UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Climate Change, Extreme Weather, and Electric System Reliability	**)))**	**Docket No. AD21-13-000**

COMMENTS OF THE INSTITUTE FOR POLICY INTEGRITY AT NEW YORK UNIVERSITY SCHOOL OF LAW

Pursuant to the Federal Energy Regulatory Commission's (FERC or Commission) March 15, 2021 Supplemental Notice of Technical Conference and Inviting Comments (Notice),[1] the Institute for Policy Integrity at NYU School of Law (Policy Integrity)[2] respectfully submits these comments highlighting the climate-related risks facing the electric system and steps that can be taken to enhance reliability and resilience. Policy Integrity is a non-partisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy. Policy Integrity staff have authored a variety of publications on subjects directly and indirectly relevant to this proceeding and strongly support, as a general matter, making the implications of climate change a standard feature of planning and valuing infrastructure and assets in and beyond the power sector.

Respectfully submitted,

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Dated: April 14, 2021

[1] Supplemental Notice of Technical Conference Inviting Comments, Docket No. AD21-13 (Mar. 15, 2021).
[2] These comments do not reflect the views of NYU School of Law, if any.

Comments of Policy Integrity

Policy Integrity welcomes this inquiry into the effects of a changing climate on electric system reliability. This proceeding's findings will illuminate important opportunities to improve reliability and resilience by adjusting approaches the Commission and others take to planning, investing in, and operating grid components. FERC can thereby make rates more just and reasonable. Policy Integrity's comments respond to several of the questions posed by the Commission in the Appendix of the Notice. We respond to some in groups and some individually.

Questions 1-3: Direct physical effects of climate change on the electric system

1. *What are the most significant near-, medium-, and long-term challenges posed to electric system reliability due to climate change and extreme weather events?*

Growing levels of heat, humidity, storm frequency and severity, precipitation intensity in some regions and drought in others, and riverine and coastal flooding are sources of especially significant challenges to electric system reliability that are driven by climate change and changing patterns of extreme weather events.[3] Notably, these impacts tend to manifest as combinations of "stressors" and "hazards."[4] Stressors nudge systems and their components beyond their design and operational specifications. For instance, hotter and more humid days coupled with relatively warm nights can stress systems by making it difficult to dispel

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[3] MELISSA ALLEN-DUMAS, BINITA KC & COLIN I. CUNLIFF, OAK RIDGE NAT'L LAB'Y, EXTREME WEATHER AND CLIMATE VULNERABILITIES OF THE ELECTRIC GRID: A SUMMARY OF ENVIRONMENTAL SENSITIVITY QUANTIFICATION METHODS 11 (2019); Craig D. Zamuda et al., *Energy Supply, Delivery, and Demand*, *in* IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES: FOURTH NATIONAL CLIMATE ASSESSMENT, VOL. II, 174, 176 (2018).

[4] U.S. Climate Resilience Toolkit, *Glossary*, https://perma.cc/LQG7-NNZH (last visited Apr. 7, 2021); Michael Oppenheimer et al., *Emergent Risks and Key Vulnerabilities*, *in* CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY. PART A: GLOBAL AND SECTORAL ASPECTS. CONTRIBUTION OF WORKING GROUP II TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 1039, 1046 Box 19-2 (Mike Brklacich & Sergey Semenov et al., eds. 2014).

accumulated heat while also driving demand up to high "needle peaks."[5] Hazards are acute events that can disrupt the operation of a system more directly and immediately. Flooding and wildfire, for instance, are hazards that are made more frequent and severe by climate change that can damage or destroy system components and thereby severely impair system operation.[6] Stressors tend to make systems more fragile to hazards and thus less able to withstand and rebound from those hazards.[7]

In the near term, electric system reliability will face more frequent and widespread stressors, like drought in the West and long spells of hot and humid weather in the East.[8] In the medium term, stressors that are already evident will become more pronounced—and will interact with hazards that are also becoming more frequent and severe.[9] Over the long term, in addition to these trends persisting, rising sea levels will add substantially to the number of power sector assets near coastlines that are susceptible to damage from storms and flooding, and changes to the availability of water for cooling at thermal power plants and for hydroelectric generation will depart from historical patterns.[10]

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[5] *See* CONSOLIDATED EDISON, CLIMATE CHANGE VULNERABILITY STUDY 4–5 (2019) (describing impacts of higher "temperature variable," which measures both heat and humidity).

[6] ALLEN-DUMAS ET AL., *supra* note 3, at 11; A. Park Williams et al., *Observed Impacts of Anthropogenic Climate Change on Wildfire in California*, 7 EARTH'S FUTURE 892, 905–06 (2019).

[7] ALLEN-DUMAS ET AL., *supra* note 3, at 6–8.

[8] *See id.* at 5 (tabulating causes of outage related to climate change); ALYSON KENWARD & UROOJ RAJA, CLIMATE CENTRAL, BLACKOUT: EXTREME WEATHER, CLIMATE CHANGE AND POWER OUTAGES (2014) (tallying outages caused by extreme weather events from 2003-2012).

[9] Zamuda et al., *supra* note 3, at 176; *see also 'Average' Atlantic Hurricane Season to Reflect More Storms: Higher Averages Based on Most Recent 30-Year Climate Record*, U.S. NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Apr. 9, 2021), https://perma.cc/MYQ6-VKFX.

[10] *Id.* at 176, 178–81; *see also* Michael Chester et al., *Infrastructure Resilience to Navigate Increasingly Uncertain and Complex Conditions in the Anthropocene*, 1 NATURE PARTNER J.: URB. SUSTAINABILITY 1 (2021).

2. *With respect to extreme weather events (e.g., hurricanes, extreme heat, extreme cold, drought, storm surges and other flooding events, or wildfires), have these issues impacted the electric system, either directly or indirectly, more frequently or seriously than in the past, and if so, how? Will extreme weather events require changes to the way generation, transmission, substation, or other facilities are designed, built, sited, and operated?*

The frequency and duration of severe outages have increased in recent years,[11] mostly due to disruptions to distribution and transmission system components,[12] but sometimes, partly or wholly, as a result of problems for generation as well. The August 2020 heatwave in California and the February 2021 cold snap in the Midwest and Texas both made clear that extreme weather events can impair generation capacity as well as distribution systems.[13] Such events have already led some utilities—generally at the direction of state authorities—to modify the design, construction, location, and operation of facilities and assets.

3. *Climate change has a range of other impacts, such as long-term increases in ambient air or water temperatures that may impact cooling systems, changes in precipitation patterns that may impact such factors as reservoir levels or snowpack, and rising sea levels among others. Will these impacts require changes to the way generation, transmission, substation, or other facilities are designed, built, sited, and operated?*

In short, yes. Recent experiences in the Northeast with Superstorm Sandy, in Texas with Hurricane Harvey, in California with wildfires, to name just a few, all serve to highlight ways in which electric system components' location, design, and operation are already incompatible with

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[11] *U.S. Customers Experienced an Average of Nearly Six Hours of Power Interruptions in 2018*, U.S. ENERGY INFO. ADMIN. (June 1, 2020), https://perma.cc/U767-3QVK (reporting data showing trends in outages in the presence and absence of "major events"); *see also Power OFF: Extreme Weather and Power Outages*, CLIMATE CENT. (Sept. 30, 2020), https://perma.cc/CQG7-KVMR.

[12] Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, 162 FERC ¶ 61,012, PP 18-19 (2018); *see also* Trevor Houser, John Larsen & Peter Marsters, *The Real Electricity Reliability Crisis*, RHODIUM GRP. (Oct. 3, 2017), https://perma.cc/9G44-FWNW (showing that only 0.00858% and 0.000007% of major electricity disturbances were caused by generation inadequacy and fuel supply emergencies during 2012-2016).

[13] *See* SYLWIA BIALEK, JUSTIN GUNDLACH & CHRISTINE PRIES, INST. FOR POL'Y INTEGRITY, RESOURCE ADEQUACY IN A DECARBONIZED FUTURE WHOLESALE MARKET DESIGN OPTIONS AND CONSIDERATIONS 19–23 (2021), https://perma.cc/5EC2-77KE.

the growing effects of climate change.[14] Sandy prompted utilities to harden assets by erecting flood barriers and elevating equipment.[15] Harvey revealed the partial irrelevance of flood maps for predicting actual flooding.[16] And Pacific Gas and Electric's role during the wildfires in 2017 and 2018,[17] as well as the impact of public safety power shutoffs in California since then,[18] highlight the degree to which climate change warrants, in some places, a close examination of the siting, design, and operation of all elements of the power system—generation, transmission, distribution, and demand as well. Given that the underlying, climate-driven causes of these disruptions are expected to grow in number and severity,[19] the Commission should anticipate that the corresponding needs to change grid components' design, siting, and operation to increase as well.

Questions 6-8: Coordination across agencies and levels of government

6. *How are relevant regulatory authorities (e.g., federal, state, and local regulators), individual utilities (including federal power marketing agencies), and regional planning authorities (e.g., RTOs/ISOs) evaluating and addressing challenges posed to electric system reliability due to climate change and extreme weather events and what potential future actions are they considering? What additional steps should be considered to ensure electric system reliability?*
7. *Are relevant regulatory authorities, individual utilities, or regional planning authorities considering changes to current modeling and planning assumptions used for transmission and resource adequacy planning? For example, is it still reasonable to base planning models*

[14] For a compilation of expected impacts to different electric system segments and their climate change-related causes, see ALLEN-DUMAS ET AL., *supra* note 3.

[15] *See* CONSOLIDATED EDISON, *supra* note 5, at 26–28.

[16] Michael Keller et al., *Outdated and Unreliable: FEMA's Faulty Flood Maps Put Homeowners at Risk*, BLOOMBERG (Oct. 6, 2017).

[17] Press Release, Pacific Gas & Elec., In Final Major Settlement, PG&E Reaches Agreement to Resolve Individual Claims Relating to the 2017 and 2018 Wildfires and the 2015 Butte Fire (Dec. 6, 2019), https://perma.cc/ZN3T-YEYF.

[18] *See* Cal. Pub. Utils. Comm'n, *Public Safety Power Shutoff (PSPS) / De-Energization*, https://www.cpuc.ca.gov/psps/ (click on "CPUC PSPS Rollup: Oct. 2013 through Dec. 2019 (as of Jan. 10, 2020)" to access spreadsheet collating all reported PSPS events, their durations, and the estimated numbers of customers affected).

[19] *Billion-Dollar Weather and Climate Disasters: Overview*, U.S. NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://perma.cc/9AXU-XMAK (last visited Apr. 8, 2021) (reporting events and noting trends since 1980).

on historic weather data and consumption trends if climate change is expected to result in extreme weather events that are both more frequent and more intense than historical data would suggest? If not, is a different approach to modeling and planning transmission and resource adequacy needs required? How should the benefits and constraints of alternative modeling and planning approaches be assessed?

8. *Are relevant regulatory authorities, individual utilities, or regional planning authorities considering measures to harden facilities against extreme weather events (e.g., winterization requirements for generators, substations, transmission circuits, and interstate natural gas pipelines)? If so, what measures? Should additional measures be considered?*

In the face of climate change and the increasing frequency and intensity of extreme weather events, a necessary first step for protecting the reliability of the electric system is the robust identification and disclosure of climate risks. State and federal regulators are working to ensure that corporations, including FERC-jurisdictional investor-owned electric utilities, are identifying and disclosing climate-related risks to their assets and operations.[20] Electric utilities and the system infrastructure they own and operate face risk from the physical impacts of climate change, like those described above.[21] The challenge of addressing physical risk is compounded by the climate-related transition risks that utilities, pipeline operators, and other actors also face as state and federal policies change, new technologies arise, and demand for fossil-fuel energy becomes more uncertain.[22] Identification and disclosure of these risks can ensure that system actors take steps to address potential impacts to assets and operation that would prevent them from providing reliable service to customers.[23]

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[20] *See, e.g.*, N.Y. Pub. Serv. Comm'n, Order Instituting Proceedings in the Matter Regarding the Need for Reporting Risks Related to Climate Change, Case 20-M-0499 (Oct. 15, 2020); SB 449, Cal. Leg., 2021-222 Reg. Sess. (Cal. 2021); Public Statement, Allison Herren Lee, Acting Chair, Securities & Exchange Comm'n, Public Input Welcomed on Climate Change Disclosures (Mar. 15, 2021), https://perma.cc/92PA-6XSV.

[21] MADISON CONDON ET AL., MANDATING DISCLOSURE OF CLIMATE-RELATED FINANCIAL RISK 5-6 (2021), https://perma.cc/2LY5-5HXK.

[22] *Id.* at 6-8.

[23] Env't Def. Fund, Inst. for Pol'y Integrity & The Sabin Ctr. for Climate Change L. at Colum. L. Sch., Joint Comments to the N.Y. Pub. Serv. Comm'n at 8-9, Case No. 20-M-0499 – In the Matter Regarding the Need for Reporting Risks Related to Climate Change (Dec. 9, 2020) [hereinafter NYPSC Joint Comments].

State level regulators, in particular, are also beginning to require utilities to undertake vulnerability assessments that can aid in the identification and disclosure of risk. These assessments may also be used to inform the steps that utilities must take to protect their assets against climate change and extreme weather events. States have already begun to adopt a number of strategies to ensure reliable electric service, including requiring vegetation management, undergrounding of priority distribution infrastructure, strengthening of distribution lines, and pole replacement.[24] Vulnerability assessments, like the one completed by Consolidated Edison[25] and those that will be completed in response to new California Public Utilities Commission rules,[26] can help utilities and regulators assess risk and determine whether further measures are needed to provide customers with reliable electric service in a changing climate. These assessments may also help identify where historical data and current planning assumptions will not be applicable in the future. Recognizing these issues will allow asset owners and operators to better integrate climate considerations into planning and decisionmaking.[27]

Vulnerability assessments can also identify where investment is needed to fortify infrastructure against climate change. Hardening systems against extreme weather and baseline changes like rising sea levels and increasing temperatures will be necessary, but hardening activities should account for the potential that there will be further changes to climate conditions. Hardening activities should therefore ensure reliability in the short and medium term but in ways that aim to also avoid—or at least minimize—making deeper changes in support of reliability

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[24] BURCIN UNEL & AVI ZEVIN, INST. FOR POL'Y INTEGRITY, TOWARD RESILIENCE: DEFINING, MEASURING, AND MONETIZING RESILIENCE IN THE ELECTRICITY SECTOR 25 (2018), https://perma.cc/373Q-PRRY.

[25] *See* CONSOLIDATED EDISON, *supra* note 5.

[26] *See* Cal. Pub. Utils. Comm'n, Rulemaking 18-04-019: Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities (Phase 1, Topics 4 and 5) (Aug. 27, 2020).

[27] NYPSC Joint Comments, *supra* note 23, at 9.

over the long term harder.[28] While hardening activities cannot build in resilience against every extreme event and baseline change that may occur in the future, building in modest resilience that considers future worsened conditions may prevent costly retrofitting and further hardening.[29] Additionally, solutions that are the primary responsibility of state and local government entities other than commissions responsible for access to reliable electricity may need to be considered, including refraining from developing (or further developing) energy infrastructure in high risk areas, where feasible.[30]

The Commission should continue to encourage coordination among RTOs/ISOs, market participants, and states to identify, disclose, and plan for risks. Given that action is now being taken across federal and state government agencies, these efforts may overlap and would likely benefit from high-level coordination—for instance by referring to an agreed set of climate modeling parameters or scenarios, facilitating state efforts to encourage development of flexible resources,[31] and removing barriers to those resources' participation in wholesale markets.[32] Similarly, RTOs/ISOs, which are responsible for coordinating transmission planning with appropriate state authorities, can and should use that process to identify and coordinate cost-beneficial measures to bolster reliability in the face of climate change.[33]

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[28] *See* ALICE C. HILL & LEONARD MARTINEZ-DIAZ, BUILDING A RESILIENT TOMORROW: HOW TO PREPARE FOR THE COMING CLIMATE DISRUPTION 27-28 (2020) (discussing need to promote low-regret investment in flexible design that enable future design modifications as conditions change).

[29] *See, e.g.*, *id.* at 24-27.

[30] *Id.* at 29-30 (discussing building in wild-fire prone regions).

[31] UNEL & ZEVIN, *supra* note 24, at 26–27.

[32] *Id.* at 36.

[33] *See* Comments of the Institute for Policy Integrity at New York University School of Law at 14-15, Docket No. AD18-7 (May 9, 2018) [hereinafter Grid Resilience Comments].

Questions 15 & 16: Resilience and NERC's role

15. *What actions should the Commission consider to help achieve an electric system that can better withstand, respond to, and recover from climate change and extreme weather events? In particular, are there changes to ratemaking practices or market design that the Commission should consider?*
16. *Are there opportunities to improve the Commission-approved NERC Reliability Standards in order to address vulnerabilities to the bulk power system due to climate change or extreme weather events in areas including but not limited to the following: transmission planning, bulk power system operations, bulk power system maintenance, emergency operations, and black start restoration? For example, should the Reliability Standards require transmission owners, operators or others to take additional steps to maintain reliability of the bulk power system in high wildfire or storm surge risk areas? Should the Reliability Standards require the application of new technologies to address vulnerabilities related to extreme weather events, such as to use new technologies to inspect the bulk power system remotely?*

The Commission should use its authority over transmission rates to encourage cost-beneficial investments in transmission infrastructure. This recommendation is particularly important given that most outages associated with high-impact, low-probability events (like extreme weather events) occur due to disruptions of the distribution and transmission systems.[34] Improvements to the resilience of the transmission system can enhance grid resilience overall, improving its ability to absorb and resist shocks, manage the disruptions that occur, quickly recover, and respond and adapt to future shocks.[35]

Using its authority over rates and tariffs, FERC can ensure that transmission developers are properly compensated for actions they take to enhance the resilience of the system. The Commission could further encourage utilities to expand the availability of spare transformers through a national transformer reserve.[36] It could also use its authority to encourage hardening of

[34] *Id.* at 30 (citing Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, 162 FERC ¶ 61,012, PP 18-19 (2018)).
[35] *Id.* at 31.
[36] *Id.* (highlighting recommendations from the National Academy of Sciences).

assets against extreme weather, burial of key transmission lines, and more regular and innovative vegetation management.[37]

The Commission should also encourage RTOs/ISOs to more fully study whether there are gaps in existing planning and coordination approaches, that, if addressed, would provide resilience benefits.[38] As previously argued, if FERC affirmatively finds a need to address resilience it could direct each RTO/ISO to develop an assessment of vulnerabilities to climate and extreme weather impacts and a plan to address them.[39] As part of this resilience planning process, the Commission might authorize cost recovery for and require completion of vulnerability assessments that focus on how the physical impacts of climate change will threaten grid assets and operation.

Additionally, the Commission could approve market rules that create incentives for generation-system resilience. Market-based tools may be appropriate where resilience-enhancing attributes can be identified and defined with specificity, and where there is substantial evidence that procurement of a resource that can provide such a service will improve electric system resilience.[40]

Notably, however, there are also several specific reasons to be cautious in adopting resilience-related market rules. First, because outages are generally not caused by generators,

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[37] *Id.* at 31.

[38] *Id.* at 33; Grid Resilience Comments, *supra* note 33, at 4.

[39] Comments of the Institute for Policy Integrity at New York University School of Law on Department of Energy Proposal for Final Commission Action at 37, Docket No. RM18-1 (Oct. 23, 2017). The New York ISO has conducted such a study in two phases. ITRON (FOR NYISO), NEW YORK ISO CLIMATE CHANGE AND RESILIENCE STUDY – PHASE 1: LONG-TERM LOAD IMPACT (2019); PAUL J. HIBBARD ET AL., ANALYSIS GRP. (FOR NYISO), CLIMATE CHANGE IMPACT PHASE II: AN ASSESSMENT OF CLIMATE CHANGE IMPACTS ON POWER SYSTEM RELIABILITY IN NEW YORK STATE--FINAL REPORT (2020).

[40] UNEL & ZEVIN, *supra* note 24, at 34.

making generation more resilient might yield limited system resilience benefits.[41] Second, attributes that may enhance generation resilience in one way may exacerbate other resilience threats.[42] Third, should a resilience-specific attribute be identified and defined, FERC should be careful to ensure that the attribute actually supports resilience.[43] Some reliability services in the ancillary services markets may provide resilience benefits as well, including contingency reserves and black-start services.[44] Likewise, resource adequacy requirements and generator performance penalties and incentives can enhance resilience.[45] Before adopting any resilience-related market rule changes, however, Commission should establish a sound protocol for weighing the costs and benefits of such changes.[46]

Finally, the Commission might direct NERC to evaluate opportunities to expand existing reliability standards or purpose new standards that will not only improve operational reliability, but also provide co-benefits for system resilience.[47] Some NERC standards already enhance resilience—for example, "TPL-001-4" requires assessment of and planning for extreme events on the bulk power system, and "FAC-008-3" requires ratings for how well facilities operate in emergency situations.[48] FERC should consider whether reliability standards for improving generation and transmission system resilience are warranted under a cost-benefit analysis and direct NERC to take develop new standards where needed.

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[41] *Id.* at 36.

[42] Grid Resilience Comments, *supra* note 33, at 12 ("For example, a resilience proposal aimed at compensating "fuel security" might, in practice, reward large central-station powerplants that have on-site access to fuel. Yet such resources often pose countervailing resilience concerns because unexpected outages of these resources place more strain on the electric system and they are often less resistant to extreme weather conditions.").

[43] UNEL & ZEVIN, *supra* note 24, at 36.

[44] *Id.* at 35.

[45] *Id.* at 35-36.

[46] *Id.* at 37; Grid Resilience Comments, *supra* note 33, at 7-8.

[47] UNEL & ZEVIN, *supra* note 24, at 32.

[48] *Id.*

CERTIFICATE OF SERVICE

In accordance with Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day served by electronic mail a copy of the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Washington, D.C., this 14th day of April 2021.

Respectfully Submitted,

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