DIALOGUE

GOVERNING THE GRID: DECARBONIZATION, ENERGY SECURITY, AND CLIMATE ADAPTATION FOR THE 21ST CENTURY

SUMMARY

Visible impacts of climate change, like the unprecedented winter storm in Texas, underscore the need to integrate climate adaptation as a principal factor in energy security. With appropriate weatherization and increased battery storage, many believe that renewables can help assure an energy-secure future that is more resilient to the impacts of climate change. On May 4, 2021, the Environmental Law Institute hosted a panel that explored how to ensure energy grids are fit for these emerging challenges, and how energy law and policy must navigate complex and intersecting governance imperatives. Below, we present a transcript of that discussion, which has been edited for style, clarity, and space considerations.

Nina Pušić was Senior Manager of Educational Programs at the Environmental Law Institute.
Kathryn F. Penry (moderator) is an Associate at Bracewell LLP.
Shalaya Morissette is Lead Program Manager, National Grid, and President of the Greater Boston Chapter of the American Association of Blacks in Energy.
Doug Vine is Director of Energy Analysis at the Center for Climate and Energy Solutions.
Eric Christensen is Of Counsel at Beverage & Diamond PC.

Nina Pušić: I would like to take a moment to thank our outstanding panelists for joining us today. Here to moderate is Kathryn Penry, an associate at Bracewell LLP, where she focuses on energy, infrastructure, environmental transactional, regulatory, and policy matters, and advises clients on matters across the oil and gas, electric power, and infrastructure industries.

Kathryn Penry: I'm going to start by introducing our panelists and giving a brief introduction of the topic. Then, we'll move into the panelists' presentations and the question-and-answer session.

First, I'd like to introduce Shalaya Morissette. She's a senior technical inspector with the Gas Pipeline Safety Group for National Grid USA. Prior to joining National Grid, she held various roles in higher education, including enrollment services project manager, and in global transportation as the director of affiliate relations. As president of the Greater Boston Chapter of the American Association of Blacks in Energy, she also facilitates positive relationships between the chapter groups and groups that would not otherwise connect, and continues to develop active engagement and encourages young people to become involved in the energy industry.

Next, we have Doug Vine. He's the director of energy analysis at the Center for Climate and Energy Solutions (C2ES), and leads the Center's work on energy decarbonization policies and technology analysis, following trends in global and domestic energy production and utilization and their impact on greenhouse gas emissions. Doug has authored numerous reports and briefs on natural gas, preserving existing nuclear power, and North American electrical grid and microgrids and clean energy standards. He's currently researching pathways toward decarbonizing power and industrial-sector emissions, including widespread electrification and the use of low-carbon fuels like hydrogen.

Last but not least, we have Eric Christensen. He's a leading energy and natural resources attorney at the Seattle office of Beveridge & Diamond. Eric assists renewable and traditional energy companies as well as major energy consumers with navigating the complex legal and regulatory systems governing the nation's energy industry. Before entering private practice, Eric served as a trial attorney at the Federal Energy Regulatory Commission (FERC).

So, what brings us here today? In recent years, we've seen severe weather events that have put millions of people out of power and tested our electrical grid. Most recently is the

Texas winter storm.[1] This storm occurred in mid-February 2021 and plunged large swaths in Texas into subfreezing temperatures and overwhelmed the state's electricity infrastructure, causing massive power outages. At the height of the crisis, according to the *Texas Tribune*, nearly 4.5 million Texas homes and businesses were without power.[2] The Electric Reliability Council of Texas (ERCOT) manages the state's main power grid, which represents 90% of Texas' electric load and serves more than 26 million customers. The storm caused almost 70% of ERCOT's customers to lose power in subfreezing temperatures and ultimately caused at least 111 deaths, mostly due to hypothermia.[3]

Also, over the past five years, we've seen major wildfires in California.[4] In mid-August 2020, California experienced a heat storm.[5] The California Independent System Operator (CAISO) cut off the power supply to about 500,000 customers during peak demand periods due to extreme heat and the inability to secure sufficient power imports from out of state.[6] It was the first set of rolling blackouts in the state since 2001, and California utilities had already been instituting localized power safety shutoffs to avoid sparking additional wildfires.

The last example, but certainly not the only other example, was in 2014 when the East Coast experienced the polar vortex, which caused PJM Interconnection's generator to fail to meet consumer demand.[7] At a very basic level, an unhealthy polar vortex could cause jet streams to break apart and allow extremely cold weather to escape and move south. This was exactly what happened in 2014 and it led to record low temperatures. On the coldest day of the winter in 2014, 22% of PJM's generation was unavailable to meet consumer demand.[8] At the same time, PJM had a record winter peak use of more than 141,000 megawatts.

It seems more likely than not that our electrical grid will continue to be tested by severe weather caused by climate change. As we've seen, the grid can be extremely vulnerable when these unprecedented events occur. When we think about how to ensure that the grid is up to the task of supporting millions of Americans, we have to ask ourselves if our electrical grid is being governed appropriately. Ensuring adequate grid governance is the key for decarbonizing the electricity sector, because the entities that maintain the electrical grid will be responsible for ensuring that decarbonized technologies are integrated with the currently more portable and more widely used resources like natural gas.

As brief background, the electricity industry consists of three basic parts: supply, transmission, and delivery. To ensure that these parts work in concert to keep our lights on, the electricity grid is in large part managed by different regional transmission organizations (RTOs). Sometimes, they're called independent system operators, but I'm going to use RTO here.

RTOs are governed by FERC. Their primary function is to manage the transmission grid and operate regional electricity markets.[9] Governance of each individual RTO varies across the country.[10] For example, PJM, which manages the electricity grid in more or less the Mid-Atlantic, where I am, is governed largely by its members and voting occurs by sector. The transmission providers have a vote, the generators have a vote, and so on. On the other hand and on the opposite coast, where Eric is, California lawmakers maintain control over CAISO, with the board of governors selected by the California governor and confirmed by the state's senate. As you can imagine, these different governance styles bring about very different results.

Another piece of grid governance is that each RTO operates under FERC authority. When an RTO proposes to change its tariff, FERC's mandate is to review the changes to determine whether their adjustment is reasonable, which is a more passive review.[11] When FERC wishes to force a change on an RTO, it bears the burden of proving that the current operation of the RTO is unjust and unreasonable, which is quite a high burden.[12] Where FERC wants to impose different decarbonizing technologies, like energy storage, it faces an uphill battle to show that the RTO's current structure is unjust and unreasonable. And, as in any administrative agency, any proposed rule takes time and is often appealed to the circuit courts. So, it's more difficult for FERC to accomplish goals toward decarbonization and climate adaptation on a reasonable time line.

We haven't mentioned the role of states yet. That's because they have less power than FERC with respect to

1. Sami Sparber, *At Least 57 People Died in the Texas Winter Storm, Mostly From Hypothermia*, Texas Trib., Mar. 15, 2021, https://www.texastribune.org/2021/03/15/texas-winter-storm-deaths/.
2. *U.S. House Committee Holds Hearing on Texas' Massive Power Outages During Deadly Winter Storm*, Texas Trib., Mar. 24, 2021, https://www.texastribune.org/2021/03/24/texas-power-outages-congress/.
3. Neelam Bohra, *Almost 70% of ERCOT Customers Lost Power During Winter Storm, Study Finds*, Texas Trib., Mar. 29, 2021, https://www.texastribune.org/2021/03/29/texas-power-outage-ERCOT/.
4. Julia Marnin, *2020 U.S. Wildfires Burned Over 10 Million Acres, Nearly 18,000 Structures: Report*, Newsweek, July 23, 2021, https://www.newsweek.com/2020-us-wildfires-burned-over-10-million-acres-nearly-18000-structures-report-1612637; Dan Whitcomb, *PG&E Pleads Guilty to 84 Counts of Involuntary Manslaughter in California Wildfire*, Reuters, June 16, 2020, https://www.reuters.com/article/us-california-wildfires-pg-e-idUSKBN23N35T (discussing the 2018 Camp Fire).
5. NASA Earth Observatory, *Extreme Heat in Death Valley*, https://earthobservatory.nasa.gov/images/147148/extreme-heat-in-death-valley (last visited July 12, 2021); California Independent System Operator, Preliminary Root Cause Analysis: Mid-August 2020 Heat Storm (2020), http://www.caiso.com/Documents/Preliminary-Root-Cause-Analysis-Rotating-Outages-August-2020.pdf.
6. California Independent System Operator, *supra* note 5, at 41-42.
7. Dann Price, *What Has PJM Learned From the Polar Vortex?*, CPower, Apr. 9, 2019, https://cpowerenergymanagement.com/what-has-pjm-learned-from-the-polar-vortex/; Paul McGlynn, *How PJM Remained Reliable During Record Cold*, PJM Inside Lines, Feb. 14, 2019, https://insidelines.pjm.com/how-pjm-remained-reliable-during-record-cold/.
8. McGlynn, *supra* note 7.
9. FERC, *Electric Power Markets*, https://www.ferc.gov/electric-power-markets (last updated July 20, 2021); *see also* Shelley Walton, *Rethinking Grid Governance for the Climate Change Era*, 109 Calif. L. Rev. 209 (2021), https://www.californialawreview.org/print/rethinking-grid-governance/.
10. Walton, *supra* note 9, at 226.
11. *See, e.g.*, 16 U.S.C. §824d.
12. *See, e.g.*, 16 U.S.C. §824e ("Whenever the Commission . . . shall find that any rate . . . for any transmission or sale subject to the jurisdiction of the Commission, or that any rule, regulation, practice, or contract affecting such rate . . . is unjust, unreasonable, unduly discriminatory or preferential, the Commission shall determine the just and reasonable rate . . .").

grid governance. In recent years, numerous states have adopted 100% clean energy targets by legislation or executive order.[13] Achieving these goals requires cooperation of the RTOs, which have to manage the integration of these resources into their grids and markets.

This has been met by some RTOs with consternation. For example, PJM's mandatory capacity market makes it more difficult for renewables to compete due to concerns about price suppression, because oftentimes renewables are supported by the states through more favorable policies and subsidies and other types of support.[14] And states have limited authority to challenge how RTOs are governing renewables because of federal preemption issues between FERC's authority and state authority.[15]

To make RTOs better serve the public interest, some suggest that a new model of agency oversight is necessary. However, any new standards that FERC or RTOs may propose or mandate come with practical challenges with implementation. Increased grid governance can also further decarbonization efforts, which are integral to adapting to climate change.

Decarbonization, as a concept, is fairly straightforward. It requires significantly cutting greenhouse gases. According to the United Nations Intergovernmental Panel on Climate Change (IPCC), capping global warming at 1.5 degrees Celsius, which is the target in the Paris Agreement, requires cutting carbon dioxide (CO_2) emissions by around 45% from 2010 levels by 2030 and to net zero by 2050.[16] Practically though, decarbonization can be daunting for those who have to implement goals set by state or federal lawmakers.

Decarbonization requires industry to create new technologies that will significantly lower emissions, which are capital-intensive and can be politically fraught. As a start to decarbonization though, several new technologies are already being implemented across the electrical grid. For example, there is an increase in renewables—with more wind and solar—and an increase in offshore wind. Sometimes, however, this can be met by challenges in local communities that do not want to see windmills off the coast of their beautiful summer homes or coastal homes.

There's energy storage, which balances out renewable energy supply by storing it during periods of abundance and releasing it during periods of undersupply. There are also distributed energy resources, which are essentially small-scale generation devices that range from "electric storage and intermittent generation to distributed generation, demand response, energy efficiency, thermal storage and electric vehicles and their charging equipment."[17] These resources can be similar to energy storage in that they can balance energy supply and demand and improve reliability and efficiency of the grid.

Finally, a phrase that I think we're all familiar with is carbon capture and sequestration. The idea is to capture CO_2 from power plants and industrial sources, transport it by pipeline, and inject it deep into underground rock formations. So, essentially capturing carbon before it's emitted into the atmosphere.

As our panelists will discuss in more detail, the expansion of more renewable energy will require construction of a lot more transmission infrastructure. This can be challenging, but adapting to the effects of climate change can no longer be considered a scholarly endeavor. It's clear that severe weather events are likely to continue and the electrical grid needs to be prepared to react.

Adapting to climate change, however, comes with a wide swath of challenges, including financial—both for the industry to develop infrastructure and to get the capital to actually build that infrastructure, and appropriations at the federal and state levels to provide for incentives for decarbonization. Of course, there are political challenges, with differences between the two major political parties and even some disagreements within each party internally.

Finally, there are regulatory challenges with regulators facing an uphill battle to propose rules and implement decarbonization strategies. Those rules are being challenged by stakeholders, which, as we all know, takes time to work its way through the courts—time that scholars suggest we don't have. With that, I'll pass it off to our first panelist.

Shalaya Morissette: Thank you, Kathryn. Currently, I'm a lead process manager in the Pipeline Safety Group for the Rhode Island Division of National Grid, but I was a senior technical inspector in my previous role. That means I've had a lot of exposure to things being done in the field on the natural gas side of our business. As a process manager, I deal with a lot of audits and a lot of notices from our regulators. I'm looking at this information and having all the conversations about it.

Let's get started with a quick glance at things. What do DHS, FedEx, UPS, the U.S. Postal Service, and National Grid have in common? Distribution. I would argue strongly that you may not have enough information to understand

13. *See* Walton, *supra* note 9, at 213.
14. Rabeha Kamaluddin et al., *FERC Upholds June 2018 PJM Minimum Offer Price Rule Order Thwarting State Subsidiaries*, Nat'l L. Rev., Apr. 27, 2020, https://www.natlawreview.com/article/ferc-upholds-june-2018-pjm-minimum-offer-price-rule-order-thwarting-state-subsidies; Scott Strauss et al., *FERC's Capacity Markets Limit Clean Energy and Cost Billions; It's Time for Congress to Act*, Utility Dive, Aug. 27, 2020, https://www.utilitydive.com/news/fercs-capacity-markets-limit-clean-energy-and-cost-billions-its-time-for/584130/.
15. *See, e.g.*, Hughes v. Talen Energy Mktg., 136 S. Ct. 1288, 46 ELR 20078 (2016) (finding that a Maryland program encouraging construction of new in-state power generation was preempted by the Federal Power Act).
16. IPCC, Global Warming of 1.5°C, an IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (Valérie Masson-Delmotte et al. eds., 2018).
17. Press Release, FERC, FERC Opens Wholesale Markets to Distributed Resources: Landmark Action Breaks Down Barriers to Emerging Technologies, Boosts Competition, Sept. 17, 2020, https://www.ferc.gov/news-events/news/ferc-opens-wholesale-markets-distributed-resources-landmark-action-breaks-down; *see also* FERC, FERC Order No. 2222: A New Day for Distributed Energy Resources (2020), https://www.ferc.gov/media/ferc-order-no-2222-fact-sheet.

that large utility companies are distribution companies. It's important to understand that for natural gas, a company like National Grid, Liberty, or Eversource owns the infrastructure and they pass on the cost of the gas to you, as a customer. There is no upsell; we pass it on.

But what you do have to pay for is what we have in the ground, our distribution system. How we get it to you is what you're paying for. Do you care about what's inside of an Amazon truck or a FedEx truck? Probably not. But what you do care about is that, when you place your order, it should arrive in two days and it should be unscathed. The same is true for pipelines. I don't care what we collectively decide to put inside the pipe, but I am concerned with the cost-effectiveness, efficiency, and safety of how it gets to me.

So, our challenge, in Massachusetts in particular, is to get to net-zero carbon emissions by 2050. Today, natural gas utility companies are actively trying to power through the challenges ahead. I'm going to take a look at some of the challenges that I'm personally seeing in the pursuit of clean energy within natural gas. Keep in mind that I've selected these topics in particular because this is what I'm hearing. This is what we're talking about in large utility companies.

The first major challenge is infrastructure—to use the infrastructure that we have or to not use the infrastructure. In the interest of public safety, I can't share a map of the current National Grid pipeline infrastructure. However, I can share with you that in Rhode Island alone there's more than 3,200 miles of pipe existing in the ground that we're using. In the region—Massachusetts, New York, and Rhode Island collectively—there's 36,000 miles of pipe. You can only imagine what that infrastructure costs to implement in the first place. That's over the course of the past 100 years that we've been doing this.

There are still what we call "yards" that were at one point horse stables, because there were horses dragging pipelines to locations to bury them in the ground. So, we still have some advancements to consider. But over the years, we've used different materials. Some were better than others, and there are still pipes in the ground that are more than 100 years old. We're working to replace them year after year; in a good year's time, we can replace about 100 miles of pipe.

Like anything new, we don't know how long plastic is going to survive. We do know that plastic exposed to sunlight is bad, which is why it is buried underground. Everyone agrees that we're going to flip the switch for a different energy source. Some say hydrogen is the way to go, but what are the safety implications? Switching to a different energy source is sort of the unknown for the gas world. So, what do we know? We know that there's always liability. And we want to minimize that as much as possible.

Cost is always a challenge. Abandoning what we have, which cost us billions to implement over, you know, 100-plus years, is a really hard pill to swallow, to just let it all go and start investing completely in other things. That's a big challenge, and it's like an act of the U.S. Congress, to get a whole bunch of people that are making money to just switch and leave everything they know behind.

The other side to it is if we decide to implement something new, there's a massive upfront cost that comes with that. It's not small money.

The other major thing to consider is time. What we have to understand is that time is a real challenge. We can't take the risk of burning down everything we've built because of the urgency of it being the best thing to do. There has to be time for trial and error. We have to get it right as we do this. Challenging the parties that are in the decision-making roles to just flip that switch is really tough because they are considering how long this is going to take. Is it going to be in their lifetime that they see this happen? It's like leaving a legacy behind; you really have to be forward-thinking, and it's a huge hurdle to overcome for utility companies in particular.

The next big challenge, which I didn't really consider until I started talking to people who work in capital delivery, is that there's a large portion of natural gas revenue that is created by implementing natural gas systems into new developments or large subdivisions. These are new areas that don't have gas mains in the ground. They ask us to come out. It could cost $100,000 for a mile of mains to go in the ground for a new development.

What do you do when you've got a perfect infrastructure? It's all plastic. There's nothing leaking. Nothing to replace. You're going to be competing for electric heating. That's going to be a real option in some areas. So, what's the growth competitiveness? Companies are really going to have to look at this and say, that's part of the revenue that we're just not going to go after anymore. But what does that mean for business?

The next big area, my favorite area, is regulatory challenges. New industries: it's like anything new has to be heavily regulated just to make sure we're doing it right until that industry can prove that they will self-govern. And even then, there is always going to be that extra layer to make sure that our citizens are protected.

The other side to this is deregulation. It can cost more. For example, I can tell you right now my Comcast bill is $100 more than it was last year. And that is a challenge. Regulators are going to look at this and say, how do we ensure that you—for instance, if we decide on hydrogen—are doing it right and doing it safely, and is the cost of operating under that regulatory wheelhouse worth it for big companies?

Sometimes, we might decide collectively it is not worth operating. We're moving on to something different. That is a real factor. And there's human capital. The average age right now in the Northeast of someone working in natural gas is 55 years old. They're leaving the industry soon. We know that we have to retrain some of our senior technicians who are out in the field, but don't have as much experience.

But what are we going to do when we implement something new? We need to retrain completely for something as simple as safety. They have no idea what they're doing. We are at the mercy of subject matter experts and we run the risk of trusting a group of people that may not know it all. That's a natural component of these things. There is going to be a huge fight between the major utility companies to

get the best subject matter experts. They're all going to be advising the same group of people, but who is going to get paid the most to do it? That's a huge expense. We're going to go back to having new hires with no expertise and no one to really be there to say, "I've got 30 years in this, and I can tell you all about hydrogen."

Then, there's overall "the unknown." We don't know what we don't know. I've got people I work with who are 40 years in who can tell you everything about natural gas and everything about our operating procedures. Sadly, they will be useless, for lack of a better word.

But the biggest part to me is the next piece, and that's the customer impact. When I talk to my mom, who's old school, there's this disbelief that natural gas or oil is going away, considering so many in the market are still using oil. We know that there are better options, but we're still using gas and oil. In the Northeast, we have the highest number of historical homes per capita. You don't get a lot of people saying, yes, I'm willing to install this huge converter to go to hydrogen in my lovely kitchen.

We also have harsh conditions. We're drilling into granite. If we decide to do something different underground, how do we deal with that? The biggest part for me, living in Boston and having lived in other areas of the country where multifamily homes are not a thing, is how do you combat the fact that Black and brown communities will be the ones at risk? They will be footing the bill for mandated new technology that they are not able to afford. They may be stuck on natural gas because they just can't convert. Who's going to break that news that you're going to pay more because you can't afford it? It's tough.

Shalanda Baker, the deputy director for energy justice in the Joseph Biden Administration, has written a wonderful book that explains the energy transition.[18] Those at the front lines, who will be most affected, are those who are Black and brown. I am a multifamily homeowner, and I don't see the incentive to switch over if I'm not living there, to help my tenants have lower bills by being energy-friendly. There's nothing there for me except for the obligation working in energy that I should do it and that it's the right thing to do.

Who's going to make that initial customer investment? And who is going to tell the customer that they're going to foot the bill? I'm sure that there will be plenty of public assistance to help out the owners, but why would they do it? Those are the challenges that I'm seeing as we transition to decarbonization. Doug is here with all the solutions.

Doug Vine: I hope that we have some of the solutions. There are many challenges on many fronts. Transmission is certainly one of them, as well as equity issues and a just transition. Moving former oil and gas workers into the new clean energy economy is also a huge challenge. So, it's multiple fronts that are going to be impacted as we transition and decarbonize.

I am going to talk about a few different things and present some solutions to the things that I bring up. Under the broad rubric of how to ensure that energy grids are fit for the unique emerging challenges of this century, I'm going to talk about climate change, climate resilience, and power infrastructure needs for resilience and decarbonization. I'll start with a high-level overview about climate change and why climate resilience, sometimes called adaptation or climate adaptation, is necessary in addition to greenhouse gas mitigation.

Also, I'll provide a few comments on the Texas grid emergency that resulted from the extreme cold weather event this past February. But the bulk of my presentation will be around a paper that we recently released about power infrastructure needs for economywide decarbonization.[19]

I'd like to share some details about my organization, C2ES. We're now in our 23rd year. We're an independent, nonpartisan, nonprofit organization focused on strong policy and action to address climate change. Our core mission is to forge practical solutions to reduce greenhouse gas emissions, expand clean energy, and strengthen resilience to climate impacts. We have a long history of bringing together diverse stakeholders and producing accessible content and publications to help promote climate solutions.

One of the unique features of C2ES is our Business Environmental Leadership Council. We believe that business engagement is critical for developing efficient and effective solutions to address climate change. The Council includes top companies in the electric power, manufacturing, transportation, high tech, oil and gas, and finance sectors. It's the largest United States-based group of companies devoted solely to addressing climate change. Though C2ES is supported by institutional funding from a variety of businesses, foundations, and individual donors, we are solely responsible for positions, web content, and publications.

Now, on to the first topic: climate change. Unfortunately, the climate is changing and perhaps not in a good way. Global greenhouse gas emissions continue to increase. Today, the world collectively emits around 50 billion metric tons of CO_2 equivalent each year.[20] This is more than 40% higher than the emissions in 1990, when there were only around 35 billion metric tons.[21]

As a result of increasing emissions and because CO_2 remains in the atmosphere for hundreds of years, concentrations of CO_2 are increasing. In the early 1990s, CO_2 concentrations were at about 350 parts per million.[22] For the month of March 2021, they were around 417 parts per million.[23] So, there's a steady march upward. These increas-

18. Shalanda H. Baker, Revolutionary Power (2021).

19. Doug Vine, Power Infrastructure Needs for Economywide Decarbonization (2021), https://www.c2es.org/site/assets/uploads/2021/04/power-infrastructure-needs-for-economywide-decarbonization.pdf.

20. Hannah Ritchie & Max Roser, *Greenhouse Gas Emissions*, Our World in Data, https://ourworldindata.org/greenhouse-gas-emissions (last visited July 12, 2021).

21. *Id.*

22. UC San Diego, *The Keeling Curve*, https://keelingcurve.ucsd.edu/ (last visited July 27, 2021).

23. *Id.*

ing concentrations are warming the planet. 2020 tied 2016 as the hottest year on record.[24] In fact, the past six years have been among the warmest on record.[25]

The impacts are growing. The National Oceanic and Atmospheric Administration (NOAA) has a web page that lists climate disasters that have occurred in the United States.[26] 2020 was a record year with 22 billion-dollar weather-climate disasters ranging from severe storms, seven tropical cyclones, and one wildfire.[27] The impacts from increasing CO_2 concentrations are expected to continue.

We had a natural experiment last year with the pandemic in that a lot of energy sources or fossil fuel sources shut down, including things like aviation and some other forms of transportation. Although we had a little bit of an experiment on reducing emissions there, we did not detect a decline in concentrations of global CO_2. It continued to rise because it takes so long for the CO_2 to break down in the atmosphere.

The sad and sobering fact is that if we stop emissions today, we're still going to be seeing climate impacts for some time. Likely for decades to come. And it's a cost. Not only is there a cost to putting on new sources of clean generation, but we also have a cost in adapting our current system and making it stronger to resist climate impacts.

The definition of "climate resilience" is the ability to anticipate and prepare for and respond to hazardous events, trends, or disturbances related to climate. Improving climate resilience involves assessing how climate change will create new or alter current climate-related risks and taking steps to better cope with these risks. For example, a warming atmosphere is giving extra energy to storms, making precipitation events like hurricanes and thunderstorms that are more intense today than those of the past. Those impacts are being felt by electric power systems.

The federal agencies, states, cities, and businesses now are developing resilience plans that identify some of the risks and vulnerabilities, and are then creating disaster recovery plans. Some of the things that they're noting is that they need to build hardened infrastructure. They're looking at the long-term outlook for how flood zones are changing and avoiding those flood zones.

Looking at the Texas extreme weather event that occurred, I think it was unique. There was sustained record-breaking cold weather. It was the second time in a decade basically that the grid faced these kinds of conditions. More than 100 people lost their lives. There were people who were without heat for days. They were actually burning their furniture to keep warm. It was a pretty dire event that occurred.

The cold weather, and perhaps the earlier PJM example, too, impacted power generation. Typically, electric transmission is the most vulnerable part of the electric system. But during these cold weather events, it seems like there are issues around winterization and things that we could have done better. We learn lessons every time these things happen.

For example, in New England, they keep backup fuel supplies for natural gas plants because natural gas has priority for home heating over power generation. Perhaps that's one climate solution that evolved up in the New England area.

It was an equal opportunity failure in Texas because a lot of the systems were not winterized. They generally do not see such extreme cold temperatures in Texas. Instead, their systems are optimized for hot weather conditions, which is what they more frequently see. For 10 months out of the year, they experience very warm temperatures, so their system is optimized that way.

All of the technologies experienced failures with natural gas being the primary source, but a nuclear power plant there had an issue with its intake being frozen and cold water intake that would cool the power plant and wind turbines that were not properly winterized, so they were stuck in place basically because they were frozen. But all of these technologies can and do work in much colder climates. For example, wind turbines and nuclear power plants are working just fine in Minnesota. But you have to prepare for these climate extremes.

Definitely some incentives for winterizing are on the table from ERCOT, as well as some additional strategies. Transmission hardening is very important, being more interconnected. The Texas grid is fairly isolated. They have a few interconnections to other neighboring RTOs, but more interconnections could help in future situations. In this particular instance, the cold outbreak was fairly widespread and neighboring RTOs were also having high demand issues, so it's not necessarily clear that that would have helped. But they had issues with the natural gas pipeline infrastructure not working because the pipelines were just too close to the surface and there was freezing.

Another great strategy for climate resilience is having a broad combination of electricity sources. Texas does generally have a broad combination, but making sure that each of those are maintained and winterized obviously is key.

I want to talk for the last bit about a paper that we recently released, *Power Infrastructure Needs for Economy-wide Decarbonization*.[28] I talked a bit about climate change already. We know that we need to shut the spigot off and reduce the amount of emissions fairly substantially.

Kathryn gave some statistics from the IPCC's 1.5 degrees Celsius report. We know that the strategy or a key part of the strategy for achieving decarbonization is making the power sector the main focal point. We're going to decarbonize the power sector. We know how to decarbonize it. Then we're going to electrify as many end-uses as we

24. Press Release, NASA, 2020 Tied for Warmest Year on Record, NASA Analysis Shows (Jan. 14, 2021), https://www.nasa.gov/press-release/2020-tied-for-warmest-year-on-record-nasa-analysis-shows.
25. Press Release, World Meteorological Organization, 2020 Was One of Three Warmest Years on Record (Jan. 15, 2021), https://public.wmo.int/en/media/press-release/2020-was-one-of-three-warmest-years-record.
26. National Centers for Environmental Information, NOAA, *Billion-Dollar Weather and Climate Disasters: Overview*, https://www.ncdc.noaa.gov/billions/ (last visited July 12, 2021).
27. *Id.*
28. Vine, *supra* note 19.

can, like electrified transportation, switching electricity in buildings from natural gas and oil heating to electric heat pumps, and so on. Then, also doing as much electrification as we can in industry. We know we're not going to be able to do 100% electrification, so there is still a need for decarbonized fuels.

Siting any lengthy high-voltage power lines across multiple states and jurisdictions has proven exceptionally challenging in many years. To be fair, many other types of energy infrastructure, from fuel pipelines to wind farms, have also faced significant opposition. So, a regional transmission can face planning and permitting hurdles, including contested permits and litigation from multiple states, regional authorities, federal agencies, and local interests. Individual lines can take more than a decade before they're fully deployed, assuming they successfully make it through the gauntlet of obstacles at all.

Some of these names may sound familiar: the Sandhills, the Northern Pass, and the Grain Belt Express projects. They all have in common that they were proposed in 2011 and 2012. None of them have been built yet. Each project has faced a barrage of legal challenges. The Northern Pass project was eventually cancelled in 2019.

But it's not all brick walls. There are strategies for transmission that have worked, too. Texas, for example, successfully spurred infrastructure development by establishing competitive renewable energy zones. They were able to construct more than 3,500 miles of transmission lines carrying more than 18,500 megawatts between 2005 and 2013.[29] As a result, wind curtailments dropped significantly in the state of Texas.

Another promising approach that could ease transmission siting difficulties involves undergrounding and colocation in existing transportation rights-of-way. While burying or undergrounding can cost 10 times the amount of overhead transmission, it can increase power system resilience, which is very important. And it can mitigate public opposition by eliminating visible infrastructure, which is one of the major objections to transmission.

This strategy of undergrounding using existing rights-of-way is one that is currently being put to the test with a project called the SOO Green HVDC Link in Illinois and Iowa. It was supposed to move ahead fairly recently, but it's caught up in some interconnection queues. There are other issues where RTOs have long waits for getting power lines and other infrastructure into the development phase.

One thing that became really clear to us in putting together the paper is that there's no one-size-fits-all policy that will solve the transmission issue. It's going to be a collection of policies that minimize the amount of long-distance, high-voltage transmission that we need. It also is going to involve having policies that have been successful and promising policies to get that transmission that we absolutely need.

The minimization angle, or decarbonization modeling, is rather extensively covered in the paper.[30] If we have a high-penetration renewable grid in the future, we don't know exactly how the balance of clean and firm generation (e.g., dispatchable or controllable clean generation on demand by a grid operator) is going to be. Things like hydropower, nuclear power, and geothermal power are all 100% clean technologies, but they're economically challenged (and not compensated for their environmental benefits in markets). The nuclear fleet is aging. But if we can maintain this existing firm, non-emitting generation for as long as possible, that's one strategy to reduce the total amount of high-voltage, long-distance transmission that we're going to need.

I mentioned the balance of electrification with everything that we can electrify versus sort of low-carbon liquid fuels—things like hydrogen or renewable natural gas that are going to be needed for perhaps heavy-duty trucking or heating needs for industry. If you can avoid electrification and find cheaper ways to produce those low-carbon fuels, that's another great strategy for minimizing the amount of transmission.

Then, there's developing new technologies as well. Right now, energy storage is good. It provides about four hours of storage. But we need long-duration energy storage as the technology to really help bring down the cost and balance out intermittent renewables. It behaves a lot like hydropower or nuclear power because it's firm. It's available for long periods of time for when the weather is uncooperative, particularly during the winter when there's not a lot of sun and perhaps not a lot of wind for weeks at a time—in other words, some of the challenges that could introduce a Texas-like situation in the future if we're too heavily reliant on one particular technology.

I know Eric is going to be talking about some of the policies that we can implement on the transmission front from a legal perspective.

Eric Christensen: I've been doing energy work for about 30 years now. A lot of this is a set of lessons learned the hard way.

I will put some concrete examples on the table for why constrained transmission is a problem. Bonneville Power Administration (BPA) is the major transmission provider in the Pacific Northwest. If you look at a map of BPA's transmission constraints, you'll see that a utility in the Seattle area, for example, is pretty much surrounded by constraints.[31]

We're now facing a Washington state law that says we have to be 100% non-emitting from our electric genera-

29. Powering Texas, Transmission & CREZ Fact Sheet (2018), https://poweringtexas.com/wp-content/uploads/2018/12/Transmission-and-CREZ-Fact-Sheet.pdf; Terrence Henry, *How New Transmission Lines Are Bringing More Wind Power to Texas Cities*, NPR State Impact, June 26, 2014, https://stateimpact.npr.org/texas/2014/06/26/how-new-transmission-lines-are-bringing-more-wind-power-to-texas-cities/.

30. Vine, *supra* note 19.

31. *See* BPA, 2020 Transmission Plan (2020), https://www.bpa.gov/transmission/CustomerInvolvement/AttachmentK/Documents/2020-BPA-Transmission-Plan.pdf.

tion by 2050.[32] That includes utilities and goes to vehicle electrification, home heating, and so on. So, we're looking at significantly increased demands at the same time as the complete decarbonization of the generation system.

And yet, when you look at the transmission constraints, there are very few options. If you want to bring in solar power from eastern Washington, which is the best resource in our state, you face these constraints across the Cascades. If you want to bring in power from California, you've got constraints both down by Portland and through the Columbia River Gorge. If you want to bring in wind from the Columbia River Gorge, which is the best wind resource in the Northwest, the transmission lines in that area are subject to major constraints. I know, from the perspective of utilities trying to bring power home, that this is a big problem.

For example, the Snohomish County Public Utility District, the utility just north of Seattle that I used to work for, was very interested in a wind farm in southwest Washington. It has very attractive generation profiles, with winter peaking, whereas most of the wind farms in the Northwest peak in the spring when we don't really need the power. But there was no way to get it home, so that transaction never came to be.

Similarly, I represent a number of independent renewable energy producers. Trying to get transmission access is a real problem. It can be a huge expense that renders otherwise really attractive projects uneconomical. The problem is illustrated by the BPA proposal to build transmission reinforcements in southwest Washington that would relieve that line of constraint just north of Portland. This provoked a huge backlash from the property owners along the corridor who would potentially be negatively affected. Electric transmission is one of the great "not in my backyard" (NIMBY) problems that we face right now.

Part of this is a legal problem. Since I'm a lawyer—just as a carpenter views every problem as a nail—I view every problem as needing a legal solution. If you compare the siting authority at FERC for electric transmission compared to what they do with natural gas siting authority, it's very different. The end result is that it's much easier to site natural gas. That's because, if you go to FERC, you demonstrate the need for a natural gas pipeline. Then, you're given authority to condemn property all along the route of the natural gas pipeline.[33]

There is no such authority for transmission. Transmission is primarily a state responsibility. There was an attempt in the Energy Policy Act of 2005 to create national interest transmission corridors that would have simplified the problems faced by transmission siting.[34] Unfortunately, two cases pretty much neutered the statute.[35] So, the result is that, if you want to build electric transmission, you have to deal with the whole patchwork of state, federal, tribal, and local siting authorities. You have to get permits from all of those authorities. It takes a long, long time.

As Doug mentioned, a lot of projects proposed in 2011 and 2012 are yet to be built. The rule of thumb in the industry is that it takes 10 years to build a transmission line. The Biden Administration is aiming to get to 80% clean energy by 2030, which is less than 10 years away. That's going to require a lot of transmission and, given the constraints, it seems like that's going to be difficult or impossible to achieve.

As I mentioned, the Biden Administration has a very aggressive agenda to promote renewable energy and at the same time to increase demand on electricity through electrification of the transportation system and other initiatives to electrify various things on the theory that, if you supply everything with green energy, then it's going to significantly reduce the carbon footprint of the entire economy. This is great, but whenever I come to transmission constraints, that's going to be a big problem.

The Biden Administration recognizes this. They have a number of proposals to improve the possibility that transmission could actually be built. The infrastructure package contains several very large initiatives for funding transmission incentives.[36] There's a proposal for tax credits for electric transmission investments, which I hope to see adopted.[37] That would certainly improve the economic case for building transmission.

The Administration proposes a U.S. Department of Energy Grid Deployment Authority,[38] which would aim to simplify the permitting process, and to employ rights-of-way along federal highways and similar corridors as the right-of-way for new electric transmission. They have already issued, I believe, the initiative to use $8.25 billion

32. Washington Clean Energy Transformation Act, ch. 288 (Wash. 2019); *see also* Eric Christensen, *Washington Clean Energy Transformation Act Establishes Aggressive Mandates for Grid Decarbonization and Renewable Energy Production*, Beveridge & Diamond News Alert, June 25, 2019, https://www.bdlaw.com/publications/washington-clean-energy-transformation-act-establishes-aggressive-mandates-for-grid-decarbonization-and-renewable-energy-production/; Eric Christensen et al., *Washington Adopts Economy-Wide Climate Legislation: "Cap-and-Invest" Approach Sets a Price for Carbon Emissions and Allows Washington to Join Existing Emissions Credit Markets,* Beveridge & Diamond News Alert, May 18, 2021, https://www.bdlaw.com/publications/washington-adopts-economy-wide-climate-legislation-cap-and-invest-approach-sets-a-price-for-carbon-emissions-and-allows-washington-to-join-existing-emissions-credit-markets/; Eric Christensen et al., *Oregon Sees Washington's 2045 Target for Grid Decarbonization, Lowers by 5,* Beveridge & Diamond News Alert, July 6, 2021, https://www.bdlaw.com/publications/oregon-sees-washingtons-2045-target-for-grid-decarbonization-lowers-by-5/.

33. Natural Gas Act §7, 15 U.S.C. §717f.

34. Federal Power Act §216, 16 U.S.C. §824p.

35. *See* California Wilderness Coalition v. U.S. Dep't of Energy, 631 F.3d 1072 (9th Cir. 2011); Piedmont Env't Council v. Federal Energy Regul. Comm'n, 558 F.3d 304 (4th Cir. 2009).

36. Statement, The White House, Fact Sheet: The American Jobs Plan (Mar. 31, 2021) [hereinafter American Jobs Plan Fact Sheet]. *See also* Eric Christensen et al., *Biden Administration Proposes Major Investments in Energy as Part of Infrastructure Proposal*, Beveridge & Diamond News Alert, Apr. 2, 2021, https://www.bdlaw.com/eric-l-christensen/publications/biden-administration-proposes-major-investments-in-energy-as-part-of-infrastructure-proposal/.

37. American Jobs Plan Fact Sheet, *supra* note 36. *See also* Electric Power Infrastructure Improvement Act, H.R. 2406, 117th Cong. (introduced Apr. 8, 2021), https://www.congress.gov/bill/117th-congress/house-bill/2406?q=%7B%22search%22%3A%5B%22electric+power+infrastructure+improvement+act%22%5D%7D&s=1&r=1).

38. American Jobs Plan Fact Sheet, *supra* note 36.

in existing authority for loan guarantees and loans to build electric transmission.[39] And there's a number of FERC initiatives that seem to be under way.[40]

On the positive side, I think there is going to be a review of Order No. 1000,[41] which was an interregional planning model adopted by FERC about 10 years ago. The results have been pretty disappointing frankly. The current Commission seems pretty intent on reviewing that and coming up with new solutions that will improve interregional transmission planning. Hopefully, it would make it easier to build transmission lines to go between different regions that are governed by different RTOs or planning organizations.

On the negative side, FERC recently changed its policy on transmission construction incentives.[42] I think it's pretty much driven by the fact that the incentives are just for transmission companies to join RTOs. The previous Commission tried to stretch that probably in a way that's not legally sustainable. But I think that the current Commission recognizes the problem and they're doing whatever they can to overcome the problems with the existing infrastructure at FERC, which is primarily aimed at how transmission lines are paid for and planned.

How could we improve the public process for the ability to build transmission? I think the most obvious thing would be to adopt the Natural Gas Act model for federal transmission siting.[43] With that, we would give electric transmission providers rights similar to those provided for natural gas pipelines currently. That would be specifically a federal approval and rights for right-of-way that would include condemnation rights to obtain property rights along the right-of-way, as well as a sort of centralized clearinghouse for all the different permitting that needs to be done. This would include what I call a "shot clock on permitting" where the state authorities and local authorities, if they have a permit that's required for the transmission, have a specified time line in which to act.

On the natural gas side, depending on the permit, it's often 90 to 120 days. For Clean Water Act (CWA)[44] permitting, there's a one-year deadline.[45] But since there's no centralized authority at FERC, there's no similar requirement. So, the delays in getting permits at the state and local levels can drag out and make it economically difficult or impossible to construct the transmission corridor.

Second, as I mentioned, there was a previous try for federal transmission corridors that came a-cropper in the courts. I think it would be a great idea to try to revive that and to create some transmission corridors where the problems are identified upfront. The preferred corridors that avoid wilderness areas, endangered species habitat, and so on, are identified. Those can be used by transmission providers as the place to build the high-voltage transmission.

The third idea is what I call the equal sharing of the misery. There is a model from the Telecommunications Act for approval of cell towers.[46] Essentially, the model says, since everybody wants great cell service but nobody wants to have cell towers in their neighborhood, local authorities can regulate cell towers, but they can't prohibit cell towers in their jurisdiction, and they can't impose environmental and other restrictions that would effectively eliminate cell towers. So, everybody has to take some hit. The return is that everybody has cell service that doesn't drop offline all the time, at least theoretically.

I think there is a similar problem with transmission. Everybody wants reliable electric service at an economical cost. That's really not possible unless everybody agrees to construction of transmission corridors. Particularly decarbonization of the grid is going to be difficult or impossible without a significant expansion of the transmission grid. So, some kind of grand bargain along the lines of this Telecommunications Act model would be a great way to achieve agreement or get some kind of a system where local authority is retained. But it's not local authority to kill the system, just local authority for a reasonable regulation.

In addition to legal solutions, there are technical solutions, as Doug mentioned. For example, if you use direct current (DC) rather than the traditional alternating current technology for building transmission lines. The DC transmission lines have a much smaller footprint. The towers that people think are a visual nuisance can be eliminated by undergrounding these lines. And it's possible to move a really large volume of electricity on these relatively small transmission corridors using this technology.

There's a number of other technologies out there that might also help to basically maximize the capacity of the existing system. For example, there are new computer technologies on the horizon where you can actually measure the temperature of transmission lines as they are in operation to figure out how much capacity is actually there.

Generally, the current system just uses a graph based on hot temperatures and low temperatures that estimates what the capacity of the transmission line is. By actually monitoring the transmission line, we can have a much better idea of what the temperature is and how much capacity is left before the line will start to melt down. Implementing such technology to maximize the existing system is really a key to this problem, but one that the regulatory system

39. Press Release, U.S. Department of Energy, DOE Announces Up to $8.25 Billion in Loans to Enhance Electrical Transmission Nationwide (Apr. 27, 2021), https://www.energy.gov/articles/doe-announces-825-billion-loans-enhance-electrical-transmission-nationwide.
40. FERC, Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection, 86 Fed. Reg. 40266 (July 27, 2021).
41. *Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities*, Order No. 1000, FERC Stats. & Regs. ¶ 31,323 (2011), *order on reh'g*, Order No. 1000-A, 139 FERC ¶ 61,132, *order on reh'g*, Order No. 1000-B, 141 FERC ¶ 61,044 (2012).
42. FERC, Electric Transmission Incentives Policy Under Section 219 of the Federal Power Act, 86 Fed. Reg. 21972 (Apr. 26, 2021).
43. *See* Natural Gas Act §7, 15 U.S.C. §717f.
44. 33 U.S.C. §§1251-1387, ELR Stat. FWPCA §§101-607.
45. CWA §401, 33 U.S.C. §1341.
46. Telecommunications Act §704, 47 U.S.C. §332(c)(7). *See also* Congressional Research Service, R46736, Stepping In: The FCC's Authority to Preempt State Laws Under the Telecommunications Act (2021), https://fas.org/sgp/crs/misc/R46736.pdf.

isn't very good at resolving because the technology risk isn't something that regulators are very good at handling.

I would like to encourage everyone to think outside the box. There was an architectural contest about how we could reduce NIMBY problems with transmission. Architects came up with the idea of turning transmission towers into attractive sculptures. They had a number of different models.[47] I think anything like this that could help to alleviate public opposition to transmission lines would be a welcome innovation in the industry.

Nina Pušić: Thank you all for your presentations. Our first question is, how long do you anticipate oil and gas to continue to provide our grids' energy mix, given the imperative of decarbonization in the face of climate change and the Biden Administration's goal of reaching net zero before 2050?

Eric Christensen: I can try the short answer. It's a matter of, if you have followed the decline in coal power production in the past 10 to 15 years, that there's been a really astonishing decline. I anticipate no reason that that won't continue. The one caveat is that, as Doug mentioned, we don't really have a good solution for long-term energy storage right now outside of pumped-storage hydro, which is really expensive and difficult to build.

I think there will continue to be a demand for natural gas peaking to cover these periods when renewables aren't able to meet high demands in extreme situations like Texas experienced. But apart from that, the economics and the policies seem to be lined up for a relatively rapid phaseout of fossil energy, in the electric sector at least.

Doug Vine: I'm a little more in the middle on this. Yes, we've seen a lot of coal plant retirements. But we've also seen a lot of natural gas spin and replace that coal, which is a main factor. This is of course highly regionally dependent. Washington State has a lot of hydro capacity in its region. So, they can use that hydro to back up the wind in the Columbia River Valley, and other renewable sources, but other parts of the country cannot. For as long as there are not clean alternatives, the reliability of the system is going to be one of the main factors.

When a power plant wants to retire, PJM or the RTO will do an analysis around what else is available to meet and ensure that we have reliable power in the system. There are new generations as a solution or a new transmission can be a solution. We talked about how hard transmission is to build. So, really it's going to be dependent on how quickly we can build some alternatives and whether they are being built in the right areas where we can retire the coal and natural gas plants.

We don't use very much oil in power generation. I think most of it is in Hawaii and far-off places that use it as power. I think as we ramp up and deploy more clean energy, then it's slowly going to unwind. But I would see it in place for quite some time still.

Shalaya Morissette: I'm hoping that it sticks around at least until I retire. Can I get 10, 15 years of natural gas use? I'm willing to switch for the challenges ahead. I would definitely say that, given that utility companies are working toward that 2050 goal, I'm going to stick with 2050 that it will be there.

Eric Christensen: That's certainly the West Coast number. Some other states have adopted the 2050 goal and interim goals that require really significant reductions in fossil energy use.

Nina Pušić: Our next question is, what are some practical steps energy policymakers can take to improve grid resilience in the face of increasingly extreme climate impacts such as unprecedented winter storms?

Eric Christensen: The Texas disaster was not unforeseen. In fact, in 2011, there was a similar cold spell. FERC and the North American Electric Reliability Corporation, which is the national reliability standard-setting organization for the electrical grid, issued a 300-plus-page report on that cold event.[48] Basically, the bottom line is that we need to anticipate that it's going to get cold even in Texas, and we need to make sure the grid is weatherized.

ERCOT is the organization that governs the grid inside of Texas. The state's electrical grid is isolated from the rest of the United States and governed by a separate organization. They effectively ignored the advice of the federal regulators. If it had been followed, certainly the worst impacts of the February event would have been avoided. Possibly blackouts and brownouts might have been avoided entirely. That's a relatively simple example.

In the larger context, I think the utility planning models by and large are pretty good. But they need to start taking into account the anticipated changes in the climate and how that's going to impact both power availability and the resiliency of infrastructure that might get knocked down in hurricanes and other extreme events that are linked to climate change.

Here, in the Northwest at least, I know that there's considerable discussion about how to do that, looking, since we're so dependent on hydropower, into a careful examination of what the long-term effects of climate change on the water supply are going to be. There are similar efforts to try to put some quantification to how much danger there is to other infrastructure from extreme weather events and how to address that. But I think, at this point, people are still trying to get their heads around this rather than having a definite plan for incorporating those into utility planning models.

47. *See, e.g.*, Choi & Shine Architects, *The Land of Giants*, http://choishine.com/Giants.html (last visited July 27, 2021).

48. Report on Outages and Curtailments During the Southwest Cold Weather Event on February 1-5, 2011 (2011), https://www.ferc.gov/sites/default/files/2020-04/08-16-11-report.pdf.

Doug Vine: I hit on some of these things as I was talking, so I'll just highlight them again. Typically, the most vulnerable parts of the power system are the transmission lines and the local distribution lines. Simple things like vegetation management are a huge activity for most utilities. Keeping trees and other plants away from the power lines is a huge help in keeping the grid up. If you go down to the Gulf of Mexico, you'll notice that the transmission towers or the local distribution towers are made of concrete. Hardening the towers that are used for transmission lines can help.

There are a lot of smart technologies, too. Putting sensors and smart technologies in substations can help show where outages are occurring and get the grid restored more quickly. I think that's huge. I think Shalaya will certainly know all about that. And in the distribution network, just knowing where the problem is. A lot of technology can help us do that. The grid was built a long time ago and we've added to it for more than 100 years. So, making these upgrades is going to be a long process, to harden all of these various transmission elements.

But then, cold weather presents another whole range of issues, which we've seen twice in Texas. Eric pointed out the PJM polar vortex events that have happened as well. Thus, we need to make sure that the intake valves for our water supply for cooling plants—like thermal plants, like nuclear plants—are able to be kept flowing and working during extreme cold weather periods. There are places in the country where it is below freezing for several months at a time. And they are able to handle and manage these things. Yes, they come at a cost, but there's also a cost when things go wrong.

In winterizing plants, markets can be used for some of these things as well. I think there's a forward market in PJM in New England. That can help deliver revenue to generators to help complete some winterizing activities. Notably, ERCOT doesn't have a forward market. That might be something that they're looking at now as they're thinking about what went wrong this time around. There are some market incentives and there's some climate resilience planning—just understanding what the vulnerabilities are.

Having a diverse fuel mix is another great strategy as well. They have a lot of wind in Texas. They're soon going to have a lot of solar in Texas. They have a couple of nuclear power plants. In thinking about clean energy options, you want to have as broad a mix as you can. That's going to reduce your risk of generation outages as well. I think most of the generation is fairly resilient with the exception of the protocol on cold weather. But it's something that we need to look at as well.

Shalaya Morissette: Doug, you mentioned all the technology that we are using and that we are implementing. And it's very, very expensive to do. Having this challenge ahead of us makes us question how much more we should invest if we're going to abandon it all eventually. If we're just going to leave it behind, why keep upgrading?

One of the things that neither of you mentioned is power companies working with other utilities. We tend to operate in silos and we're not partnered with our water companies, local or large, to really help facilitate those cold winter months. Even when we're installing a new pipe in the ground, we're not really consulting with other utilities that are in the ground with us. We do what we want and we say, hey, if you encroach on us, we'll just spend a bit more money and move it later, as opposed to real city planning and figuring this out as we go in the ground. I would hope that, as a more practical application, we start to work with each other.

Eric Christensen: Again, if I can add one more thought, one of the things we need to do is build more transmission. If you remember back to the transmission system in the Northwest, we haven't had a really severe cold snap in about 20 years. But if one occurs, it tends to result in low or no wind. So, that would mean no wind power production. It occurs in the winter. We might have seven hours of daylight in mid-winter. So, not much solar.

What then is the solution? We've got to have transmission access to California where the sun is likely to be shining, to Montana and Wyoming where in the winter the wind blows like hell. But without those, we're kind of islanded. We're in danger of being the equivalent of Texas, where they could have imported power from other parts of the country had the grid in Texas been interconnected. But it's not. The result of the transmission constraints that we're facing creates that same kind of danger for the Northwest and other regions as well.

Doug Vine: On that interconnected point, California and Texas both had grid issues. I don't know that this is necessarily a trend, but they did share it in common. When it was really hot in California, it was also really hot in Oregon and Washington at the same time. So, even interconnection is not always going to solve the problem.

The same for Texas. When it was very cold in Texas, it was also very cold in Louisiana. Pretty much the entire South and Great Plains were suffering cold weather at the same time they were having their own demand issues. But at least we were able to keep their generation going, more so than Texas was, because their systems experienced that condition more often.

So, is the answer micro grids? I don't know. We need to again think outside the box about it. Wider swaths of the country seem to be affected at this time, whereas things in the past seemed more local. I don't know if I can yet make that complete observation, but at least recently the experiences in California and Texas do share that.

Shalaya Morissette: Some more practical applications are in overall construction. I know, here in Boston, they're in the process of building the largest passive house in North America, for example. But if you look at some of the other countries that are leaders in climate change, you'll see we're just not doing enough in all areas.

Kathryn Penry: I think the point, too, about interconnectedness goes to what Eric was saying, that, right now, transmission siting is more of a state-approval issue. Maybe the idea would be to make it more of a federal issue so that we can deal with the cross-border issues that we're seeing and get the power back to where it needs to go.

We do have a question that I would love to get Shalaya's thoughts on. The question is, what does energy justice look like to you and what are some practical steps we can take toward it?

Shalaya Morissette: When you really think about energy justice, it's the simple goal of achieving equity in the social and economic aspects of it. There should be no reason why in an inner city it costs more for solar. We know that to be true, that Black and brown folks are paying more for clean energy. It's a sad truth. What are we going to do about it? It's equity. It's being fair and upfront about it. It's having opportunities.

When you have a salesforce that is 100% white and they're going into Black communities and it's something new to present to these groups, how can you do that? How am I going to trust someone who doesn't live in my neighborhood? There's no one else in my area that has solar. You have to build up that trust and get those communities to almost the same level because it's happening with or without them. It's much more likely that they will be left behind if they're not part of the transition. We need to include those community leaders who can talk to people that the masses cannot reach.

There's this overall sense of loss when I think about energy justice. That they're going to be the ones most disenfranchised, like they have been historically, in all the progress that we make. I hope that, if nothing else, our policies include protections for those that are going to potentially suffer the most. That's what I'm looking at when we talk about energy justice.

Kathryn Penry: Thank you. Along with that, what does National Grid do about public perception of different projects? When you're coming into another neighborhood, or when you're building a pipeline and you have NIMBY issues, or you're burying transmission lines, what happens at the community level to introduce those different construction projects that might be happening? Whether it's the establishment of new power resources or individuals' bills are going up because of X, Y, or Z. Or what do companies do in those situations at the local level?

Shalaya Morissette: We're regulated to do it. We have to by law communicate in multiple languages to make sure that people know what's going on. There's an abundance of resources to find out what we're doing in local communities, but you have to seek it out and you have to feel comfortable seeking it out. I think that's where all utilities perhaps miss the mark, because it is sort of a white male-dominated industry providing services to customers that don't necessarily look like that. There's nothing wrong with that, but do you spend the dollars in reaching them if you're leaving information and it's not in their language? Because, again, that sort of overarching rule has only happened in the past 10 years.

There are plenty of different communities. I can tell you, in Rhode Island, there is a population of Portuguese people and Italian people where English was not their first language and we were not doing justice for them. Having a translator available when you're in the community, having people that are there to answer questions who speak their language is a big deal.

I can't speak on behalf of National Grid in what they do. That's not my area of expertise. But I can tell you, working in regulatory, that it's something we are forced to do. We do go above and beyond in terms of the phone calls, commercials, and all that layering. Let's be honest, utility companies are a monopoly in one sense of the word. There's really no other option for me in where I live for who I buy natural gas from and how it's brought into my home. So, I'm forced to use it. The responsibility of getting information is also on the consumer. If you are using the resource, then you do have somewhat of a consumer obligation to figure out what's happening around you.

Kathryn Penry: Doug, what about in your research? When you're looking at decarbonizing the economy and electrifying the economy, what do you see as the human impact or the public perception on hurdles that we have to overcome so we can get to where we need to be by 2050?

Doug Vine: I talked about some of the challenges that we're looking at with regard to transmission and minimizing transmission. I think this plays into building things near where people are. One of the strategies that I didn't probably emphasize as much is the whole centralized versus distributed challenge. A lot of people think we can do a lot more distributed generation, using things like rooftops.

I think the evidence is that we're going to have to do both because there's a lot of utility-scale generation. Still, there are a lot of utility-scale excellent renewable resources that are far away from people that are going to be quick wins, that are super-inexpensive, but they do require the transmission challenge to get them hooked up to the grid. And we will do that in California. The Administration just announced a huge 350-megawatt solar project in California.[49]

But when we're building these things in local distribution networks, like micro grids or solar gardens, we have to think about things differently than how we thought about siting infrastructure in the past. And this perhaps goes to Eric's point about the telecommunications and the cell towers, that we need to share in the infrastructure equally across where these projects are being built.

49. Press Release, U.S. Department of the Interior, Interior Department Approves Solar Energy Project in California Desert (May 3, 2021), https://www.doi.gov/pressreleases/interior-department-approves-solar-energy-project-california-desert.

We all benefit from them by having cleaner air and lower risk from climate impacts. So, we really need to reimagine how we have these discussions when we site things near where people are in cities and we do a lot more distributed generation, which is something that I think will be happening for sure.

People like the idea of being off-grid or generating their own power and having their own batteries at home. I think that's a trend that will continue to develop. Certainly, it's very expensive and only accessible to the wealthier people out there right now. But as the costs come down, cities may start providing that to public housing and communities as a way to improve conditions in public housing. It's a huge challenge and we cannot neglect these equity and just transition issues.