karen Brown, the principal of Grundy High School, recalls Porsches and Mercedes-Benzes parked in the high school lot when she went to school there.

Karen Brown, principal of Grundy High School, said luxury cars were parked there when she was a student at the school. Matt Eich for The New York Times

Coal is still the most prominent business, employing one in six workers in the county and accounting for one-third of its total wages. But it can no longer support such living standards. The income of Buchanan County's residents has fallen to about two-thirds of the national average. And about 40 percent of that comes from federal transfers like Social Security.

The county population has declined to under 22,000, of whom almost 3,500 people receive disability benefits. Over a quarter live in poverty. And it is getting old. The only age group that has grown in the last two decades is the population over 55. Ms. Brown's high school, which housed about 1,000 students when she was there, these days educates just a bit over 400. The county's elementary and middle school population has shrunk by a fifth over the last 10 years, to under 2,000 students.

A guests walk out at the end of a theatrical rendition of "Frozen" featuring performers aged 3-18 at Grundy High School. Matt Eich for The New York Times

Grundy is hardly unique. It is one of many victims of globalization, technology and other economic dislocations that have wreaked havoc with small-town America. For years, most economists argued that rather than spend millions in pursuit of a new economic engine for such places, it would make more sense to help residents seek opportunities elsewhere.

But the proliferation of towns like Grundy across what used to be the nation's industrial heartland — stymied by joblessness, awash in opioids and frustration — has prompted a new sense of alarm. At a recent conference organized by the Federal Reserve Bank of Boston, Lawrence H. Summers, once a top economic adviser to President Barack Obama, put it this way: "There is probably no issue more important for the political economy of the next 15 years, not just in the United States but around the world, than what happens in the areas that feel rightly that they are falling behind and increasingly left apart."

Since the last industry peak, in 2012, the coal mines of Buchanan County have shed 1,000 jobs — roughly half. And they are not paying quite as well as they once did. Mikey Elswick estimates that 90 percent of his family has worked in the coal industry, including his father, his uncle and his brother-in-law. Still, he got out four years ago after Cambrian Coal bought the mine where he worked and said it would cut wages to around $20 an hour from $22.50. Luckily for him, the local exterminator was retiring and let him take over the business, including his roster of clients.

Mikey Elswick is a former coal mine blaster who now owns an extermination company. Julia Rendleman for The New York Times

"There are not many jobs around here," Mr. Elswick said. "Just teachers, state troopers and coal." Cambrian Coal filed for bankruptcy in July.

Migration, as economists would have predicted, has become an increasingly compelling option: Those lucky enough to find work somewhere else leave. They include Ms. Brown's two daughters — Peyton, 23, and Bailee, 25 — who last summer followed their husbands from the coal industry to more stable jobs at the Toyota plant in Georgetown, Ky.

"There are more restaurants, more shops, more like a downtown area, more traffic, more places to live," Peyton said. While it will be tough to start a family so far from her parents, a three-and-a-half-hour drive away, she added, "it would not be wise for us to go back home." The economics just don't work.

Luckily, she already has a job, as a bank teller, and a community to rely on. "Friends that me and my husband went to high school with are down here already," she said.

Brian Ward owns a small company he started, to provide crews and equipment to coal mines in the area, but has been forced into residential construction — remodeling, mostly — as coal has waned. Migration is not new, he said.

Jim Hill, a former coal miner who is now a preacher, and Henrietta Hale at the Liberty Church of Christ near Grundy. Julia Rendleman for The New York Times

"We lost one generation of workers to Detroit, another to the Carolinas," he said. These days, workers will go anywhere. "I don't know where we are losing them to now," Mr. Ward added.

Buchanan County is in some ways better off than other coal-mining regions. To be sure, its coal production has shriveled, virtually pushed out of the power market by the cheaper coal coming from the gargantuan open-top mines in the West since the 1980s. Automation has also taken out thousands of jobs.

But the county is bountiful in what's known as metallurgical coal, used in steel making. Much of it is exported. This insulates local mines from the transition that power plants are making to natural gas. Indeed, coal jobs in the county experienced a bump starting in 2016, driven by exports to Europe and Asia. And while that has passed, as growth prospects overseas have dimmed, steel making guarantees some future for the region's coal.

"We have been hoping and looking for infrastructure legislation," said Harry Childress, president of the Virginia Coal and Energy Alliance in Lebanon, in the heart of coal territory 40 miles south of Grundy. "That could put steel production in the United States back online."

"We are looking for any business except minimum-wage jobs," said Jay Rife, head of the local economic development authority. Julia Rendleman for The New York Times

Crews working on a building that will house the Southwest Virginia Technology Center in the Southern Gap industrial park. Julia Rendleman for The New York Times

Philanthropy from the McGlothlins, the Streets and the other baronial families that minted fortunes from Buchanan's coal have helped fund projects in the area, including the law school and the college of pharmacy. Though dwindling, coal revenues can provide resources for the community's diversification. Coal-related tax revenues, including property taxes and severance taxes imposed on the extraction of coal, are not what they once were. But they remain an important source of county funding. A share of severance taxes goes to the Virginia Coalfield Economic Development Authority, which funds Industrial Development Authority projects. The authority has funded broadband development in Buchanan County and a logistics and transportation center in Southern Gap.

Shannon Blevins, associate vice chancellor for economic development and engagement at the University of Virginia College at Wise, 60 miles from Grundy, says she is optimistic about the diversification initiatives in southwestern Virginia. She puts a lot of hope in the university's computer-science and software-engineering graduates, who might draw the interest of high-tech firms worried about labor costs in bigger cities.

Tourism is another promising option. There are efforts to develop forest products and crops like hemp in the region, and even to identify abandoned coal mines that could house data centers, taking advantage of the low underground temperatures to keep them cool.

"This is a great time to invest in southwestern Virginia," Ms. Blevins said.

And yet her optimism contrasts with the more jaundiced views of many residents. "There has been a ton of money spent in Buchanan County through grants," said Mr. Ward, now in construction. "Not one penny has provided a replacement job for coal workers."

He admits he doesn't have good alternatives to their "pie-in-the-sky ideas," but wonders, "How can you replace $30-an-hour jobs in the mines with mom-and-pops renting little cabins and paying $8 an hour?" His business has "not made any real money since 2011."

The big call center on Southern Gap closed in September, cutting nearly 200 jobs. Mr. Ward is sure that 10 years from now, Walmart will have left Grundy.

Mr. Hill, left, and another former miner, Ralph Rowe, center, recalling coal's boom times over breakfast at the Dairy Queen. Julia Rendleman for The New York Times

Mr. Ward, 50, often shares breakfast with a rolling cast of septuagenarian veterans from the mines at the Dairy Queen on U.S. 460. There is Jim Hill, who left the mines to become a preacher in one of the county's many Church of Christ congregations, remembering how in the old days people could retire from the mines with $1 million in their pocket. There is the guy they call "Honest Moe," counting all the local businesses that have closed in the last few years. Together, they painted a complicated picture of the lives coal supported: dangerous but prosperous. Overwhelmingly, they support President Trump, who promised to bring coal back. But it doesn't look as if they have much faith in the promise. As Hoot Dellinger said, leaning over the edge of his booth, "This community will never prosper again."

Without prosperity, who will stay? "Ninety percent of the girls become nurses and leave," Mr. Ward said. "We've seen a lot of guys chasing gas up in the Marcellus Shale." But even moving doesn't always work out. As shale jobs there have waned, Mr. Ward added, "a lot of them are trying to come back, and there's nothing to come back to."

Ms. Blevins acknowledges that the numbers can look bleak. But "people have to look beyond the numbers," she said, and tease out the opportunities. "I want our region's children to have the opportunity to stay."

# The 2003 Northeast Blackout--Five Years Later

SA scientificamerican.com/article/2003-blackout-five-years-later/

JR Minkel

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## IN BRIEF

On August 14, 2003, shortly after 2 P.M. Eastern Daylight Time, a high-voltage power line in northern Ohio brushed against some overgrown trees and shut down—a fault, as it's known in the power industry. The line had softened under the heat of the high current coursing through it. Normally, the problem would have tripped an alarm in the control room of FirstEnergy Corporation, an Ohio-based utility company, but the alarm system failed.

Over the next hour and a half, as system operators tried to understand what was happening, three other lines sagged into trees and switched off, forcing other power lines to shoulder an extra burden. Overtaxed, they cut out by 4:05 P.M., tripping a cascade of failures throughout southeastern Canada and eight northeastern states.

All told, 50 million people lost power for up to two days in the biggest blackout in North American history. The event contributed to at least 11 deaths and cost an estimated $6 billion.

So, five years later, are we still at risk for a massive blackout?

In February 2004, after a three-month investigation, the U.S.–Canada Power System Outage Task Force concluded that a combination of human error and equipment failures had caused the blackout. The group's final report made a sweeping set of 46 recommendations to reduce the risk of future widespread blackouts. First on the list was making industry reliability standards mandatory and legally enforceable.

Prior to the blackout, the North American Electricity Reliability Council (NERC) set voluntary standards. In the wake of the blackout report, Congress passed the Energy Policy Act of 2005, which expanded the role of the Federal Energy Regulatory Commission (FERC) by requiring it to solicit, approve and enforce new reliability standards from NERC, now the North American Electricity Reliability Corporation.

FERC has so far approved 96 new reliability standards.* These cover the three Ts—"trees, training and tools"—identified by the blackout task force but are not limited to them, says Joseph McClelland, director of FERC's Office of Electric Reliability, which was established last September. Standard PER-003, for example, requires that operating personnel have at least the minimum training needed to recognize and deal with critical events in the grid; standard FAC-003 makes it mandatory to keep trees clear of transmission lines; standard TOP-002-1 requires that that grid operating systems be able to survive a power line fault or any other single failure, no matter how severe. FERC can impose fines of up to a million dollars a day for an infraction, depending on its flagrancy and the risk incurred.

If the standards have reduced the number of blackouts, the evidence has yet to bear it out. A study of NERC blackout data by researchers at Carnegie Mellon University in Pittsburgh found that the frequency of blackouts affecting more than 50,000 people has held fairly constant at about 12 per year from 1984 to 2006. Co-author Paul Hines, now assistant professor of engineering at the University of Vermont in Burlington, says current statistics indicate that a 2003-level blackout will occur every 25 years.

He says many researchers believe that cascading blackouts may be inherent in the grid's complexity, but he still sees room for improvement. "I think we can definitely make it less frequent than once every 25 years."

**The U.S. power grid consists of three loosely connected parts**, referred to as interconnections: eastern, western and Texas. Within each, high-voltage power lines transmit electricity from generating sources such as coal or hydroelectric plants to local utilities that distribute power to homes and businesses, where lights, refrigerators, computers and myriad other "loads" tap that energy.

Because electricity in power lines cannot be stored, generation and load have to match up at all times or the grid enters blackout territory. That can result from a lack of generating capacity—the cause of the 2000 California blackouts—or because of one or more faults, as in

the 2003 blackout. The interconnectedness of the grid makes it easier to compensate for local variations in load and generation but it also gives blackouts a wider channel over which to spread.

Transmission system operators scattered across some 300 control centers nationwide monitor voltage and current data from SCADA (supervisory control and data acquisition) systems placed at transformers, generators and other critical points. Power engineers monitor the data looking for signs of trouble and, ideally, communicate with one another to stay abreast of important changes.

One of the realizations since 2003 is that "you can't just look at your system. You've got to look at how your system affects your neighbors and vice versa," says Arshad Mansoor, vice president of power delivery and utilization with the Electric Power Research Institute of Palo Alto, Calif.

Until recently, there was no one place to view information from across the grid. McClelland says FERC is working with industry and other government agencies to pull data into a prototype coast-to-coast real-time monitoring system at its Washington, D.C., headquarters. "We have put the system together and it is functional," he says, although "some parts are better than others": FERC has full coverage of the western U.S. and good information from the Southeast, he says, but data from Texas and other areas is still spotty.

**Gathering the data is only the beginning.** The holy grail is a smart grid capable of monitoring and repairing itself, similar to the way air traffic control systems are used to coordinate aircraft routes. Mansoor says that dream is still a good 20 years away because it depends on better data, a reliable communications network and computer programs capable of making decisions based on the data.

One promising tool for collecting better data is called a phasor measurement unit (PMU), which measures voltage and current on power lines and uses GPS (global positioning system) connections to time-stamp its data down to the microsecond. That level of resolution across a network of PMUs could reveal an important electrical property of power lines called phase, which tells whether power generators are rotating in sync with respect to one another, Hines says.

When a blackout approaches, that difference, called the phase, is believed to grow rapidly. "A lot of people have conjectured that if we could have seen that the [phase] distance between generators was increasing [on August 14, 2003], we could have prevented the blackout," Hines says.

There are currently about 100 PMUs installed in the eastern interconnection, up from zero in 2003, as part of the North American SynchroPhasor Initiative based at the Pacific Northwest

National Laboratory in Richland, Wash. "We still need a couple of hundred more [PMUs] to get a full coverage," Mansoor says, but he adds that they are already helping local utilities diagnose the causes of blackouts much faster than they could before.

**Another challenge for keeping the grid balanced** is the growing demand for electricity —increasing load, in other words—as consumers buy more computers, air conditioners and rechargeable handhelds. The U.S. Department of Energy's Energy Information Administration projects a load growth of 1.05 percent a year from now until 2030, which means transmission capacity will have to keep pace.

The main obstacle to building new transmission lines is siting, better known as the "not in my backyard" effect: Nobody wants power lines near them. One potential way of getting around that is so-called smart metering—hourly readouts of electricity usage that allow utilities to offer price discounts on power during off-peak times. Pilot smart-metering programs are under way in Idaho, California and other states.

Mansoor notes that advanced metering tools might become useful given the potential for increasingly intermittent power sources. Wind power, for example, stops and starts with the breeze, which means system operators would have to adjust the load to compensate. Although wind energy accounts for 19.5 gigawatts of power in the U.S., or less than 2 percent of total power generation, it represented 35 percent of new generating capacity installed in 2007, up from 5 percent in 2003.

**An alternative to power lines in cities and other urban areas** is power cables based on high-temperature superconductor (HTS) technology. When chilled to −321 degrees Fahrenheit (77 kelvins, or −196 degrees Celsius) the composite material yttrium barium copper oxide begins to carry a current with almost zero resistance. HTS power cables can therefore be made smaller than the copper kind.

In a concept called the secure supergrid, would bolster existing transmission lines and would resist the stresses that can cause blackouts, because the lines shut down when the current spikes (reflecting the "almost" in an HTS cable's "almost zero resistance"). Some researchers have proposed combining an HTS supergrid with a coast-to-coast hydrogen pipeline to suppy fuel cells for cars and homes.

The Long Island Power Authority switched on a $50-million, 69-kilovolt HTS system in April to supply power to up to 300,000 homes. Consolidated Edison Company of New York and the U.S. Department of Homeland Security have commissioned cables for a $40-million supergrid system in downtown Manhattan known as Project Hydra, scheduled for operation in 2010.

None of these tools would guarantee the extinction of large blackouts. When researchers study very complex systems, whether they be power grids or sandpiles, they often find a

simple relationship: The frequency of larger and larger catastrophes—such as blackouts or avalanches—remains relatively high. "If you look at all the steps that have been taken since 2003, I think overall the risk is less today than it was in 2003," Mansoor says. "But the risk is always there."

*Correction (8/14/08): This article originally stated that FERC has approved 83 new reliability standards; that number refers to the first standards to take effect in June 18, 2007.



Final report by the U.S.-Canada Power System Outage Task Force

ELECTRIC VEHICLES

# EV battery maker: Court ruling threatens Biden climate plan

David Iaconangelo and Timothy Cama, E&E News reporters • Published: Thursday, February 18, 2021


The logo of battery maker SK Innovation is seen in front of its headquarters in Seoul, South Korea, in this February 2017 photo. Kim Hong-Ji/Reuters/File Photo/Newscom

A major manufacturer of electric vehicle batteries is warning that a federal trade court's ruling this month could have a "serious adverse impact" on President Biden's climate goals, unless the president overrides the ruling.

SK Innovation Co. is on track to be the nation's third-largest battery producer, with 21,500 megawatt-hours of capacity either announced or under construction, according to data released yesterday in Bloomberg New Energy Finance's "Sustainable Energy in America Factbook."

It's behind only the Tesla Inc.-Panasonic Corp. partnership and LG Chem Ltd., which round out the triad expected to drive most of the growth in domestic supplies of EV batteries — an industry that the Biden administration wants to jump-start. And by 2025, SK Innovation's two planned battery facilities in Georgia could account for 17% of the country's capacity of EV batteries, according to BNEF analysts.

Last week, SK Innovation was banned from importing battery cells and modules for 10 years by the U.S. International Trade Commission, after LG Chem accused it of stealing trade secrets. The ruling established temporary grace periods during which SK Innovation can supply batteries for Volkswagen AG's and Ford Motor Co.'s forthcoming all-electric models (*Energywire*, Feb. 11).

SK Innovation, in particular, is trying to get the Biden administration to intervene and overturn USITC's decision, fearing that it will effectively force it to abandon plans for a second, $940 million addition to its in-development EV battery facility in Georgia.

Spokespeople for the company cited "serious concerns ... for the future of our EV-battery facility" there after the federal decision, adding in a statement that they believed the ruling "could have a serious adverse impact on President Biden's policies to combat climate change and expand the electrification of the US auto fleet in coming years."

"SK is urging presidential review and disapproval of the ITC decision, and will work closely with all stakeholders in the decision-making process," spokespeople wrote in an email to E&E News.

USITC gave little justification for its ruling in the Feb. 10 order, although a public version of its opinion is expected to be released in the coming months. Kim Jong-hyun, CEO of LG Energy Solution, an LG Chem subsidiary, praised the ruling, saying it was "protecting our innovations and significant economic investments in the United States."

The White House did not provide comment.

**A settlement?**

Some EV analysts also are raising concerns about what USITC's decision might mean for Biden's broad aims of accelerating EV adoption.

Eliminating SK Innovation's contribution to the U.S. battery chain would "complicate" but not "derail the country's EV market," wrote four BNEF analysts in a research note this week.

Biden's recently declared goal of converting the entire federal fleet to EVs, for example, "will likely require that SKI's U.S. manufacturing plants remain operational," they wrote.

To sidestep USITC's ruling, and the 10-year ban it entails, SK Innovation's options are twofold. Either the company can reach an out-of-court settlement with LG Chem, or Biden can veto the court's decision within 60 days of the ruling.

Only one veto of an USITC import exclusion has been issued this century, by former President Obama in 2013 in a dispute between Samsung and Apple Inc. over consumer electronics.

The president has made decarbonization of transportation "central to his climate objectives," and political pressure is likely to mount on him to preserve SK Innovation's two Georgia battery factories, the analysts wrote. And Volkswagen and Ford may also have trouble finding alternative domestic suppliers for their U.S.-produced electrics, despite their initial exemption from the import ban. Those exemptions last two and four years, respectively.

Volkswagen and Ford both say they hope the two companies can reach a settlement out of court.

"While we appreciate the ITC took into account our plans to bring the all-electric Ford F-150 to market mid-2022, a voluntary settlement between two auto suppliers based outside of the U.S. is ultimately in the best interest of manufacturers and workers operating right here," Ford spokesperson Jennifer Flake wrote in an email to E&E News.

Volkswagen's spokespeople, too, said the company had become "an unintended victim" in the dispute, adding that they would request that their exemption from the ban be extended from two years to at least four years.

SK Innovation and LG Chem are currently in talks over a settlement, according to reports from South Korean media this week. And Dave Callahan, co-counsel for LG Chem in the case, said that the company was open to reaching a settlement.

Callahan added that the company anticipated the opportunity to provide information to the Office of the U.S. Trade Representative as part of any presidential review of USITC's ruling. "We anticipate we'll participate in that process and explain that this case is like the overwhelming majority of cases in which the president does not exercise his right to veto."

The exemptions for Volkswagen and Ford gave both automakers the necessary protections, Callahan said. "It's SKI's obligation, now, to take care of ... the people who're going to build those batteries and the state of Georgia, which invested a lot of its money encouraging SKI to build their plant there."

**New lobbyists**

One lobbying firm retained in late January by SK Innovation, Chartwell Strategy Group, is squarely focused on the USITC ruling, according to a person familiar with the firm's Washington strategy.

That advocacy includes both pushing the Biden administration to act on the matter and working to get lawmakers to weigh in as well, particularly those representing Georgia.

"We look forward to having detailed discussions with Biden administration officials charged with reviewing the ITC's ruling and carrying out the President's policies related to electric vehicles and the environment," wrote SK Innovation's spokespeople.

Chartwell is just the latest piece of a multipronged strategy by SK Innovation to fight LG Chem. It has previously retained Covington & Burling LLP, mainly to conduct legal work and represent it in the USITC process, and has gotten help from former EPA Administrator and Obama climate czar Carol Browner for the USITC battle.

Communications firm Ridgley Walsh LLC, helmed by former Republican consultant Juleanna Glover, is handling public relations on the matter.

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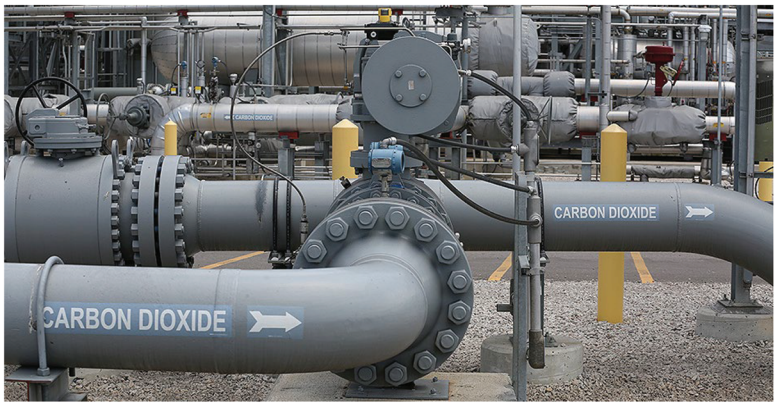
TECHNOLOGY

# Petra Nova is closed: What it means for carbon capture

**Carlos Anchondo and Edward Klump, E&E News reporters** • Published: Tuesday, September 22, 2020




The Petra Nova project near Houston helped pioneer carbon capture at an existing power plant. Now, with Petra Nova mothballed, industry players are exploring different ways of doing business. Trish Badger/Reuters/Newscom

When news broke this summer that the Petra Nova carbon capture power project was offline, advocates leapt to the defense of the Texas facility, one of the largest in the world.

Petra Nova has not sent captured carbon dioxide to an off-site oil field in over four months, though its backers say the retrofitted coal plant surpassed capture targets before halting operations and, notably, was built on time.

Even so, the pioneering facility's mothballed status — the result of low oil prices amid the coronavirus pandemic and the fallout of a global trade war — is prompting some carbon capture proponents and developers to reexamine project revenue streams and how best to hedge against swings in the price of oil.

Boosting the number of coal plants with carbon capture is seen as one way to battle climate change. Yet even before Petra Nova went offline, the capture capacity of the two large-scale power projects in operation was "well off track," according to a June **report** from the International Energy Agency. With Petra Nova's carbon capture on hold until economies improve, some onlookers say the need to safeguard projects in development from pitfalls is increasingly important.

"We are clear that we need carbon capture in a comprehensive decarbonization strategy by midcentury," said Mahmoud Abouelnaga, solutions fellow at the Center for Climate and Energy Solutions (C2ES). "As long as we now admit the need for that, that means we need to make sure that the business model that can enable carbon capture to participate in the portfolio of technologies is as risk-free as possible."

While the economics of Petra Nova give reason for caution, a number of coal plants and project developers are still considering carbon capture to offset their emissions, especially in a power sector that is increasingly focused on natural gas and renewables.

Recent rolling blackouts in California have served as a point of discussion for carbon capture and whether coal could help solve issues in a renewable-heavy portfolio (***Energywire***, Aug. 20).

Akshaya Jha, an assistant professor of economics and public policy at Carnegie Mellon University's Heinz College, said coal isn't what he'd think of as a fill-in technology — typically, that's natural gas, which can be used to ramp up more quickly.

"Carbon capture, in terms of being economic, I don't really see it for coal-fired power plants just simply because there's no federal carbon regulation in place," he said.

But supporters of the industry see a place for their efforts, which are backed by a federal tax credit known as 45Q. And the West Coast fits into that discussion.

"We would love to provide the decarbonized baseload power to keep the lights on in California," said Peter Mandelstam, chief operating officer of Enchant Energy Corp., which is pursuing a carbon capture project in New Mexico.

### Oil's wild ride

Roughly 3 ½ years after it began operating, Petra Nova hit pause on May 1 and co-owner NRG Energy Inc. halted delivery of CO2 to an off-site oil field, where it was being used for enhanced oil recovery in which NRG has an interest.

The company, which is based in Houston and New Jersey, told E&E News in July that a drop in the price of oil — which sat above $60 a barrel at the start of the year but briefly went negative in April — was the culprit (***Energywire***, July 31).

Pat Hammond, an NRG spokeswoman, did not say if NRG has a specific oil price range in mind to make the economics of Petra Nova work.

While Petra Nova's capture facility is still offline, carbon capture supporters say it is not because of faults with the technology. The project remains a pioneer in carbon capture, utilization and storage, which is commonly referred to as CCUS.

David Greeson, a former vice president at NRG who helped develop Petra Nova,

CARBON CAPTURE

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said he doesn't consider the project a commercial success. But he said it was a "raging success" at capturing carbon.

Greeson now consults on a carbon capture project in North Dakota, and he noted the lack of a targeted federal tax credit to help Petra Nova as he worked to develop its revenue stream.

Congress adopted an expanded 45Q tax credit in 2018, over a year after Petra Nova got started (***Greenwire***, Feb. 9, 2018).

Oil prices have been on a roller coaster since, with oil benchmarks recently trading around $40 a barrel.

Greeson recalled that oil hit $100 a barrel before the financial close of the Petra Nova deal in 2014, and he said plans factored in a potential $75 oil price.

The oil field did not react to CO2 the way backers had hoped, according to Greeson. Instead of 60 million barrels over a decade, it may take 20 or 30 years to produce that, he said.

Still, he suggested that "if oil was $75, they'd still be running" Petra Nova.

Deepika Nagabhushan, program director of decarbonized fossil energy at the Clean Air Task Force (CATF), said Petra Nova is successful in the sense that it demonstrated carbon capture technology on a commercial scale — **capturing** 92.4% of CO2 over its life span — and has brought down costs for other projects in the works.

"I think it has already delivered a lot for the future application of this technology," she said.

Rich Powell, executive director of conservative nonprofit ClearPath, said Petra Nova has also proved to be a more cost-effective proposition than some other policies aimed at curbing CO2 emissions.

Even if the facility never resumed operations, Powell said, the project is less expensive than some other programs aimed at lowering emissions. With a nearly $200 million investment from the Department of Energy, the project captured CO2 emissions at a rate of approximately $55 to $60 per ton, he said.

"If we're able to get the incentives right to keep CCS [carbon capture and storage] projects running in the long term, we could see a pathway running toward really cost-effective ways of managing CO2," Powell said.

Hammond, the NRG spokeswoman, did not say whether or not NRG was planning to use the 45Q tax credit, but said project sponsors "will consider all options to improve the economics of the facility."

### A CO2 pipeline system?

Of the 32 publicly announced CCS projects in the United States, roughly half are for the power sector, according to a **list** maintained by CATF.

While several projects are still looking to use captured CO2 for enhanced oil recovery — as Petra Nova did — some are considering dedicated storage in saline formations, either in addition to EOR or exclusively.

Permanent storage in geologic formations is one way to "de-risk" projects, said Nagabhushan, the CATF program director.

Under the **45Q tax credit**, companies can receive up to $50 per metric ton of CO2 that's captured and stored securely underground — known as "secure geological storage" — and up to $35 per metric ton for EOR.

Dedicated storage in saline formations doesn't have to contend with the same uncertainties as EOR projects that are tied to fluctuations in the price of oil, Nagabhushan said, but, historically, there has been less interest in saline or other forms of geologic storage.

EPA has only received eight permit applications since July 2011 for Class VI wells, which are used to inject CO2 into underground formations for geologic sequestration (***Energywire***, Sept. 8).

Regardless, carbon capture proponents say taking advantage of the 45Q tax credit will be a key difference maker for many projects if they can meet a crucial deadline. Those looking to use the credit must start project construction by the end of 2023, a cutoff point that advocates including the Carbon Capture Coalition are lobbying Congress to extend.

An additional mechanism that could allow more CCS projects to succeed are government policies that could help to build out CO2 pipeline networks and storage sites, analysts say.

Doug Vine, a senior energy fellow at C2ES, said the idea of a CO2 network is comparable to the national highway system or the internet and commerce.

"In order to have a more robust carbon capture network, we need a pipeline system," Vine said.

### Following 'brave souls'

Project Tundra involves a plan to use carbon capture at a generating unit in North Dakota. Minnkota Power Cooperative is leading the project. Minnkota Power Cooperative

Petra Nova wasn't the first carbon capture project attached to a power plant in North America.

That title belongs to Boundary Dam, which is operated by SaskPower, a Canadian utility company headquartered in Regina, Saskatchewan.

Boundary Dam has an independent buyer for the CO2 used to boost oil recovery. The facility also sends CO2 to a storage site — Aquistore.

Norm Sacuta, communications director at the Petroleum Technology Research Centre in Regina, said the majority of CO2 captured at Boundary Dam goes to the Weyburn oil field, which also takes CO2 from a coal gasification facility.

"Except for a recent shutdown at Boundary Dam in May-June for regular maintenance at the plant, CO2 continues to be captured and shipped to the Weyburn field," Sacuta said in an email.

SaskPower spokesman Joel Cherry said carbon capture is part of the utility's strategy to reduce its greenhouse gas emissions 40% from 2005 levels by 2030. He also said carbon capture will help the Boundary Dam facility avoid a government-mandated phaseout of traditional coal-fired electricity by 2030.

"This facility would be able to continue operating beyond 2030, despite it being a coal-fired facility because of this carbon capture and storage facility there," he said.

A number of other projects are on the drawing board, including by Enchant Energy at a generating station in New Mexico and Project Tundra at a plant in North Dakota.

"At Tundra, we plan to build on the learnings from those brave souls that went before us," said Greeson, who's now president of Proven Project Development Group, which is consulting on the project.

Greeson said Tundra doesn't plan to rely on oil production and pricing to support the project. But the plan does call for using the 45Q program.

"We don't have to build a project on a volatile production scenario for oil and on a volatile price scenario for oil," Greeson said.

Project Tundra is a $1 billion project that aims to capture 100% of flue gas from a 455-megawatt system. Technology then can capture 90% or more of the CO2 in the flue gas. The power plant runs on lignite in North Dakota, and the project includes a plan to store CO2 under the nearby mine. The carbon capture system could be operating in 2025.

In New Mexico, Enchant Energy's Mandelstam described 45Q as the make-or-break element of carbon capture in the coming years. He said Enchant Energy's project associated with the San Juan Generating Station, which currently has an 847-MW capacity, would involve about $1.3 billion of risk capital before a nickel of 45Q credits would be received under the current setup.

Enchant Energy is counting on a few buckets for potential lifetime revenue for the San Juan project, according to Mandelstam. Over 12 years, that would mean about 40% from selling electricity, 20% from CO2 sales and 40% from 45Q. Enchant Energy could also seek an enhanced oil option or put CO2 directly into the ground. The carbon capture project could start initial operations in 2023.

Oil prices consistently below $40 a barrel would not support enhanced oil efforts tied to San Juan, Mandelstam said. But if wells are converted broadly to act as injection wells, he said, that's good for the carbon capture industry.

Greeson said Tundra is not competing with other carbon capture projects.

"We're all cheering each other on because the more each of us is successful, the more access to capital we believe all of us will have in building these projects in the future," he said.

Greeson said most companies investing in developing carbon capture believe that decarbonizing products will be worth more in the future.

He said there's no technology without a carbon footprint, and he argued that the United States can show the world how to drive down costs on carbon capture and how to do saline storage.

"Coal can be a part of the solution in the future," Greeson said. "We have the technology. People love technology to solve problems."

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**Attachment—Additional Questions for the Record**

**Subcommittee on Energy**
**Hearing on**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**Thursday, February 18, 2021**

Dr. Stephen W. Pacala, Frederick D. Petrie Professor of Biology, Princeton University, Department of Ecology and Evolutionary Biology

**The Honorable Kathy Castor (D-FL)**

1. Dr. Pacala, we're coming out of the COVID-19 pandemic and the economic devastation it has wrought. Opportunities to create good paying jobs are more important than ever from upgrading and expanding the electric grid to electrifying transportation, buildings, and industry. Could you please tell us more about what your study concluded about the potential for jobs from the transition to a clean energy economy? Which economic sectors could we expect to see revitalized? How would the average wages of these new jobs compare to the national average today? What can Congress do to facilitate the creation of high-quality jobs?

**RESPONSE:**

Drawing on recent trends in clean energy employment and projections of jobs created during a net-zero transition, the National Academies report *Accelerating Decarbonization of the U.S. Energy System* that formed the basis of my testimony concluded that the transition to a clean energy economy could result in a net increase in energy system employment of roughly 1 to 2 million jobs. The transition provides an opportunity to revitalize U.S. manufacturing, construction, and commercialization sectors and strengthen U.S. global leadership in clean energy and climate mitigation solutions. Clean energy jobs typically have higher wages than the current national average and often have lower education requirements, making them both attractive and accessible. The establishment of educational and training initiatives is critical for training a net-zero energy workforce, maintaining U.S. competitiveness, promoting energy innovation, and providing fair access to high-quality jobs. To facilitate the creation and security of high-quality jobs, the committee recommends that Congress do the following:

- Establish a federally authorized and funded non-profit Green Bank with a specific public mission to finance low- or zero-carbon buildings and technologies, business creation, and infrastructure.
- Ensure that Buy American and Buy America provisions are appropriately applied and enforced to cover key materials and products on federally funded projects.
- Establish a 10-year GI Bill-type program for anyone who wants a vocational, undergraduate, or master's degree related to clean energy, energy efficiency, building electrification, sustainable design, or low-carbon technology. These programs should include a cost-of-living stipend. Such a program would ensure that the U.S. workforce

transitions along the physical infrastructure of our energy, transportation, and economic systems.

- Support the creation of innovative new degree programs in community colleges and colleges and universities focused uniquely on the knowledge and skills necessary for a low-carbon economic and energy transformation.
- Provide support for doctoral and postdoctoral fellowships in science and engineering, policy, and social sciences, for students researching and innovating in low-carbon technologies, sustainable design, and energy transitions, with at least 25 fellowships per state to ensure regional equity and build skills and knowledge throughout the United States.
- Pass the Promoting American Energy Jobs Act of 2019 to reestablish the Energy Jobs Strategy Council under the Department of Energy, require energy and employment data collection and analysis, and provide a public report on energy and employment in the United States.
- Provide manufacturing incentives through loans, loan guarantees, tax credits, grants, and other policy tools to firms that are matched with corresponding performance and wage requirements. Subsidies provided directly to manufacturers must be tied to the meeting of performance metrics, such as production of products with lower embodied carbon or adoption of low-carbon technologies and approaches.

Importantly, achieving employment and economic benefits from a net-zero transition requires programs and policies to ensure that the transition does not adversely affect certain workers or communities, but rather provides equitable access to new opportunities. Anticipated challenges – such as temporal and geographic mismatches between jobs created and lost – must be confronted proactively to avoid regional economic declines and maintain public support for decarbonization. Actions that the committee recommends Congress take to ensure a just transition include:

- Establish 2-year federal National Transition Task Force to assess vulnerability of labor sectors and communities to the transition of the U.S. economy to carbon neutrality.
- Establish White House Office of Equitable Energy Transitions that will develop criteria to ensure equitable and effective energy transition funding, sponsor external research to support the development and evaluation of equity indicators and public engagement, and report annually on energy equity indicators and triennially on transition impacts and opportunities.
- Establish a new federally chartered, independent National Transition Corporation (NTC) to complement the functions of the White House Office of Equitable Energy Transitions, to ensure coordination and funding in the areas of job losses, critical infrastructure, and equitable access to economic opportunities and wealth creation.
- Provide funds to create interdisciplinary doctoral and post-doctoral training programs, similar to those funded by NIH, which place an emphasis on training students to pursue interdisciplinary, use-inspired research in collaboration with external stakeholders that can guide research and put it to use in improving practical actions to support decarbonization and energy justice.
- Authorize and appropriate funds for the establishment of 10 regional centers to manage socioeconomic dimensions of the net-zero transition, a net-zero transition office in each state capital, and local community block grants for planning and to help identify especially at-risk communities.

I also want to note that I am helping to lead the Princeton Net-Zero America project, a comprehensive national-level modeling effort that examines several technological scenarios to achieve a net-zero transition by mid-century and quantifies the scale and cost of physical assets, institutional change, and human-resource efforts for all sectors over time. In contrast to the National Academies report, the Princeton Net-Zero America project does not look at policy but has a high level of spatial definition that helps to illustrate the extraordinary scale of the transition, including the potential impacts on jobs.

The Princeton analysis, which is separate from the National Academies study but was referenced within it, shows that all but a handful of states will see steady increases in energy jobs during a 30-year transition to net-zero. The exceptions are some coal-producing states (i.e., West Virginia and Wyoming), which will see a continuation of the current downward trend in coal employment, and states most reliant on oil and gas production (i.e., Texas, Oklahoma, and Louisiana), which will generally see net energy job losses beginning in the late 2020s when oil and gas demand declines because of increased deployment of renewable electricity and vehicle electrification. However, net-zero industrial jobs (i.e., net-zero steel, cement, chemicals, etc.) are not included in this analysis. There would be more than enough of these jobs to eliminate the net fossil job losses in the few states that would experience them, if appropriate policies were developed.

These results helped motivate the Academies report's focus on developing tools for states and local governments to pre-emptively address this transition. They also motive the committee to put even greater emphasis on jobs and jobs transition during its second report (expected 2022). I believe that this is one of the most critical issues, if not the most critical issue, that needs to be addressed in the United States' transition to a net-zero economy.

2. Dr. Pacala, we want to ensure that all Americans experience the benefits of the transition to a clean energy economy. Given the recent winter storm in Texas and the Southern Plains, how would upgrading and expanding the electric grid increase resilience and benefit everyday Americans? How can Congress support hardening and weatherizing grid infrastructure?

**RESPONSE:**

Electrification of energy services in transportation, buildings, and industry and production of carbon-free electricity are two primary technological goals during the first 10 years of a transition to net-zero emissions. Additionally, access to electricity is known to improve the standard of living, health, and education of households; and the literature indicates that all else equal, communities disconnected from larger electricity grids face higher electric costs.

Therefore, upgrading and expanding the electric grid to make it accessible to every American is an attractive proposition. In the future, if the American power industry seeks to take advantage of high-quality wind and solar resources, expanding the electric grid will be even more essential.

At the same time, measures must be taken to ensure that the grid remains reliable and resilient to avoid situations like those that occurred following recent winter storms and/or other extreme

weather events (including heat waves, storm surge, coastal and riverine flooding, derechos, and wildfires).

The committee recommends several policies aimed toward these goals:

- Congressional authorization for DOE and FERC to plan, fund, permit, and build additional electrical transmission, while requiring fair public participation measures to ensure meaningful community input in the planning and siting activities.
- Congressional appropriations to increase electrification of tribal lands through direct financial assistance for the build-out of electricity infrastructure through DOE-IE grant programs.
- Congressional authorization for rural electric cooperatives and private companies to expand broadband for rural and low-income customers.
- Congressional directive to FHWA to expand the EV charging infrastructure on interstate highways and to DOE to invest in EV charging for low-income businesses and residential areas.
- A tripling of Congressional appropriations to DOE to invest in low- or zero-carbon RD&D, which will include funding for technologies that improve grid reliability and resilience such as clean firm electricity generation (e.g., advanced nuclear) and energy storage (e.g., low-cost, long-duration batteries).

Notably, two other committees of the National Academies have produced reports that address these important electric grid resilience issues:

- The Future of Electric Power in the U.S. (2021); and
- Enhancing the Resilience of the Nation's Electricity System (2017).

3. Dr. Pacala, your study notes that renewable energy interconnection costs are higher in the United States than in other countries. Could you please elaborate on that? What can Congress do to help alleviate this situation?

**RESPONSE:**

The specific text in the committee's report refers to high soft costs associated with deployment of renewables–those associated with permitting, interconnecting, and the like. The relatively high renewable energy interconnection costs in the United States stem in part from the current federal/state jurisdictional split around transmission infrastructure (in which FERC regulates transmission planning and access and states approve transmission facilities) as well as the fact that interconnection policies and practices vary across regions of the country (for interconnections to the bulk power system) and across distribution systems (e.g., for utility-scale and rooftop solar systems).

Although the committee did not explicitly address these interconnection issues for renewables (and indeed the report overall focused on myriad efforts under federal jurisdiction–e.g., bulk power systems–rather than state jurisdiction–e.g., distribution system policies and practices), the committee did observe that there are actions that Congress could (and should) take to address hurdles in determining the need for and siting of new transmission enhancements to support renewable and other zero-carbon generation resource portfolios.

These include the following committee recommendations:

- Congress should establish a U.S. National Transmission Policy to enable a high-voltage transmission system to support the nation's (and states') goals to achieve net-zero carbon emissions in the power sector.
- Congress should amend the Federal Power Act to authorize and direct FERC to require transmission companies and regional transmission organizations to analyze and plan for economically attractive opportunities to build out the interstate electric system to connect regions that are rich in renewable resources with high demand regions; this is in addition to the traditional planning goals of reliability and economic efficiency in the electric system.
- Congress should amend the Energy Policy Act of 2005 to assign to FERC the responsibility to designate any new National Interest Electric Transmission Corridors and to clarify that it is in the national interest for the U.S. to achieve net-zero climate goals as part of any such designations.
- Congress should authorize FERC to issue certificates of public need and convenience for interstate transmission lines (along the lines now in place for certification of gas pipelines), with clear direction to FERC that it should consider the location of renewable and other resources to support climate-mitigation objectives, as well as community impacts and state policies as part of the need determination (i.e., in addition to cost and reliability issues) and that FERC should broadly allocate the costs of transmission enhancements designed to expand regional energy systems in support of decarbonizing the electric system.

The report also recommends that DOE fund studies and policy evaluations aimed at reducing the soft costs of clean energy technologies (including interconnection) and notes that Congress could direct them to do so.

**The Honorable Peter Welch (D-VT)**

1. Your National Academies of Science Decarbonization Report outlines the ambitious steps needed to take in the next decade to avert a climate disaster. Can you please elaborate on how much renewable generation needs to be installed this coming decade in order to reach our clean energy goals and specifically reach a zero-carbon power sector by 2035?

**RESPONSE:**

The report recommends that carbon-free electricity represent roughly 75 percent of U.S. generation by 2030 and 100 percent by 2050 or sooner. Reaching these goals will require deploying 250-300 GW of new wind and 280-360 GW of new solar by 2030, so that wind and solar represent 45-55 percent of electricity nationwide by that date, up from 10 percent today. Given the projected increases in energy demand, approximately 2 billion MWh of new carbon-free generation needs to come online during the 2020s. Such deployments represent additions that are multiples of what the United States has experienced in recent decades.

The committee's analysis identified various other efforts needed before 2030 to meet clean electricity goals, including:

- retiring coal-fired capacity or retrofitting it with carbon capture systems,
- preserving existing nuclear generation,
- keeping installed capacity of natural gas-fired generation roughly constant,
- deploying 10-60 GW/40-400 GWh of battery energy storage capacity,
- expanding long-distance transmission capacity by about 120,000 GW-miles, and
- reinforcing distribution networks to accommodate increases in aggregate peak demands.

2. Can you please explain why energy efficiency standards are so important to implement in combination with federal climate policies which would naturally lead to massive increases in electrification?

**RESPONSE:**

As stated in the report, "Energy and materials efficiency is one of the most cost-effective near-term approaches to reduce energy demand and associated emissions." Increased energy efficiency can reduce the total electric capacity and output needed to meet the projected growth in electricity demand. Assuming, as the committee does, that achieving economy-wide net-zero emissions by mid-century will require significant steps to electrify buildings, vehicles, and industry (and will thereby increase overall demand for electricity), doing so through strategies that improve energy efficiency in these sectors will be critically important.

Thus, in anticipation of such demand increases, the committee recommends that Congress direct federal agencies to adapt and strengthen existing efficiency standards for appliances, buildings, and transportation and to establish a clean manufacturing standard. Improvements in energy efficiency will also help to control energy costs and provide emissions reductions in hard-to-electrify sectors such as aviation, long-distance shipping, and chemical manufacturing.

Importantly, given that the committee's recommended carbon price ($\$40/tCO_2$, rising at 5% per year) is insufficient to achieve net-zero emissions on its own, setting energy efficiency standards helps to ensure that private sector decisions align with decarbonization goals.

**Attachment—Additional Questions for the Record**

**Subcommittee on Energy**
**Hearing on**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**Thursday, February 18, 2021**

Ms. Paula R. Glover, President, Alliance to Save Energy

**The Honorable Bobby L. Rush (D-IL)**

1. In a February 1, 2021 op-ed, you wrote that "energy consumption in the U.S. and related emissions would be about 67 percent higher today if not for the efficiency gains we've made since 1980, which has saved consumers $800 billion annually on energy bills." Additionally, you stated that the Department of Energy's minimum efficiency standards for appliances save the average U.S. household over $500 per year and that energy efficiency can account for nearly half of the emissions reductions needed to meet the goals of the Paris Climate Agreement. However, minority, low-income, urban, and rural communities continue to endure the burden of high energy costs and the disproportionate burden of greenhouse gas pollution.

    a. How can the federal government better meet the needs of minority, low-income, urban, rural, and other overburdened communities through energy efficiency and energy conservation measures?

**RESPONSE:** According to the Department of Energy, one in three U.S. households faces challenges in paying their energy bills, and one in five faces the dire decision whether to "heat or eat." Households earning less than 200 percent of the federal poverty level spend an average of 16.3% of their income on energy costs, while households earning more than 200 percent of the federal poverty level spend just 3.5%. Put another way, a family of four that is supported by two wage-earners making less than $12.75 an hour faces a burden nearly five-times as painful as a similar household making the national average of $24.60. Energy efficiency is a powerful tool for addressing this cost burden, which is a significant impediment for housing affordability and economic stability in minority, low-income, urban, and rural communities. Addressing this burden requires intentional, strategic policies.

Energy efficiency solutions inherently favor households with greater incomes and higher financial literacy— and energy efficient programs and products often consist of higher costs upfront. That said, the effectiveness of energy efficiency adoption in low-income and minority communities is fully dependent on the consumer's ability to access and afford energy efficiency resources and solutions.

From a product or appliance perspective, low-income consumers should be incentivized to purchase the most energy efficient performing asset, which as a general rule will cost more. Therefore, incentives should be designed to provide more immediate cost advantages at time of purchase, in addition to any savings the consumer will receive over a product lifetime cycle. At-time-of-purchase incentives that match affordability concerns will have the effect of driving low-income consumers to the most energy efficient product or appliance, because it is the most affordable.

Additional programs to assist with affordability and access include:

- Expanding the Department of Energy's Weatherization Assistance Program and coordinating it more closely with the Department of Housing and Urban Development to ensure that households that need it most are receiving services.
- Making energy efficiency a priority for all federal affordable housing programs to ensure that affordable housing comes with low energy costs. Ensure all new federally assisted housing is built to be energy efficient, by requiring them to meet or exceed the most recently published model building energy codes including locally-developed building performance standards.
- Homes receiving federally backed or insured mortgages should be encouraged or incentivized to participate in benchmarking and transparency programs, including energy audits.
- All federally backed or insured mortgages should consider energy costs, or energy cost savings due to energy efficiency, in its affordability and ability-to-pay metrics and home valuations.
- Continuing a robust appliance and equipment standards program that protects consumers from higher energy bills by setting a floor for energy performance for commonly used products.
- Providing technical assistance, grants and other resources to strengthen model building energy code adoption and enforcement by States and local jurisdictions to ensure all new homes are built to a minimum energy performance standard.
- Adopting stronger tax incentives and/or rebate programs encouraging energy efficiency improvements in homes as well as construction of high-efficiency new homes and multi-family housing.
- Update long-outdated efficiency performance standard for manufactured homes.

**The Honorable Kathy Castor (D-FL)**

1. Ms. Glover, you mentioned in your opening statement that energy efficiency has an important role to play in creating economic opportunities. Could you elaborate on what kind of job opportunities you see in energy efficiency? How would investing in energy efficiency jobs ultimately help create a stronger workforce in communities across the country? What can Congress do to facilitate the creation of high-quality jobs as part of the transition to a clean energy economy?

   **RESPONSE:** Energy efficiency is by far the largest job creator in the clean energy economy, with nearly 2.4 million jobs nationwide before the COVID-19 pandemic resulted in more than 300,000 job losses in the sector over the past year. For context, the

efficiency workforce entering 2020 was nearly seven times the size of the wind and solar industries combined, and more than 10 times that of the coal industry. Some 60% of efficiency jobs are in construction, with the remainder in manufacturing, engineering, professional services, and other areas. Importantly, these jobs are spread throughout the country, in rural and urban areas alike. At least 99.7% of U.S. counties have energy efficiency jobs, and 40 states employ at least 11,000 efficiency workers each. According to a recent report by Environmental Entrepreneurs (E2), energy efficiency is a family-supporting industry with workers earning an hourly wage of $24.44, or 28% more than the national median of $19.14. Additionally, most efficiency jobs are in small businesses. There are 361,329 energy efficiency companies in the U.S., and 80 percent of them have fewer than 20 employees. Congress has a tremendous opportunity to expand energy efficiency jobs and entrepreneurial activity through policies encouraging efficiency improvements. Programs such as providing efficiency improvement grants to small businesses, retrofitting critical public buildings, expanding tax incentives for home and building efficiency improvements, and expanding weatherization assistance would stimulate billions of dollars in additional economic activity and create hundreds of thousands of jobs.

Notwithstanding the above, African Americans and other minorities have been underrepresented in the energy industry in general, and the energy efficiency sector more specifically. According to the 2020 U.S. Energy and Employment Report, African Americans represent only 8% of the energy efficiency workforce, as compared to 77% for whites, and 15% for Hispanics and Latinos. These number while concerning provide substantive opportunities. For example, Chairman Rush's Blue Collar to Green Collar Jobs Development Act – specifically addresses new skill requirements and ensures that economic opportunities arising from the energy transition reaches historically disadvantaged businesses and communities, and those workers in communities at greatest risk from the energy transition.

2. Ms. Glover, we want to ensure that all Americans experience the benefits of the transition to a clean energy economy. Given the recent winter storm in Texas and the Southern Plains, how would investments in energy efficiency and weatherization benefit everyday Americans?

**RESPONSE:** The recent storms in Texas and the Southern Plains clearly demonstrated just how vulnerable our grid is and the massive economic costs that prolonged outages can impose, particularly with severe weather events expected to increase as a result of climate change. Energy efficiency is an essential resource that should be considered when planning to manage overall demand on the grid to ensure reliable and affordable power for all Americans. Improved energy efficiency-- and increasingly, new digital technologies for shifting loads and creating demand flexibility, are a critical piece of the equation. For example, if homes and buildings in Texas had used 20% less energy by being more efficient, not only would have occupants of those structures been better able to maintain safe conditions, but it would have required 20% less energy to keep the grid operating. We should avoid looking only at power generation as a

solution for reliability and resilience, and focus at least as much on optimizing energy consumption and efficiency to create a modern grid that is more sustainable, reliable and affordable.

**ATTACHMENT—ADDITIONAL QUESTIONS FOR THE RECORD**

**Subcommittee on Energy**
**Hearing on**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**Thursday, February 18, 2021**

Mr. Craig Gordon
*Senior Vice President, Government Affairs*
Invenergy

**The Honorable Bobby L. Rush (D-IL)**

1. On February 16, 2021, The New York Times released an article entitled "Texas Blackouts Hit Minority Neighborhoods Especially Hard". The article reported that experts and community groups believe that marginalized communities were the first to be impacted by power outages during the recent Texas winter weather crisis. Further, it reports that these communities are historically the last to have their power reconnected after these events.

    a. How can power generation operation and development companies, like Invenergy and others, better serve historically marginalized communities during a similar extreme weather event? How can these companies better support marginalized communities generally?

**RESPONSE:** Reliability and resilience are key criteria for all Invenergy projects. Our systems must be reliable, meaning they should be available as much as possible to meet the demand for affordable power on the grid. They must also be resilient, which means they must be able to recover quickly from system disturbances. Said differently, Invenergy is responsible for making sure, to the extent possible, that power flows to the grid so that our utility or corporate customers have access to power. Ultimately, load-serving entities receive power that Invenergy has produced and make restoration prioritization decisions about their residential customers. To those ends, development and operations companies like Invenergy must continue to strive for the highest level of reliability, resilience, and safety so that the load-serving entities can meet their demand. In the wake of the Texas events, Invenergy wind technicians were on-site around the clock for several days focused on restoring wind turbines to service. At no period during the Texas weather crisis were all Invenergy turbines offline, due in large part to the hard work of our project site employees focused on recovery.

Invenergy is committed to making workforce and direct investments in disadvantaged communities through our project development and philanthropic work, in addition to bringing low-cost, clean energy to American families and businesses. First, Invenergy has a number of development and operating projects in predominantly low-income rural areas. These projects bring hundreds of jobs and millions of dollars to these communities, as well as other direct investments such as local education and sports contributions and other community benefits. In addition to the myriad benefits our projects bring to communities where they are located, Invenergy is finding new and innovative ways to support historically marginalized communities

all over the country. For example, Invenergy is committed to investing in training and STEM programs, especially in poor, rural, or otherwise disadvantaged communities. In Deuel County, South Dakota, Invenergy created a $30,000 per year scholarship to benefit students at the local high school. We also have partnerships or relationships with organizations such as the Chicago Urban League, which supports and advocates for equality for African Americans, and Chicago's Project SYNCERE, which inspires and paves the way for underrepresented students to pursue careers in STEM careers. And, in 2019, Invenergy became the first sustainable energy company to make a three-year commitment to support the National FFA organization.

**The Honorable Kathy Castor (D-FL)**

1. Mr. Gordon, there is a growing consensus that upgrading and expanding the electric grid is a critical next step on the pathway to a clean energy economy. You mentioned that the rapid development and expansion of transmission infrastructure will create millions of jobs. Can you expand more on the potential of these jobs in a clean energy economy? What can Congress do to facilitate the creation of high-quality jobs as part of the transition to a clean energy economy?

**RESPONSE:** In the last decade, utilities and developers have deployed massive amounts of additional renewable resources, but the transmission infrastructure has lagged behind. We must build new long-distance, high-voltage transmission lines to enable the United States to deploy enough renewable generation capacity to decarbonize the power sector in a cost-effective way. For example, new transmission is a critical part of delivering the best renewable resources, often wind located in rural areas, to load centers where the power is needed. It is the only way to connect regions of the country with complimentary generation profiles to improve reliability and resilience. And, new transmission or transmission upgrades are necessary to continue to bring new variable generation onto the system to alleviate congestion.

Development and construction of long-distance high-voltage transmission lines will support thousands of jobs across a project footprint, including substantial direct, primarily union jobs, as well as additional indirect and induced employment. As an example, Invenergy is developing the Grain Belt Express transmission line, which will carry 4,000 megawatts (MW) of power from southwest Kansas to western Indiana. This line will take electricity from the Great Plains and deliver it to the PJM Interconnection, the grid operator for the mid-Atlantic region. The Great Plains is home to one of America's most abundant and low-cost wind energy resources, and this transmission line will provide direct access to this domestic energy resource for consumers across the Midwest and East Coast, where there is significant demand for low-cost, clean power.

Kansas, Missouri, and Illinois are the three states that will primarily benefit from construction of the Grain Belt Express transmission line, while also experiencing wind energy industry supply chain benefits from the 4,000 MW of new wind energy generation to be built in Kansas that will be enabled by the line. This combined buildout represents $10 billion in new clean energy infrastructure investment for the Midwest. This will support approximately 12,000 jobs and $1 billion in annual worker earnings each year over the three-year construction period, as well as approximately 1,500 full-time, permanent jobs and $88 million in worker earnings during operations. Additionally, the project will deliver billions of dollars in electricity cost savings for

consumers in the Midwest and eastern half of the U.S. while at the same time advancing energy de-carbonization.

Transmission development is incredibly expensive and time consuming, and often unpredictable because of siting and permitting challenges that can arise at any point. Developers are hesitant to embark on such expensive gambles because current federal law provides no assurances that a developer can complete (much less earn a reasonable rate of return on) merchant or interregional transmission projects. As a result, these projects rarely make it across the finish line. There are several policies that Congress could consider, and actions the federal government can take, to promote new transmission deployment. For example, Congress can pass federal incentives for transmission, such as an investment tax credit for new or upgraded long-distance, high voltage transmission. Federal incentives can reduce the costs for new transmission and provide financing opportunities for these projects that may not have existed otherwise. Congress could also reform transmission siting policies so that developers have more certainty that they will be able to complete projects that are important for reliability, resilience, and renewables integration. Furthermore, to advance needed transmission buildout Congress should request federal agencies establish processes to ensure early-stage alignment between and across federal agencies and departments, such as the U.S. Fish and Wildlife Service and the Army Corp of Engineers, that allows for a predictable and consistent process for environmental review and permitting; this is particularly critical for projects that cross multiple jurisdictions, where reviews must be coordinated between multiple offices, districts and regions. Related, federal agencies should establish binding milestones for development of environmental review documents and issue resolution.

2. Mr. Gordon, we want to ensure that all Americans see the benefits of the transition to a clean energy economy. Given the recent winter storm in Texas and the Southern Plains, how would upgrading and expanding the electric grid increase resilience and benefit everyday Americans? How can Congress support hardening and weatherizing grid infrastructure?

**RESPONSE:** Recent weather events in Texas, Oklahoma, and Kansas illustrate how harmful and costly it is for the United States to maintain an outdated electric transmission system that does not efficiently connect generation to load. These events reveal vulnerabilities with our outdated and insufficient system, exposing both reliability concerns (unplanned and unexpected outages) and resiliency deficiencies (severe problems with the grid's ability to quickly and effectively recover after a major outage). Because weather is provincial, meaning that what happens in one region of the country may not be occurring in another, transmission expansion can support regions experiencing outages due to inclement weather. Connecting regions, utilities, regional transmission entities, and electric interconnections with one another can diversify supply and reduce overall risk of power outages.

In addition to the significant reliability and resilience benefits a more connected transmission system can provide, new high-voltage electric transmission lines are more efficient. These new lines can reduce line loss, allowing for the delivery of more power that makes its way from point

A to point B across longer distances. These lines also allow utilities and developers to install more resources onto the grid because they decrease the power losses and, subsequently, the required reserve margins of a given region. For example, existing renewable projects already experience "curtailments," as a result of grid congestion, wasting valuable new clean energy that the system cannot handle and depressing wholesale power prices. Improving and expanding transmission can help avoid these curtailments by absorbing additional power brought onto the system. Relatedly, it can also help clear the logjammed interconnection queues across the country so projects can come online to supplement the system. Again, these improvements ultimately benefit customers, because it reduces electric costs to customers while still delivering clean power and ensuring reliability and resilience.

Congress can do several things to support expansion and hardening of the grid to realize the benefits this important infrastructure can bring about. First, Congress can pass federal incentives, such as an investment tax credit (ITC), for new or upgraded electric transmission that supports the reliability and resilience of the system by bringing on new clean energy generation or connecting regions or interconnections. Second, Congress can pass legislation to improve the siting process for electric transmission, which is currently a multi-phase process requiring approvals at the landowner, local, and state levels all along the route. Finally, Congress can pass laws that improve interregional planning processes, incentivize improvements and new technology to make transmission more efficient, and improve environmental permitting processes. Each of these policies will allow and encourage developers and utilities to improve the grid, which will harden the grid and facilitate resource-sharing to protect areas experiencing serious weather events.

3. Mr. Gordon, hundreds of gigawatts of wind, solar, and energy storage projects are stuck in interconnection queues waiting to connect to the electric grid. What can Congress do to help alleviate this situation?

**RESPONSE:** Regional transmission organizations (RTOs) and independent system operators (ISO) are functions of the Federal Power Act that allow regions of the country to share transmission resources, pool power to reduce costs and ensure reliability. In addition, RTOs and ISOs ensure non-discriminatory access to the transmission system in accordance with the Federal Energy Regulatory Commission's (FERC) Order 888 by administering the generation interconnection process. Each of these RTOs and ISOs have their own rules for permitting the interconnection of new generation as well as separate processes and procedures for studying the impact of generators interconnecting to neighboring systems. The industry is at an inflection point – one need look no further than each region's interconnection queue to see the massive amount of renewable generation that is waiting to replace retiring fossil fuel generation but these interconnections are occurring in new locations further away from load centers where the retiring generating facilities are located today. Renewable generation must be sited and interconnected where the natural wind or solar resource is most plentiful, but these areas tend to be sparsely populated and do not have robust transmission infrastructure. Because generators must interconnect where the natural resource is strongest (or build long generator tie lines to tap these regions) many developers are simultaneously interconnecting to the same weak spots on the system. This has resulted not only in long study delays due to the volume of interconnection requests but also unacceptably expensive upgrades costs that are added to individual projects and

an inefficient and piecemeal upgrading of the transmission system. This is occurring not through thoughtful long range transmission planning that would tap into the best resource regions and result in the largest benefit for the cost, but through individual projects paying hundreds of millions of dollars to upgrade the existing system which was not designed to accommodate the generation mix of the future. In other words, transmission planning and interconnection planning are bifurcated and considered in isolation rather than through an integrated process that would produce efficiencies. Decision-makers should ensure that new, high voltage transmission or network upgrades are forward thinking in nature in order to avoid long interconnection queue delays as well as the piecemeal, expensive, and inefficient upgrading of the transmission system that is occurring today.

Congress can do at least two things to reduce these issues: first, Congress must exercise its oversight of FERC to be sure that interconnection queue processes are just and reasonable. The current process in some of the regions is clearly not working, so FERC must monitor these regions and act to address the issue. Second, Congress can take actions to encourage the development of new long-distance, high voltage transmission and upgrades to existing lines to expand capacity. As mentioned above, Congress can create federal incentives for transmission, such as an investment tax credit for new or upgraded long-distance, high voltage transmission. Congress could also reform transmission siting policies so that developers have more certainty that they will be able to complete projects that are important for reliability, resilience, and renewables integration. Finally, Congress could designate a single agency or office as a "clearinghouse" for electric transmission permitting and siting to avoid duplication of efforts or conflicting or impossible deadlines that could otherwise end a project.

**Attachment—Additional Questions for the Record**

**Subcommittee on Energy**
**Hearing on**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**Thursday, February 18, 2021**

Mr. Richard J. Powell, Executive Director, ClearPath Inc.

**The Honorable Cathy McMorris Rodgers (R-WA)**

**1. We should build on the benefits of our shale revolution not walk away from them, would you agree and why?**

**RESPONSE:**

I agree. America's energy policy should maximize the benefits of the shale revolution and the abundance of clean, domestic natural gas. According to the Energy Information Administration, natural gas has reduced the power sector carbon emissions more than any other resource or technology over the past decade. New natural gas technologies, such as carbon capture, can drive even further emission reductions. Leading technology developers and utilities, such as Southern Company and BASF, are actively exploring how to install carbon capture technologies at new and existing power plants. Outside the power sector, natural gas can also play a large role in reducing transportation and industrial sector emissions through the use of natural gas-derived hydrogen and other chemicals.

**2. One challenge facing massive build out and reliance on wind and solar is the need for extensive transmission, which can take years and face significant local opposition. And there are other obvious limits to these technologies.**

**a. In Washington state, innovators like TerraPower and X-Energy are looking to demonstrate a new generation of nuclear reactors, promising exciting benefits and economic opportunity for future energy systems in the United States and around the world.**

**b. Would you explain some of the potential benefits of these small modular reactors and some of the new designs and how they can be sited in places that may not be so reliant on massive new transmission infrastructure?**

**RESPONSE:**
Today, there are dozens of U.S. companies designing the next generation of advanced nuclear reactors. These designs range in size from microreactors, which provide single digit megawatts of electricity, to larger designs that provide 100s or even 1000 megawatts of electricity. These advanced reactor designs also operate at higher temperatures, allowing them to provide both

clean electricity and process heat that can support industrial decarbonization. This variety provides a new flexibility on siting that historically has not been an option for utilities or communities.

Since these designs will also have a small footprint, there is an opportunity to site them near existing nuclear plants which have extra space, effectively expanding the output of clean electricity from a current site. This is similar to X-energy, which will build its reactor near the operating Columbia Generating Station in Richland, WA through the Department of Energy's Advanced Reactor Demonstration Program (ARDP). Decommissioned nuclear sites can also be an option as Holtec is considering building it's small modular reactor at the Oyster Creek site in New Jersey.[1] In all of these cases, a new advanced reactor can leverage the existing power generation and transmission facilities, easing the siting restrictions required to build new transmission. More importantly, these new reactors can leverage the skills and expertise of the surrounding community.

Internationally, there is also a significant market for nuclear energy, which is currently dominated by China and Russia. If the United States lacks a cost-competitive reactor design to sell abroad, we will continue to cede our global leadership on nuclear energy.

As you stated, innovators like TerraPower and X-Energy are looking to demonstrate their designs in Washington state through the ARDP. This moonshot program has the potential to reinvigorate the U.S. nuclear industry, provide utilities and states cost-competitive nuclear options when considering new clean energy resources, and make U.S. nuclear technologies available for the global market. It is important to maintain support for the ARDP and our nation's nuclear innovators as they develop the next generation of technologies.

**3. The Majority is pursuing a massive buildout of incumbent wind and solar over the next 14 years. Does this rushed approach—which of course is very expensive and challenging to achieve—risk creating a *disincentive* for private investment in other low-carbon technologies such as advanced nuclear or CCUS?**

**RESPONSE:**
Effective government policy should be as outcome oriented (i.e. emissions) and technology-inclusive as possible, and should not pick one technology over another. Government policy should be clear and focused on specific aspects of affordability, reliability, and sustainability, ultimately letting the market decide which individual projects should be built. Dispatchable, low-carbon technologies like advanced nuclear and CCUS are critical for creating an affordable clean energy system. Nuclear and CCUS allow affordable clean heat, which is necessary to reduce emissions from industrial and building sectors.

**a. How does the United States develop truly world-changing technologies if it at the same time it removes incentives for deployment of that technology in the United States?**

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[1] https://www.ans.org/news/article-2530/holtec-smr-could-be-built-at-site-of-former-one-in-nj-ap-news-reports/

**RESPONSE:**
Energy innovation is a continuum ranging from basic research and development (R&D) on fundamental science, to applied R&D regarding engineering, commercial demonstration of early stage technologies, and finally to larger scale innovations in manufacturing in deployment. In order to reap the benefits of the U.S. R&D investment into world-changing technologies, appropriate support at each stage of that continuum. Only investing in basic R&D without ensuring its transition to the U.S. marketplace means that we are investing in technologies that other countries can then profit from. The key to success is ensuring that the government supports new technologies until they gain their footing, but without overwhelming the marketplace.

There are clear market signals the government can send to establish new technologies without disrupting private finance. Recent examples of these market signals include the expanded 45Q carbon capture tax credit, and the initial market for High Assay low-Enriched uranium enacted in the Energy Act of 2020. Tax incentives and government procurement, such as proposals in this Committee to enhance the government's ability to enter into longer-term power purchase agreements for clean electricity, are useful market signals that can be used to aid technology commercialization while avoiding government mandates.

b. **You can't innovate on cleaner coal or gas generation if other policies essentially flood the market for alternatives, can you?**

**RESPONSE:**
Electricity markets are a very challenging environment with low-cost natural gas and renewable energy. Limited incentives can help demonstrate novel and game-changing technologies in a traditionally-slow moving sector. Technology specific incentives, particularly for already commercially successful technologies, distort market signals.

At the same time, Congress has funded a significant number of initiatives through the Department of Energy on lower-emission coal and gas generation. If appropriated, the carbon capture and high efficiency turbines demonstrations authorized in the Energy Act of 2020 would further lower the cost of cleaner fossil energy technologies. Multiple analyses show that the availability of dispatchable clean energy technologies, such as fossil energy with carbon capture, significantly improves the economics and probability of achieving deep decarbonization. The carbon capture demonstration authorization supports a portfolio of applications, from coal, natural gas and industrial facilities on a timeline consistent with the sunset of the federal carbon capture tax credit. Leveling the playing field between technologies incentives could help reduce disparities in the rate of deployment between fossil and renewable energy technologies.

**c. What happens to that industrial knowledge base? Doesn't it just go to Asia where the use of fossil energy continues? How does that help American interests or the climate?**

**RESPONSE:**
Nearly a quarter of all global carbon emissions are "traded" between countries in the form of embedded emissions in manufactured products, with a significant share of these emissions

originating in Asia. Policies that encourage offshoring of American industries to higher polluting countries is not beneficial for our interests or the climate.

The shale gas revolution, and the resulting abundance of low-cost natural gas, has encouraged companies to invest in new manufacturing facilities in the United States. For example, modern direct reduced iron and steel facilities have been built that produce cleaner commodities than conventional processes. These facilities can also be equipped with carbon capture to further reduce emissions. If fossil fuel production in the United States is curtailed, associated production and manufacturing costs in the United States will increase with unclear impacts on the international carbon emission balance.

**d. How should policymakers approach this dilemma?**

**RESPONSE:**
The most effective policy is to focus on supporting the quality of energy desired, such as cleanliness, affordability, and reliability, rather than penalizing the source of energy. Incentives to make fossil fuels and industrial processes cleaner in an affordable way can help reduce emissions without those facilities closing.

**4. Hydropower provides 70 percent of the power in my home State of Washington, which is why we have some of the lowest electric rates in the world.**

**a. Expanding this emissions-free resource offers great potential for clean energy and also provides good job opportunities for skilled craft workers.**

**b. What are some of the challenges you see to expanding hydro, and which of those might Congress address?**

**RESPONSE:**

Hydropower is known as America's first and most reliable renewable resource. By harnessing the force of flowing water to create electricity, hydropower has provided a flexible, baseload source of renewable power for more than a century. Until recently, hydropower was also America's largest renewable resource, but due in part to the bureaucratic federal licensing process, new hydropower development has stalled in recent years. To get new projects approved, developers must navigate a licensing process that can take between 6 to 10 years or more, spanning multiple state and federal agencies.[2] The Department of Energy (DOE) estimates that the U.S. could add 50 GW of hydropower by 2050, a 50% increase over current capacity,[3] but that won't happen without the types of licensing reform efforts you have spearheaded over multiple Congresses.

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[2] https://clearpath.org/energy-101/hydropower-101/

[3] https://www.energy.gov/sites/prod/files/2018/02/f49/Hydropower-Vision-021518.pdf

Pumped storage hydro is another reliable, renewable American resource. At over 21 GW of installed capacity, pumped hydro is the largest source of energy storage on the grid, making up over 95% of the market today.[4] Pumped storage hydro works like a large battery that can be charged by pumping water uphill and discharged by letting the water flow back down across a generator. With more intermittent renewables such as wind and solar power coming online, pumped storage can provide flexible, long-duration electrical storage to balance the grid.

The bipartisan energy package includes multiple provisions on hydropower and pumped storage hydro. The bill updates DOE authorizations for research, development, and demonstration programs with an emphasis on grid reliability and resilience, including through technologies that facilitate new market opportunities, such as ancillary services, for water power. The package also authorizes RD&D to advance efficient and reliable integration of hydropower and pumped storage systems with the electric grid. The bill also extends hydropower production incentives to facilitate new hydro development. With smart policies that invest in innovation, America's hydropower and pumped storage hydro can play a key role strengthening grid reliability and modernizing the U.S. energy system.

[4] https://www.energy.gov/eere/articles/get-pumped-about-pumped-storage

FRANK PALLONE, JR., NEW JERSEY
CHAIRMAN

CATHY McMORRIS RODGERS, WASHINGTON
RANKING MEMBER

ONE HUNDRED SEVENTEENTH CONGRESS

# Congress of the United States

## House of Representatives

COMMITTEE ON ENERGY AND COMMERCE

2125 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515-6115

Majority (202) 225-2927
Minority (202) 225-3641

March 18, 2021

Mr. Daniel C. Camp III
Chairman
Beaver County Commissioners
810 Third Street
Beaver, PA 15009

Dear Mr. Camp:

Thank you for appearing before the Subcommittee on Energy on Thursday, February 18, 2021, at the hearing entitled "A Smarter Investment: Pathways to a Clean Energy Future." I appreciate the time and effort you gave as a witness before the Committee on Energy and Commerce.

Pursuant to Rule 3 of the Committee on Energy and Commerce, members are permitted to submit additional questions to the witnesses for their responses, which will be included in the hearing record. Attached are questions directed to you from certain members of the Committee. In preparing your answers to these questions, please address your response to the member who has submitted the questions in the space provided.

To facilitate the printing of the hearing record, please submit your responses to these questions no later than the close of business on Friday, April 2, 2021. As previously noted, this transmittal letter and your response, as well as the responses from the other witnesses appearing at the hearing, will all be included in the hearing record. Your written responses should be transmitted by e-mail in the Word document provided to Lino Peña-Martinez, Policy Analyst, at lino.pena-martinez@mail.house.gov. To help in maintaining the proper format for hearing records, please use the document provided to complete your responses.

Thank you for your prompt attention to this request. If you need additional information or have other questions, please contact Lino Peña-Martinez with the Committee staff at (202) 225-2927.

Sincerely,

Frank Pallone, Jr.
Chairman

Attachment

cc: The Honorable Cathy McMorris Rodgers
Ranking Member
Committee on Energy and Commerce

The Honorable Bobby L. Rush
Chairman
Subcommittee on Energy

The Honorable Fred Upton
Ranking Member
Subcommittee on Energy

[Mr. Camp did not answer submitted questions for the record by the time of publication.]

**Attachment—Additional Questions for the Record**

**Subcommittee on Energy**
**Hearing on**
**"A Smarter Investment: Pathways to a Clean Energy Future"**
**Thursday, February 18, 2021**

Mr. Daniel C. Camp III, Chairman, Beaver County Commissioners

**The Honorable Cathy McMorris Rodgers (R-WA)**

1. The Majority's proposed climate policies include not only provisions that may limit the use of natural gas, there are new regulatory initiatives that call for a moratorium on air permits, in which the EPA Administrator can object even to state air permits, for industrial facilities associated with the feedstock and chemicals derived from natural gas and used for making plastics. This would appear to affect Shell's Pennsylvania Petrochemical Complex in Beaver County.

    a. What would be the impact of several years in delays in permitting for a facility like this to Beaver Country?

    b. What would be the impact on other economic development in your area that is building off the benefits of the American shale revolution?

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