UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Resilience in Regional Transmission Organizations and Independent System Operators	)))	**Docket No. AD18-7-000**

REPLY COMMENTS OF THE AMERICAN WIND ENERGY ASSOCATION AND THE AMERICAN COUNCIL ON RENEWABLE ENERGY

The American Wind Energy Association ("AWEA") and the American Council on Renewable Energy ("ACORE") hereby submit these reply comments and responses ("Comments") to the resilience issues and inquiries identified in the Federal Energy Regulatory Commission's ("Commission" or "FERC") Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures issued on January 8, 2018.[1]

I. EXECUTIVE SUMMARY

AWEA and ACORE agree with Commissioner LaFleur's concurrence in the Commission's January 8, 2018 Order: "resilience – the ability to withstand or recover from disruptive events and keep serving customers – is unquestionably an element of reliability."[2] In other words, addressing resilience should properly be viewed as part and parcel of reliability and, therefore, approached from that perspective.

The comments of regional transmission organizations ("RTOs") and independent system operators ("ISOs") submitted in this proceeding overwhelmingly support that the grid is reliable and, in turn, resilient. Indeed, all of the RTOs and ISOs categorically agree that the grid is currently reliable, and five of the seven RTOs and ISOs disclaim any resilience concerns.[3]

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[1] Grid Resilience in Reg'l Transmission Orgs. and Indep. Sys. Operators, 162 FERC ¶ 61,012 (2018) (providing for reply comments within thirty days of the RTO/ISO submission).
[2] Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures,
[2] Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures,
162 FERC ¶ 61,012 (2018) (Commissioner Lafleur concurrence at 1).

This should come as no surprise given the robust processes that are already in place to ensure that any potential reliability concern is addressed in a timely manner and well in advance before a problem materializes. The RTOs' and ISOs' comments also support the fact that reliability and resilience needs are region-specific and should be considered on that level.[4]

The regions should be able to develop region-specific solutions, through their stakeholder processes. The Commission should not impose a generic (*i.e.*, one-size-fits-all) solution to address reliability and resilience, especially without a record to support such an action, and should resist any calls for undertaking remedies to address perceived reliability and resilience concerns, without an evidence-based determination of the need for such measures and the benefits to consumers. If not, the Commission will merely succeed in hurting jurisdictional markets and raising costs for consumers.

While the evidence in the record of this proceeding supports the fact that the grid is resilient and reliable, to the extent the Commission decides to take any action in response to this docket, we respectfully suggest that there are several steps that the Commission could take to enhance long-term reliability and resilience needs. Each of these steps recognizes and builds upon the Commission's core commitment to competition and wholesale markets: (1) continuing to promote the development of competitive wholesale markets; (2) furthering regional and interregional transmission planning; (3) improving interregional, market-to-market operations and transactions, so as to facilitate the sales of electricity; and (4) providing compensation for essential reliability services, such as voltage support and primary frequency response. We respectfully suggest that the time is ripe for the Commission to make progress in each of those areas.

[4] Comments of CAISO, ISO-NE, MISO, NYISO, and SPP on Grid Resilience Issues, Docket No. AD18-7-000, 17 (March 9, 2018).

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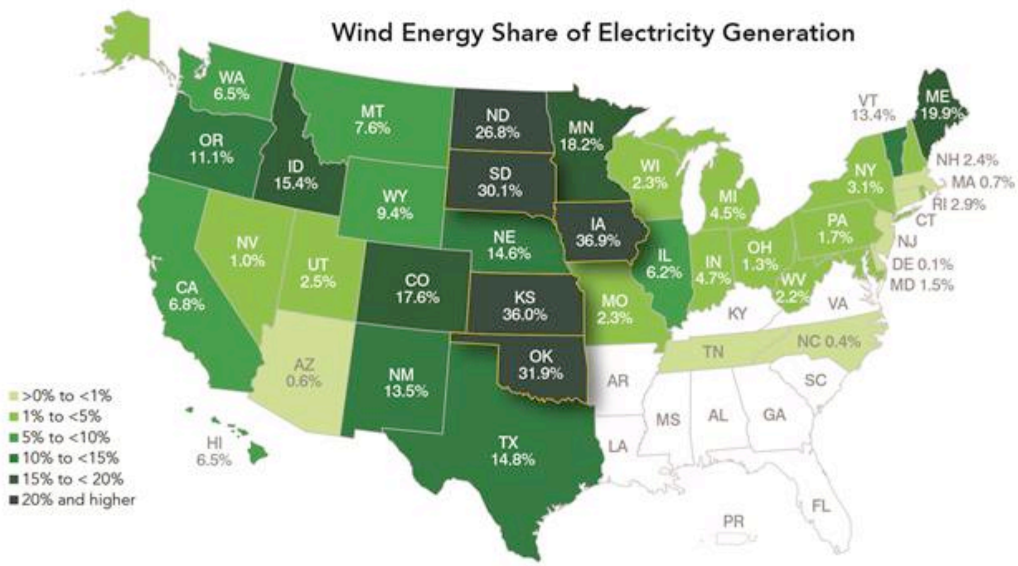
II. COMMENTS

We appreciate the opportunity to provide the following comments in this proceeding. We first cite the extensive studies and real-world experience demonstrating that a system with a high penetration of renewable can be equally or more reliable and resilient than today's systems. Next, we discuss how resilience is already being addressed by NERC, transmission providers, and Reliability Coordinators, and how there is no gap in FERC regulations related to generation or energy markets. Transmission planning also currently incorporates resilience. However, if the Commission is inclined to take new action on resilience, transmission should be a primary focus of its efforts because transmission has a much greater impact on reliability and resilience than issues related to generation or fuel supply. Beyond transmission, we urge FERC to continue promoting the proliferation and expansion of wholesale markets and defining and compensating for needed market products. We offer specific recommendations for reforms the Commission could take in that area that would significantly enhance electric reliability and resilience, while also providing consumers with lower-cost electricity by enhancing market competition.

A. High penetration renewable systems can be equally or more reliable and resilient than today's systems

Wind and solar energy are making important contributions to the reliability and resilience of the power system today, and studies by grid operators show that much higher levels of renewable generation can be reliably accommodated. The Southwest Power Pool ("SPP"), the California Independent System Operator ("CAISO") and the main Colorado grid operator ("PSCO or Public Service Company of Colorado") obtain more than 23 percent of their electricity from wind and solar resources today. At times wind output has gone significantly higher, with SPP recently obtaining 64 percent of its electricity from wind at one point last month.[5] As Bruce Rew, SPP's VP of Operations, has explained, "Ten years ago we thought hitting even a 25 percent wind-penetration level would be extremely challenging, and any more than that would pose serious threats to reliability. Since then, we've gained experience and implemented new policies and procedures. Now we have the ability to reliably manage greater than 50 percent wind penetration. It's not even our ceiling."[6]

Iowa, Kansas, South Dakota and Oklahoma now generate over 30 percent of their electricity using wind power. As shown below, 14 states generate at least 10 percent of their electricity using wind, including Texas, the country's largest electricity consumer and producer.

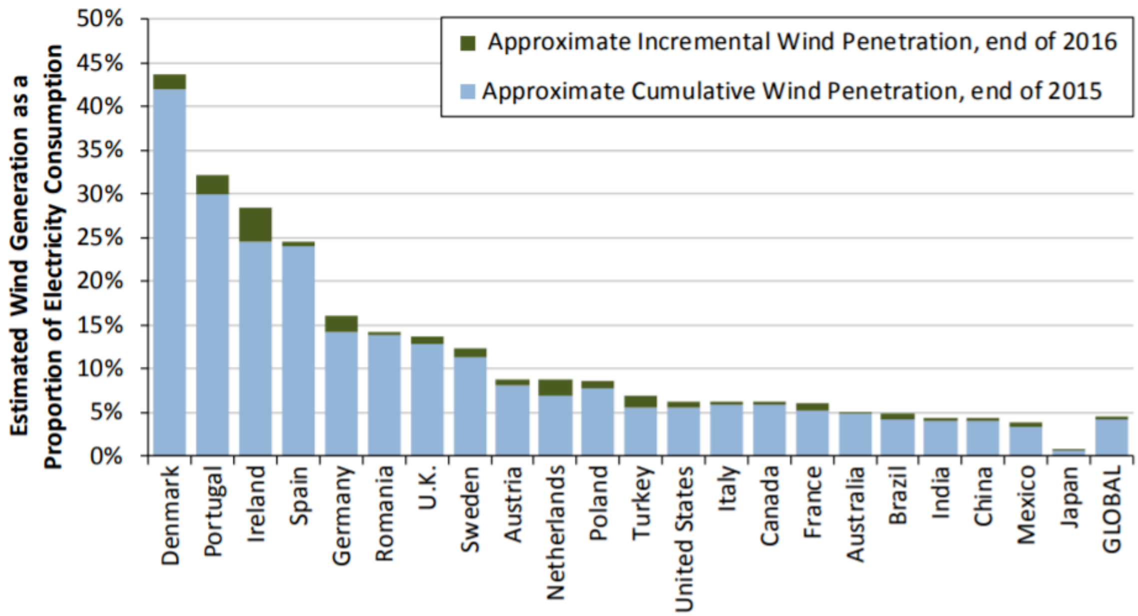


1. International Experience

Many of the most reliable power systems in the world obtain a large share of their electricity from wind and solar. Notably, this has been achieved without the benefit of America's abundant and diverse renewable resources and large and well-integrated power system. As shown in the Department of Energy chart below, many countries already reliably obtain 15 to 45

[5] Southwest Power Pool, Twitter (May 1, 2018) https://twitter.com/SPPorg/status/991355149812674560.
[6] Michelle Froese, *Southwest Power sets North American record for wind power*, Windpower (Feb. 14, 2017), https://www.windpowerengineering.com/projects/southwest-power-sets-north-american-record-wind-power/.

percent of their electricity generation from wind.[7] Germany has a comparable amount of solar generation, bringing combined output from wind and solar to one-third of its total generation last year.



Source: Berkeley Lab estimates based on data from GWEC, EIA, and elsewhere

Ireland obtains around 25 percent of its electricity from coal and peat, with natural gas providing 43 percent,[8] and wind at around 28 percent in 2016.[9] As an island, Ireland has only a small interconnection to the U.K., so it must be largely self-sufficient during periods of high demand. The U.K. reduced coal's share of generation to less than 7 percent last year, and will phase out all coal and all but one nuclear plant by 2025. Gas and wind now make up the bulk of generation.

The power systems of Spain and Portugal are connected to each other but largely isolated from other countries. In 2016 wind provided a third of the electricity in Portugal and a quarter in

[7] Wind Technologies Market Report, 7 (2016), https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf,.
[8] Martin Howley, *Is Ireland set to meet its 2020 targets for renewable electricity?*, Roadbridge (Oct. 4, 2016), http://www.engineersjournal.ie/2016/10/04/irelands-renewable-electricity-increased-to-25-in-2015-seai-2/.
[9] Wind Technologies Market Report, 7 (2016), https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf,.

Spain, with coal and nuclear making up less than 40 percent of generation in Spain, coal at around 20 percent in Portugal, and gas and hydropower supplying most of the remainder.[10]

Wind provides around 45 percent of the electricity in Denmark, facilitated by the country's transmission interconnections to Scandinavia, which is powered nearly 100 percent by hydropower and wind, and Germany which generated 33% of their electricity from wind and solar in 2017.[11] Germany saw significant continued drops in the use of coal and nuclear.[12]

These power systems with high penetrations of renewable energy and retirements of aging generators have much higher reliability than the U.S., though as noted later in these comments, the vast majority of customer outages are caused by distribution system outages, not generation-related issues. Germany and Denmark have some of the most reliable power systems in the world, and their reliability has only been increasing. German customers experienced 15.3 minutes of outages in 2013 on average, down from 21.5 in 2006, while Denmark has seen even greater improvements to reach a comparable outage rate.[13] In comparison, the top quartile of most reliable U.S. utilities experienced 93 minutes of customer outages.

Power systems that operate reliably with little to no coal or nuclear generation are quite common globally. Many large and developed countries run almost entirely on hydropower and other renewables, including island nations like Iceland and New Zealand that must be entirely self-sufficient due to a lack of interconnections to neighboring power systems. Other developed nations rely almost entirely on natural gas generation, with Mexico and many Middle Eastern

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[10] Renewables Now, *Renewables produce 33.7% of Spain's power in 2017* (Dec. 29, 2017), https://renewablesnow.com/news/renewables-produce-337-of-spains-power-in-2017-596136/.
[11] *Id*.
[12] Craig Morris, *Germany's energy consumption in 2017,* Energy Transition The Global Energiewende (Jan. 11, 2018), *https*://energytransition.org/2018/01/german-energy-consumption-2017/.
[13] Peter Fairley, *Germany's Grid: Renewables- Rich and Rock-Solid,* IEEE Spectrum (Aug. 28, 2014), https://spectrum.ieee.org/energywise/energy/the-smarter-grid/germanys-superstable-solarsoaked-grid.

countries using gas for around two-thirds of their electricity, for example.[14] These real world examples all demonstrate that a changing generation mix, especially one shifting towards a higher penetration of renewable energy, can be managed with high levels of reliability and resilience.

2. Studies show renewables contribute to reliability and resilience.

Dozens of studies by grid operators, national laboratories, and other experts, including all of the ISOs,[15] have found that power systems with high levels of renewable generation are reliable and resilient. Several of these studies have found no reliability concern with wind and solar providing 20-50 percent of total generation.[16]

The dozens of renewable integration studies have also found that the impact of wind and solar energy on total power system variability is quite small.[17] Fluctuations in electricity demand and other sources of supply are typically a larger contributor to variability and uncertainty, and those changes cancel out many of the changes in renewable output. The comments by ERCOT and the PUCT in this docket explain how advances in renewable energy forecasting have greatly reduced the uncertainty in renewable output: "In their current state, these models have generally

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[14] The World Bank, *Electricity production from natural gas sources (% of total),* https://data.worldbank.org/indicator/EG.ELC.NGAS.ZS?view=map (last accessed May 9 2018); The Shift Project, *Breakdown of Electricity Gneration by Energy Source,* Data Portal, http://www.tsp-data-portal.org/Breakdown-of-Electricity-Generation-by-Energy-Source#tspQvChart (last accessed May 9, 2018).

[15] GE Energy Applications and Systems Engineering, EnerNex Corp., & AWS Truepower, *Final Report: New England Wind Integration Study,* (Dec. 5, 2010), https://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/prtcpnts_comm/pac/reports/2010/newis_report.pdf; ISO New York Indpendent System Operator, *Wind Integration Study: Sturdy Results and Final Report,* (June 18, 2010), http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2010-06-18/NYISO_Wind_Integration_Study_June_18_Workshop_final_draft_6_14_10.pdf; http://www.pjm.com/committees-and-groups/subcommittees/irs/pris.aspx, http://mn.gov/commerce-stat/pdfs/mrits-report-2014.pdf; Southwest Power Pool, *2016 Wind Integration Study* (Jan. 5, 2016), https://www.spp.org/documents/34200/2016%20wind%20integration%20study%20(wis)%20final.pdf, Warren Lasher, *Wind Integration/ Ancillary Services Requirements Study,* ERCOT (March 7, 2008), http://www.ercot.com/content/meetings/dswg/keydocs/2008/0307/04_DSWG_GE_Wind_Study_Update.pdf, David Hawkins, *California Independent System Operator Renewable Integration Study*, California ISO (Sept. 2007), https://caiso.com/Documents/Presentation-AchievingCalifornia%E2%80%99s20PercRenewablePortfolioStandard25-Sep-07.pdf.

[16] https://www.nrel.gov/docs/fy15osti/63979.pdf, https://www.nrel.gov/analysis/re-futures.html.

[17] Library of studies available at https://www.esig.energy/resources/.

been very accurate and have played a critical role in ensuring system reliability."[18]

The U.S. power system has more than enough flexibility to accommodate even very large additions of renewable generation without adding any new flexible capacity, in part because all power plants of all types are already backed up by all other power plants.[19] In fact, the impact of wind generation on power system variability and uncertainty is much smaller than the impact of the sudden and unpredictable failures of large conventional power plants, which necessitate holding large quantities of expensive, fast-acting reserve generation at all times.[20] For a discussion of misconceptions about the reliability of renewable resources, see the analysis and citations in the report in the footnote.[21]

Contrary to one common misconception, adding wind energy does not increase the power system's need for generating capacity to meet peak demand, but rather reduces it because wind generation always makes a positive contribution to meeting the power system's need for capacity. Studies by grid operators and other experts confirm that wind energy does make large contributions to meeting power system capacity, with between 50% and 100% of a wind plant's average energy output typically counting towards meeting system capacity needs, and solar generators providing a capacity value to the system that is several times greater than their average energy output.[22]

3. Renewables are resilient to many types of extreme events.

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[18] Comments of ERCOT and PUCT, at 11, AD18-7-000.
[19] *See, e.g.* NREL, Eastern Wind Integration and Transmission Study, at 54, available at http://www.nrel.gov/docs/fy11osti/47078.pdf.
[20] Michael Goggin, *Fact Check: Wind's integration costs are lower than those for other energy sources,* Into the Wind (July 25. 2014), http://www.aweablog.org/fact-check-winds-integration-costs-are-lower-than-those-for-other-energy-sources/.
[21]Michael Goggin, *Renewable Energy Builds a More Reliabile and Reslient Electricty Mix*, American Wind Energy Association (May 2017), http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA%20Renewable%20Energy%20Builds%20a%20More%20Reliable%20and%20Resilient%20Electricity%20Mix.pdf.
[22] PJM Renewable Integration Study Report, pages 29-30, available at http://www.pjm.com/-/media/committees-groups/subcommittees/irs/postings/pjm-pris-task-3a-part-f-capacity-valuation.ashx?la=en.

This contribution of renewables to meeting peak demand has been vividly demonstrated during several recent extreme weather events, when high renewable output made up for lower than expected output from coal generators that experienced equipment failures. During the "Bomb Cyclone" cold snap in early January 2018, wind output was consistently high across PJM and the Northeast, several times greater than the level grid operators plan for and pay wind plants for.[23]

After the fact analysis from Daymark Energy Advisors showed that offshore wind generation would have had huge benefits for the ISO-NE system during the Bomb Cyclone event.[24] They found that had a proposed 800MW wind farm off of the coast of Massachusetts been operational from January 4th to January 7th, significant economic, environmental and reliability benefits would have been realized. Analysis shows that under the conditions of the bomb cyclone event, the 800MW wind farm would have been running at full output nearly the entire time. This would have resulted in lower ISO-NE wholesale prices by nearly $20 per megawatt hour, 67,485 metric tons less of carbon dioxide emissions, and additional fuel assurance in the area of the Pilgrim Nuclear Station where weather-related malfunctions were a concern.

Wind plants also performed well during the Polar Vortex event in 2014 and a cold snap in ERCOT in 2011.[25] In all three events, many coal and gas generators experienced failures, largely

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[23] Hannah Hunt, *How did Wind perform during the Bomb Cyclone?,* Into the Wind (Mar. 30, 2018), https://www.aweablog.org/wind-energy-perform-bomb-cyclone/.

[24] Vineyard Wind, *Study: Massachusetts Offshore Wind Farm Would Have Substntially Curtailed Environmental and Grid impacts Created by "Bomb Cyclone"* (Jan. 29, 2018), https://www.vineyardwind.com/news-and-updates/2018/1/29/bombcyclone.

[25] Greg Hresko & Michael Goggin, *Wind energy saves consumers money during the polar vortex,* American Wind Energy Association, (Jan. 2015), http://awea.files.cms-plus.com/AWEA%20Cold%20Snap%20Report%20Final%20-%20January%202015.pdf, https://www.texastribune.org/2011/02/04/an-interview-with-the-ceo-of-the-texas-grid/.

due to equipment freezing in the cold.[26] Further, Texas wind plants generally performed well above their expected capacity values during Hurricane Harvey, while some coal and gas generators were de-rated due to wet or flooded coal piles and low gas system pressure.[27] This further exemplifies that resilience is best viewed as an attribute of a power system, with needed services provided by a portfolio of generation resources brought together in a market via the transmission system and delivering electricity to customers through the distribution system.

4. Renewables excel at providing needed reliability services.

Renewable resources also make important contributions to needed grid reliability services, in many cases exceeding the reliability capabilities of conventional generators. For example, power electronics enable wind and solar plants to provide reactive power support to regulate voltage on the power system. This response is fast and accurate and can be available even when the renewable plants are not generating electricity.[28]

Wind and solar plants can also be operated in a highly flexible, dispatchable manner[29] to quickly and accurately follow fluctuations in electricity supply and demand to keep frequency stable, as is now done regularly by grid operators in Texas and Colorado.[30] NERC recently noted that the Texas power system's frequency response is noticeably improved when wind output is high.[31]

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[26]H.B. Doggett, *Review of February 2, 2011 Energy Emergency Alert (EEA)*, ERCOT (Feb. 14, 2011), http://www.ercot.com/content/meetings/board/keydocs/2011/0214/Review_of_February_2,_2011_EEA_Event.pdf; PJM, *Analysis of Operational Events and Market Impacts During the January 2014 Cold Weather Events,* (May 8, 2014), http://www.pjm.com/~/media/library/reports-notices/weather-related/20140509-analysis-of-operational-events-and-market-impacts-during-the-jan-2014-cold-weather-events.ashx.

[27] Available at https://www.nerc.com/pa/rrm/ea/Hurricane_Harvey_EAR_DL/NERC_Hurricane_Harvey_EAR_20180309.pdf.

[28] Available at https://www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf.

[29] Available at http://www.nrel.gov/docs/fy14osti/60574.pdf.

[30] Available at http://iiesi.org/assets/pdfs/ieee-power-energy-mag-2015.pdf.

[31] Available at http://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/SOR_2017_MASTER_20170613.pdf.

Because no single resource excels at cost-effectively providing all needed services, grid operators have always used a division of labor across a portfolio of resources to ensure cost-effective and reliable power. As a result, no single resource or technology is essential to reliability or resilience because the needed energy and reliability services can be provided by a wide range of technology combinations. Combinations that include no nuclear, no coal, no gas, or no renewable resources have been demonstrated to be reliable and resilient. The table below shows the capabilities of various technologies to provide the three main types of essential reliability services defined by NERC.[32] Each of these resources have capabilities to provide some of the needed services, but none can cost-effectively provide all essential reliability services and none are unique in their ability to provide any one service.

Reliability Service	Wind	Solar PV	Demand Response	Battery Storage	Gas	Coal	Nuclear
Voltage support Key: Green is positive, yellow is medium, and red indicates that in most cases the resource does not provide that service.							
Reactive power and voltage control	Green	Green	Yellow	Green	Yellow	Yellow	Green
Voltage and frequency disturbance ride-through	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow
Frequency support Note: For the following reliability services, yellow means the resource can provide the service, but during many hours it may not be the most economic choice to do so.							
Fast frequency stabilization following a disturbance (through primary frequency response and inertial response)	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Yellow
Ramping and balancing							
Frequency regulation	Yellow	Yellow	Yellow	Green	Green	Yellow	Red
Dispatchability / Flexibility / Ramping	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Red
Peak energy, winter (color reflects risk of common mode unavailability reducing fleetwide output below accredited capacity value)	Green	Yellow	Yellow	Green	Yellow	Yellow	Green
Peak energy, summer (color reflects risk of common mode unavailability reducing fleetwide output below accredited capacity value)	Yellow	Green	Green	Green	Yellow	Green	Green

[32] The table is based on NERC material (2016). Elements in this table reflect the capabilities of the most modern generation and automated demand response offerings commercially available today; not all of the equipment currently deployed across the grid are able to provide these reliability services on demand without controller, inverter or other modifications.

For most reliability services, the most efficient way to achieve that division of labor is through a market. The market should be based around provision of needed reliability services, and all resources that are able to provide a service, including demand-side resources, should be able to compete.

It is essential to define the services procured in these markets based on the actual reliability services the grid needs, not based on attributes of certain generators. There is considerable danger in poorly defining resilience. For example, a recent report by the National Energy Technology Laboratory ("NETL") presents attributes like increased utilization during times of high demand, having onsite fuel, or being "baseload" as metrics of resilience. However, the data presented in that report and elsewhere show that none of those are reliable predictors of actual performance in providing needed services. Rather, as PJM and others have explained, increased utilization of coal resources during the Bomb Cyclone relative to an arbitrary earlier period only shows that coal plants had spare capacity during the earlier period because they were not competitive with natural gas.[33]

A recent IHS Markit report also offers dubious definitions of resilience.[34] Much of the report's focus is on nuclear power's fuel price stability and lack of emissions, services that renewable resources also offer but aren't clearly related to resilience. The report does argue nuclear plants offer considerable value for reliability by assuming an extremely high cost for the value of lost load of $170,000/MWh, at least an order of magnitude higher than most other estimates. A prior IHS Markit report also contains significant flaws, most notably a major

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[33] Michael Goggin, *Fossil Lab misses mark in cold weather "resilience" report,* Sustainable FERC Project (March 28, 2018), http://sustainableferc.org/fossil-lab-misses-mark-in-cold-weather-resilience-report/; PJM, *Perspective and Response of PJM Interconnection to National Energy Technology Laboratories Report Issued March 13, 2018* (2018), http://www.pjm.com/-/media/library/reports-notices/weather-related/20180413-pjm-response-to-netl-report.ashx?la=en.
[34] Available at https://d3n8a8pro7vhmx.cloudfront.net/nuclearmatters/pages/320/attachments/original/1525300979/Ensuring_resilient_and_efficient_PJM_electricity_supply_The_value_of_cost-effective_nuclear_resources_in_the_PJM_power_supply_portfolio.pdf?1525300979.

overstatement of the cost of renewables and an understatement of their contributions to reliability services.[35]

5. Wind and solar have strong disturbance ride-through capabilities, and any concerns can be addressed through updates to standards.

A crucial element of power system reliability and resilience is that all generators will remain online following the frequency or voltage disturbances that occasionally occur on the power system due to the unexpected loss of a large conventional generator or transmission asset. As a result, many countries and grid operators have adopted ride-through requirements as part of the grid code that generators must meet before connecting to the grid. These mandatory requirements typically specify that resources must remain online for disturbances of a certain length and magnitude (in terms of how much frequency or voltage deviate from normal).

Wind and solar photovoltaic ("PV") plants have excellent technical capability to ride-through disturbances. Inverters and other power electronics electrically separate the generators from disturbances on the bulk grid and provide far greater control over the plants' behavior during and following a disturbance than is possible with a synchronous generator. Any concerns about ride-through issues can be addressed, as wind and solar plants can be designed to meet any reasonable standard. To ensure standards are just and reasonable and not unduly discriminatory, any requirements should apply to all generators on a technology-neutral basis and should only apply on a prospective, not retroactive, basis.

6. PV ride-through.

PV plant inverters offer excellent capabilities to provide the power system with a range of reliability services, as CAISO has documented.[36] However, during several recent events in California, some solar photovoltaic plants have not fully ridden-through grid disturbances, as

[35] Michael Goggin, *Report by competing energy sources ignores renewable energy technology advances,* Into the Wind (Oct. 24, 2017), *https*://www.aweablog.org/report-ignores-renewable-technology-advances/.
[36] Available at https://www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf.

noted in the comments filed in this docket by CAISO.[37] The observed ride-through concerns result from ride-through standards not keeping pace with the growth and technological evolution of solar PV, and therefore can and are being resolved by updating those standards.

Historically, PV was a small share of total generation and much of it was installed behind the meter. Most standards dictated that PV generators should not ride-through disturbances due to concerns about PV remaining online following a grid disturbance and therefore potentially posing a safety risk to utility personnel attempting to restore the system. However, now that PV generation makes up a significant and increasing share of generation, with many utility-scale deployments, the ability to ride-through disturbances is becomingly increasingly important.

Standards are evolving to match solar PV's role as a large share of generation. IEEE 1547 was recently updated to provide flexibility to regions to implement ride-through requirements. NERC has already taken action following the events in California, which has resulted in greatly improved performance during more recent events. NERC is now developing a guideline that will provide the design criteria for inverter manufacturers' ride-through settings, which could evolve into a standard. PV and inverter manufacturers have explained that they are capable of meeting any reasonable ride-through standard, they just need that standard to be clearly defined.

7. Wind ride-through.

Wind generation underwent an evolution in ride-through requirements in the last ten to fifteen years that is similar to what solar PV is experiencing today. As wind power's market share began to grow significantly around 2005, technological advances such as the widespread use of power electronics in turbines made it possible to meet a rigorous ride-through standard. In 2005, FERC Order 661A specified that new wind plants installed after a certain date must ride through voltage and frequency disturbances, while previously many standards had called for

[37] Comments of CAISO, Docket No. AD18-7-000, 108, 173 (March 9, 2018).

wind generators to not ride-through disturbances. Thanks to the capabilities of turbine inverters and power electronics, all wind turbines installed over the last decade have met this standard, even though the ride-through requirement in Order 661A is so rigorous that many conventional generators are unable to meet it.

Comments filed by ERCOT in this docket suggest that an event in South Australia necessitates a closer look at wind's ride-through capabilities.[38] However, due to the extreme severity of the weather event that caused the South Australia outage, as well as operating decisions that placed the system in a vulnerable position going into the event, one should be cautious in extrapolating from the event.

On September 28, 2016, the South Australia power system collapsed due to a record-breaking severe storm, with hundreds of lightning strikes, tornadoes, and high winds causing dozens of transmission lines to fail in a matter of minutes. Such an event would pose a major risk to the power system under the best of circumstances. However, grid operators failed to adopt defensive operating procedures going into the event, relying on imports via the single transmission line to the neighboring Victoria power system to meet over 1/3rd of South Australia's load, and remote transmission-connected wind providing the bulk of the remainder.[39] Even though the transmission interconnection to Victoria consists of two circuits on a single tower, the grid operator does not treat the loss of that transmission line to be a credible contingency for planning and operating purposes. As a result, there is no planned mechanism to respond to the loss of the intertie other than shedding firm load. The highly linear and radial

[38] Joint Comments of Electric Reliability Council of Texas, Inc. and the Public Utility Commission of Texas, Docket No. AD18-7-000, 9 (March 9, 2018).
[39] Available at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2017/Integrated-Final-Report-SA-Black-System-28-September-2016.pdf, https://www.esig.energy/download/session-3-black-system-south-australia-28-september-2016-resulting-grid-code-modifications-nick-miller/#.

nature of the South Australia power system also provided little network redundancy as multiple key transmission lines failed.

The failure of numerous large transmission lines near the wind plants in a matter of seconds caused repeated extreme voltage disturbances at the wind plants. Over a period of 87 seconds, two more distant voltage disturbances were followed by four close-in disturbances.[40] To protect against the severe damage that repeated voltage disturbances can cause to electrical and mechanical systems at any type of generator, many of the turbines shut down as designed. The power system then quickly spiraled into collapse as the transmission link to Victoria overloaded and supply was inadequate to meet demand. Wind plants and conventional generators farther from the repeated transmission faults did not trip during the initial voltage disturbances, likely because they were less exposed to the voltage disturbances. NERC has noted that all wind plants in South Australia remained online when the system experienced three voltage faults in 1.6 seconds on March 3, 2017.[41]

Nick Miller, an electrical engineer formerly with GE, has performed a close analysis of the 2016 South Australia outage event.[42] He explains that any type of generator would be severely damaged if required to remain online following repeated large voltage disturbances. He notes that most grid equipment is designed to withstand two such faults, and that requiring a synchronous steam generator to remain online through a third fault would expend about 5% of its total fatigue life. He calculated loss of the plant's fatigue life would approach 20% from remaining online for four large close-in faults in rapid succession, similar to what was

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[40] North American Electric Reliability Corporation, *Lesson Learned, Loss of Wind Turbines due to Transient Voltage Disturbances on the Bulk Transmission System*, https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/LL20170701_Loss_of_Wind_Turbines_due_to_Transient_Voltage_Disturbances.pdf.
[41] *Id*.
[42] Available at https://www.esig.energy/download/session-3-black-system-south-australia-28-september-2016-resulting-grid-code-modifications-nick-miller/#.

experienced by the wind plants in South Australia. Remaining online for any additional events would greatly erode its useful life and require the steam generator to be taken offline for an extended outage to inspect for damage. Despite the inability of any generator to remain online through repeated voltage disturbances without experiencing significant damage, South Australia has proposed requiring all generators to remain online through 15 consecutive large close-in voltage faults. The root cause of the disturbance and subsequent collapse was a lack of transmission not generation issues. South Australia would be better served addressing their transmission issues instead.

ERCOT writes that it "is currently working on a formal assessment considering multiple voltage events to determine the system response under extremely stressed system conditions." While it is certainly helpful to conduct that analysis, it is not advisable to follow the path of South Australia in adopting a ride-through standard that cannot be met by any generator without experiencing significant damage. Standards should properly balance costs from loss of load against costs in making the system resilient, which in this case would include the exorbitant cost of over-engineering all generators to withstand repeated severe faults and the cost of damage to generators from remaining online.

Power system planning and operations correctly recognizes that it is not feasible to withstand every conceivable event with zero loss of load, at least without incurring unreasonable costs. In many cases it is not possible to prevent a loss of load when many major parts of the transmission system are taken offline in a matter of minutes; therefore, the focus should shift to minimizing the extent and duration of an outage. Rather than setting infeasible ride-through standards, it would likely be more fruitful to examine other steps that could be taken to improve system resilience to such an event. In the case of South Australia, that would likely include reducing imports to free up emergency capacity on the intertie to Victoria and generally more conservatively positioning the power system when weather forecasts indicate imminent risk to the system.

NERC has documented that some wind turbines in ERCOT disconnected following an event with seven repeated but relatively minor voltage disturbances over a ten-minute period, even though each individual disturbance did not exceed the threshold at which generators are allowed to trip under ERCOT's voltage ride-through requirement.[43] It should be noted that ERCOT's ride-through requirement differs from FERC Order 661A, which applies to wind plants in the Eastern and Western Interconnects.

Because minor voltage disturbances do not typically cause the generator to experience the electrical and mechanical damage that result from repeated large disturbances, it may be worth examining ride-through requirements to determine the appropriate threshold at which it is unreasonable to require generators to remain online following repeated large disturbances. However, any clarifications or revisions to requirements that would require changes to turbines should only apply on a prospective basis with an adequate grace period for future projects, given that the retroactive application of standards typically results in significant costs and sets a troubling precedent that causes business and investor uncertainty. The Commission correctly recognized this in making changes under Order 661A, Order 827 on reactive power requirements, Order 842 on primary frequency response capabilities, and others that only apply on a prospective basis with an adequate grace period.

Most importantly, it should be noted that under Order 661A, wind plants already meet a far more rigorous standard than other generators for voltage and frequency disturbance ride-through. When NERC standard PRC-024 was initially proposed as a performance requirement

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[43] North American Electric Reliability Corporation, *Lesson Learned, Loss of Wind Turbines due to Transient Voltage Disturbances on the Bulk Transmission System*, https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/LL20170701_Loss_of_Wind_Turbines_due_to_Transient_Voltage_Disturbances.pdf.

nearly a decade ago, representatives for many conventional generation owners expressed concern that their generators would likely not be able to meet the standard. As a result, the standard was reduced to a relay-setting requirement, which allows a generator to trip offline as long as its relays were set in accordance with the standard. If the Commission is interested in taking action on generation resilience, bringing conventional generators up to the ride-through standard already met by wind generators under Order 661A would likely be more useful than other generation-related resilience steps, as the failure of conventional generators to ride through disturbances has been a contributing factor in some events that resulted in a loss of load.[44] Technology-neutral standards are critical to competitive and not unduly discriminatory power markets.

B. Resilience is already being addressed by NERC, transmission providers, and Reliability Coordinators, so there is no need for new resilience standards or policies.

NERC and each RTO and ISO state that they already address resilience issues.[45] They are addressing resilience as part of reliability, which does not stop at preventing outages; it includes post-outage activities as well. In NERC's Adequate Level of Reliability standards, it includes activities that are post-outage as well as pre-outage.[46] They include "Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner."[47] There have been standards on issues such as black start that relate to post-outage situations, that NERC has proposed and FERC has approved under their respective reliability authorities. This is consistent with

[44] Wayne Barber, *Both Calvert Cliffs nuclear units go offline due to D.C. area disruption*, Power Engineering, (April 8, 2015), https://www.power-eng.com/articles/2015/04/both-calvert-cliffs-nuclear-units-go-offline-due-to-d-c-area-disruption.html.
[45] See NYISO Filing in AD18-7 pp 3-4 and ERCOT filing in AD18-7 p.2.
[46] Informational Filing on the Definition of Adequate Level of Reliability, Docket No. RR06-1-000, May 10, 2013, https://www.nerc.com/pa/Stand/Resources/Documents/Adequate_Level_of_Reliability_Definition_(Informational_Filing).pdf .
[47] Id. at 2.

Commissioner Lafleur's statement that "[i]n my view, resilience -- the ability to withstand or recover from disruptive events and keep serving customers – is unquestionably an element of reliability."[48]

NERC has also catalogued how its reliability requirements and other activities address resilience.[49] NERC explains how its mandatory standards make the system robust against a range of threats and require operators to plan to respond to events, while other activities provide the coordination and situational awareness to recover from events. The entire purpose of many standards is to make the power system resilient against unexpected losses of transmission or generation. For example, generator ride-through standards and Transmission System Planning Performance Requirements under the TPL standards prevent cascading outages in the event of the loss of a transmission or generation asset.

Since resilience is already covered under FERC, NERC, and Reliability Coordinator responsibilities, there is no need for generic action to cover resilience as a new category of activity. If it were, the Commission would need to distinguish it from reliability, as argued by the California ISO: "The Resilience Order does not address any potential overlap between resilience and reliability, clearly articulate the differences between the two, state why a new, wholly separate concept is needed, or indicate what specific requirements a resilient system must meet. These are necessary steps if the Commission is to distinguish resilience from reliability and establish objective resilience standards and guidelines that are separate and distinct from reliability standards."[50]

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[48] Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, 162 FERC ¶ 61,012 (2018) (Commissioner Lafleur concurrence at 1).
[49] Available at www.nerc.com/comm/PC/Agenda%20Highlights%20and%20Minutes%202013/Draft_PC_Meeting_Presentations_March_6-7_2018_Jacksonville_FL.pdf, at 58-65.
[50] CAISO Comments, at 9, AD18-7-000.

There is no generic resilience problem to be addressed by FERC thus far in the record. Most of the RTO/ISOs ask for no Commission action in their comments. For example, NYISO states: "The NYISO respectfully requests that the Commission allow the NYISO to continue to work with its stakeholders in assessing and developing the enhancements necessary to ensure that the wholesale markets, in serving the evolving needs of the electric system, continue to provide significant benefits to the State and its electricity consumers."[51]

Generic action is also inappropriate due to the regional differences that exist. CAISO states: "CAISO['s] footprint faces natural threats primarily from earthquakes, drought, and fires, not hurricanes or extreme cold conditions like other regions. The CAISO also has a different resource mix than other regions. There are no baseload coal resources in the CAISO balancing authority area, and the one remaining nuclear unit is scheduled to retire in 2024. Where other regions are experiencing an influx of natural gas-fired resources, such resources are declining in number in the CAISO footprint."[52]

C. There is no basis for action in the generation sector or energy markets.

Fuel supply issues are at best a tiny fraction of reliability risk from the customer's perspective. The Rhodium Group found that generation inadequacy accounted for less than 1/10,000th of all customer-hours of outages, with fuel supply emergencies an even smaller share at fewer than 1 in 1.4 million.[53] Similarly, analysis in Public Utilities Fortnightly found that "distribution system outages appear to impose roughly two orders of magnitude more minutes of outage on customers than does resource adequacy … 146 compared to 1.2 minutes a year."[54] That analysis went on to note that even that is likely to be an overestimate of outages caused by generation shortfalls, as Balancing Authorities can typically resort to steps such as leaning on

[51] NYISO Comments, at 3, AD18-7-000.
[52] CAISO Comments, at 1, AD18-7-000.
[53] Available at https://rhg.com/research/the-real-electricity-reliability-crisis-doe-nopr/.
[54] Available at https://www.fortnightly.com/fortnightly/2010/04/reconsidering-resource-adequacy-part-1.

neighboring power systems or reducing system voltage in the event of a generation shortfall and avoid resorting to customer outages.

The RTOs and ISOs generally found no issue with generation or power markets. For example, NYISO states: "NYISO remains confident in the ability to work collaboratively with its stakeholders to develop and implement the necessary market and procedural enhancements to continue to efficiently and reliably serve New York's energy needs."[55] And: "The NYISO markets are designed to provide proper financial incentives and price signals to ensure the continued reliable operation of the electric system in New York. The NYISO markets inherently value and support elements of resilience that are embedded in maintaining reliability."[56]

The RTOs and ISOs agree that reliability threats are more related to transmission and distribution than with generation. PJM states: "The challenges to the resilience of the BES are primarily associated with the transmission and distribution systems."[57]

Supply is generally more than adequate across FERC-jurisdictional markets.[58] DOE's Staff Report notes that "[a]ll regions have reserve margins above resource adequacy targets."[59] This was affirmed by NERC's testimony to FERC that "the state of reliability in North America remains strong, and the trend line shows continuing improvement year over year,"[60] as well as FERC staff analysis.[61] Reserve margins in PJM over the next several years will be around 30 percent, nearly twice the target level of 16.6 percent, and could go as high as 60 percent if

[55] NYISO Comments, at 2, AD18-7-000.
[56] Id. at 5.
[57] PJM Comments, at 48, AD18-7-000.
[58] Available at https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_12132017_Final.pdf, at 10.
[59] DOE Staff Report at 66.
[60] Available at https://www.ferc.gov/CalendarFiles/20170717080645-Cauley,%20NERC.pdf.
[61] Available at https://www.ferc.gov/market-oversight/reports-analyses/mkt-views/2017/10-19-17-A-3.pdf.

planned generation additions materialize.[62] Reserve margins in SPP are also around 30% when their required margin is only approximately 12%.

The reliability value of further generation support is extremely low at the current high reserve margin levels. PJM analysis has demonstrated that once reserve margins exceed 20 percent, the marginal benefit of additional reserve capacity for reducing customer outages is negligible.[63] Analysis by Xcel's Colorado utility reached the same conclusion.[64] The Brattle Group conducted a similar analysis for ERCOT and calculated that above a 10% reserve margin, the cost of extra generating capacity outweighs the benefits of reduced risk of shedding firm load and lower costs for operating reserves and production costs.[65]

Reliability in bulk power supply is assured through provision of Essential Reliability Services ("ERS") as defined by NERC.[66] These include frequency support, voltage support, and flexibility/balancing. There is not another reliability service that could increase resilience that is not already covered by ERSs.

Generation shortfall concerns were raised in three regions, ISO-NE, PJM, and CAISO. We address each of them below and support the analysis of Silverstein, Gramlich, and Goggin.[67]

1. New England

While the ISO raised concerns about fuel security and found in its analysis that some resource portfolio combinations did not serve all load in the future, many other combinations of

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[62] Available at https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_12132017_Final.pdf, page 10.
[63] Available at http://www.pjm.com/~/media/committees-groups/subcommittees/raas/20160927/20160927-2016-pjm-reserve-requirement-study.ashx, page 39.
[64] Available at https://www.xcelenergy.com/staticfiles/xe/PDF/Attachment%20AKJ-2.pdf, page 391.
[65] Available at http://www.ercot.com/content/wcm/lists/114801/Estimating_the_Economically_Optimal_Reserve_Margin_in_ERCOT_Revised.pdf, p. vA.
[66] Available at https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSWG_Sufficiency_Guideline_Report.pdf.
[67] Silverstein, Gramlich, Goggin, "A Customer-focused Framework for Electric System Resilience," https://gridprogress.files.wordpress.com/2018/05/customer-focused-resilience-final-050118.pdf.

resources did, including some with high renewable energy penetration. Moreover, stakeholders have identified many assumptions that were outdated in the ISO's analysis that are being updated in further assessments. More recent runs of the ISO's model show that reliability is preserved with most portfolios.[68]

The transition towards cleaner resources is helping rather than harming reliability. ISO-NE states "The [Operational Fuel Security Assessment] simulations of scenarios with higher levels of LNG, dual-fuel generating capability, imports, and renewable resources indicate that a resource mix with these resources help to reduce the fuel-security risk."[69] Three of the four most reliable scenarios in ISO-NE's analysis included high renewables. All of these scenarios performed many times better than the baseline scenario.

2. PJM

Similar to ISO-NE, PJM performed an analysis of the regions generation portfolios. Also similarly, PJM found a multitude of combinations of resources that would be reliable under a variety of conditions. Finding that some resource combinations do not serve load in all conditions does not mean there is a problem with the market design. Many of the reliability scenarios had many times more renewable energy capacity than exists today, and many others had significantly less coal and nuclear capacity than exists today.

Recently PJM announced that it will be studying fuel security risk, as one aspect of resilience. We welcome the forthcoming study of resource adequacy and fuel security. We're confident that when done using reasonable assumptions and scenarios that the analyses will

[68] ISO New England, Operational Fuel Security Analysis, Stakeholder Requests for Additional Scenarios, March 2018, https://www.iso-ne.com/static-assets/documents/2018/03/a2_operational_fuel_security_presentation_march_2018.pdf .
[69] Available at https://www.iso-ne.com/static-assets/documents/2018/01/20180117_operational_fuel-security_analysis.pdf, page 51.

demonstrate no compelling need to require the presence of any particular class of generating resource.

3. California

CAISO stated "studies showed potential shortfalls in load-following and reserves, with capacity insufficiencies occurring in the early evening after sunset, based on 1,000-2,000 MW of retirements in the latest sensitivity analyses. This is a concern to the CAISO."[70] We do not disagree with this assessment; however, we note that 1) this has nothing to do with the loss of coal and nuclear generators, which are almost absent from the California market and which likely could not help with providing flexibility since they are not flexible resources, and 2) this is not a new product or need beyond what reliability requires to be procured. Thus, there is no need in this resilience proceeding to act in response to this balancing challenge.

D. Market Design and Resilience

Even if fuel security or resource adequacy problems are found, there is no need for new generic regulations or new products. The issues that have been raised can be fixed within the existing products and markets. For example, if the common mode failure of a gas pipeline or compressor station outage are found to impact multiple gas generators, that could be a basis for changing the capacity value of those generators. That is a simple change within the existing market framework. All generators have assigned capacity values that are less than 100% of their nameplate capacity based on statistical assessments of their availability. Those statistical assessments can be changed through simple rule changes filed with the Commission.

The Commission can and should continue to evaluate market designs to ensure supplies of energy and essential reliability services are provided when and where needed. NYISO states, "Since the experiences of the 2013-2014 winter period, the NYISO and its stakeholders have

[70] CAISO Comment in AD18-7, page 36.

generally focused their fuel and performance assurance initiatives on energy market design enhancements that seek to provide proper incentives for improved resource performance."[71]

The Commission should foster greater procurement for flexible resources. Flexibility supports efficiency, reliability, and resilience, and in a future with much greater penetrations of variable resources, more flexibility will be needed. The Commission should consider further efforts to:

- Have prices reflect the value of energy and reliability services when they are scarce, as a means of attracting flexibility.
- Evolve definitions of reserves based on evolving system need.
- Continue to remove legacy product definitions and software restrictions that limit participation from new technologies.
- Create a market for primary frequency response, with a premium fast service.
- Remove barriers to participation in regulation and other ancillary services markets
- Standardize a methodology for reactive power compensation

E. Transmission and system planning processes already ensure resilience, yet action on transmission rather than generation is more effective for improving resilience.

Existing transmission and system planning processes already include resilience considerations and ensure the grid is able to withstand threats and disturbances. Threats to the resilience of the transmission system vary significantly by region, but RTOs are already taking these considerations in to account in their existing planning processes and utilizing lessons learned from prior events.

When it comes to the risks presented by cyber and physical attacks, grid operators have already taken significant steps to protect their systems. For example, "The CAISO plans for and

[71] NYISO Comments, at 30, AD18-7-000.

manages risks associated with physical and cyber-attacks, fuel supply disruptions, and extreme weather events through established processes, procedures, and protocols that are an integral part of the CAISO's overall business practices." [72] CAISO further states that planning for HILF events occurs on both a regular and as needed basis as specific challenges arise (e.g. SONGS closure, Aliso Canyon, etc.).

As NYISO highlights in its comments, grid operators are already going well beyond existing NERC requirements to ensure grid resilience. For example, security practices are constantly improving through collaboration with "various state and federal agencies, other ISOs/RTOs, and other industry partners."[73] CAISO also points out that its "tariff authorizes the CAISO to establish planning guidelines and standards beyond those established by NERC and WECC to ensure the secure and reliable operation of the CAISO controlled grid."[74] These examples serve to illustrate that RTOs have been planning for the impacts of HILF events for years and have gone well beyond stated requirements to ensure the resilience of their systems.

To the extent the Commission takes action in this proceeding, efforts focused on the transmission system will be more fruitful for improving electric reliability and resilience than generation-focused efforts.

Department of Energy data confirm that the vast majority of customer outages result from failures on the transmission and distribution systems, while very few are caused by generation shortfalls or fuel supply issues. As mentioned above, the Rhodium Group used another EIA dataset to look at the causes of losses of customer electricity hours in the U.S. between 2012 and 2016. Additional analysis by the Rhodium Group finds that averaged over the four years 2012-2016, only 8.6% of outage minutes are due to "loss of electricity supply" to the distribution

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[72] CAISO Comments, at 33, AD18-7-000.
[73] NYISO Comments, at 26, AD18-7-000.
[74] CAISO Comments, at 70, AD18-7-000.

utility, which includes those caused by transmission failures, generation failures, fuel emergencies, generation shortfalls and weather impacts to transmission and generation assets.[75] The other 91.4% of outage minutes are due to events affecting the distribution system itself.

As documented in the Silverstein, Gramlich, and Goggin report, of the 27 major U.S. blackouts that have caused outages to more than 1 million customers since 2002, only four were due to non-weather problems – three started on the transmission system (the 2003 Northeast Blackout, the 2008 Turkey Point blackout, the 2011 Southwest Blackout) and one from a power plant fire (Puerto Rico 2016).[76] Only the ERCOT 2011 rolling blackouts were related to a generation shortfall (most due to inadequate equipment weatherization for extremely cold weather).[77] It should also be noted that, due to their larger size and geographic diversity, the Eastern and Western Interconnections (which are subject to FERC jurisdiction) tend to be more resistant to generation shortfalls than ERCOT.

Taken together, these data indicate that over 90 percent of customer outage minutes are caused by distribution system failures, while the vast majority of the remainder are caused by transmission system failures. While distribution system issues are outside of the jurisdiction of the Commission, the Commission does have authority over the transmission system, its reliability, and policies governing how transmission is planned and paid for.

F. ISOs agree that the Commission should focus on transmission.

[75] Marsters et al. (2017).

[76] Available a https://gridprogress.files.wordpress.com/2018/05/customer-focused-resilience-final-050118.pdf, Appendix A

[77] As described in the FERC-NERC investigation report, a five-day stretch of extremely cold weather caused the loss (outage, derate or failure to start) of 210 individual generating units within ERCOT, leading to controlled load-shedding of 4,000 MW affecting 3.2 million customers. Local transmission constraints and loss of local generation caused load shedding for another 180,000 customers in South Texas. Outside ERCOT, El Paso Electric lost 646 MW of local generation, and two Arizona utilities lost 1,050 MW of generation. Some of these losses were due to frozen generation equipment and others were due to the loss of gas supply due in part to frozen pipeline equipment. See https://www.ferc.gov/legal/staff-reports/08-16-11-report.pdf.

In their comments in this docket, the RTOs unanimously and strongly agree that transmission should be a primary focus of any efforts to increase resilience. In its March 9 comments to the Commission, MISO focused on "Transmission Planning" and "Inter-regional Operations" as two of the three areas the Commission should focus for improving resilience (the other being "Information Technology Tools"). As MISO explained, "Continued industry dialogue on more effectively identifying, valuing, and incorporating resilience attributes in transmission planning processes will help the Commission identify further opportunities to support and advance grid resilience."[78]

Similarly, PJM argues that "resilience efforts will require changes to transmission and infrastructure planning," explaining that "the Commission could provide assistance to RTOs by requiring them to plan for and address resilience, and confirm that resilience is a component of regional transmission system planning" and that "Robust long-term planning, including developing and incorporating resilience criteria into the [Regional Transmission Expansion Plan], can also help to protect the transmission system from threats to resilience."[79]

In its comments, NYISO explained that the Commission "must also recognize the critical importance of maintaining and enhancing grid interconnections. These interconnections support and bolster reliability and resilience by creating a larger and more diverse resource pool available to meet needs and address unexpected and/or disruptive events throughout an interconnected region."[80] It provided a detailed explanation of how "The resiliency value of an interconnected grid has been clearly demonstrated during recent periods of system stress," and explained that "Maintaining and protecting existing interconnections between neighboring regions and continually assessing opportunities to improve interregional transaction coordination can bolster

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[78] Available at https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14837872, at 2.
[79] Available ahttps://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14838232, at 11, 69, 50.
[80] Available at https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14838205, at 10-12.

the resiliency of the grid throughout an interconnected region. These interconnections foster the opportunity for the Northeast and Mid-Atlantic markets to rely on a broader, more diverse set of resources to meet the overall needs of the region."

ISO-NE discusses the consumer savings and resilience benefits of its recent transmission investments, noting that "As a result of these investments, the region has a robust transmission system that has the ability to operate reliably under myriad operating conditions."[81] SPP also notes how "This additional transmission has enabled resources of all fuel types to help meet customer demand during a range of potential threats to reliability and resilience," and that "The construction of new transmission facilities pursuant to modern design standards enhance the robustness of the system."[82] CAISO explains that a key function of its transmission planning process is "maintaining reliability through a resilient electric system."[83]

Finally, in their comments, ERCOT and the PUCT explain that "One of the most critical elements of system resilience is ensuring that the transmission system is planned in such a way as to ensure continued operations following an unexpected outage of one or more generators or transmission elements."[84]

In its comments in docket RM-18-1, the predecessor to this docket, NERC also explained the central role of transmission for reliability and resilience and the importance of improved transmission planning methods, noting repeatedly that "The right combination and amount of resources and transmission together maintain adequacy of the system."[85]

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[81] Available a https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14837909, at 15.
[82] Available a https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14838087, at 3, 5.
[83] Available a https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14838234, at 148.
[84] Available at https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14837920, page 7.
[85] Available at https://www.nerc.com/FilingsOrders/us/NERC%20Filings%20to%20FERC%20DL/Comments%20of%20NERC%20re%20Proposed%20Grid%20Reliability%20and%20Resilience%20Pricing.pdf, page 2.

By implementing policy reforms that will unleash private investment to strengthen America's power grid, the Commission could increase reliability and resilience in all FERC-jurisdictional areas nationwide, not just in the Regional Transmission Organizations.

G. The Commission can greatly improve reliability and resilience by focusing on transmission.

The Commission could use its authority over transmission policy to significantly improve electric reliability and resilience. Establishing workable policies for transmission planning and cost allocation, for both intra- and inter-regional transmission, would unleash private investments to strengthen America's power grid. The final section (E) of our comments offers detailed recommendations for concrete steps the Commission can take to achieve that end.

It is intuitive that a stronger transmission system with more network paths to deliver power will be more reliable. Just as most commuters have a backup route in case their primary road to work is blocked by traffic or an accident, grid operators are required to have at least one backup path to get electricity to homes, businesses, and hospitals. However, having multiple backup paths becomes particularly valuable when a disaster takes out multiple power lines simultaneously.

Researchers have modeled theoretical power systems and demonstrated that strengthening the grid by adding network paths significantly increases the system's resilience to damage and prevents customer outages.[86] Similar modeling of the U.K. power system has demonstrated that investing in stronger transmission infrastructure as well as additional backup paths for power significantly reduces the risk of power outages due to windstorms.[87] If anything that study likely understates the value of additional backup transmission paths because it only looks at windstorm events. With a wind storm there is a very high correlation between the failure

[86] Available at http://public.lanl.gov/rbent/pscc_resilience.pdf.
[87] Available at https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7801854.

of the first circuit and backup circuits because the storm affects a large area. With other events that account for most transmission line outages (equipment failure, human error, wildfire, lightning strike, tower collapse, tree damage, tornado) there would be a much lower correlation for the loss of the two circuits, making additional backup paths much more valuable.

Real-world experience confirms that investing in transmission does improve electric reliability and resilience. Kansas utility Westar has reported that transmission investment has been associated with a 40% reduction in transmission-related customer outages.[88]

By enabling the delivery of electricity from other regions, transmission plays a particularly important role in keeping electricity reliable and affordable when unexpected events such as extreme weather affect part of the system. Because weather and other extreme events tend to be geographically limited in scope, one region is almost never experiencing its extreme supply shortfall at the same as all neighboring regions. For example, during the Bomb Cyclone event in early January 2018, the low temperature anomaly was far worse in eastern PJM than in western PJM, causing wholesale electricity prices in eastern PJM to be consistently hundreds of dollars per MWh higher than in western PJM. Greater west-to-east transmission capacity in PJM would have saved PJM consumers hundreds of millions of dollars during that event alone. The next extreme event might more strongly affect western PJM, causing greater demand and price spikes and generator unavailability there than in eastern PJM, so over time transmission expansion would tend to greatly benefit all in the footprint.

Another reliability concern is that much of America's transmission infrastructure is now reaching the end of its useful life, including transmission lines, towers, transformers, and other substation equipment. Like most infrastructure, this equipment will likely see a higher failure rate as it nears the end of its life, putting reliability at risk. In part due to its obsolescence, the

[88] Available at https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf, at 15.

American Society of Civil Engineers recently gave America's power grid infrastructure a "D+."[89] Grid operators confirm that their transmission infrastructure is reaching the end of its life and must be replaced.[90]

Nationally, most of our transmission infrastructure was built between 1960 and 1980; according to one estimate, just replacing that infrastructure alone will cost around $8-14 billion per year over the next 25 years.[91] A similar estimate is that the grid will need $57 billion over the next five years alone.[92] As America undertakes that investment, it should also account for future needs and ensure that the size of transmission investment is optimized to maximize benefits.

Higher-voltage transmission lines tend to experience fewer outages, suggesting that investment in these higher-capacity lines will improve system reliability. Higher-voltage lines tend to have multiple circuits and multiple AC power phases, which protects against the loss of a single phase or circuit. As American Electric Power explains, "765 kV [kilovolt] circuits experience, on average, 1.0 forced outages per 100 mile-years. A comparable statistic for 500 kV is 1.4 forced outages per 100 mile-years. While single-phase faults are the dominant type of failures for both voltage classes, no multi-phase faults have been recorded at 765 kV in normal operation, short of tower failure."[93] NERC data confirm that higher-voltage transmission lines and infrastructure have a lower outage rate than lower-voltage lines.[94]

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[89] Available at http://www.infrastructurereportcard.org/cat-item/energy/.
[90] Available at http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Power_Trends/Power_Trends/2016-power-trends-FINAL-070516.pdf, at 2.
[91] Available at http://files.brattle.com/system/publications/pdfs/000/005/190/original/investment_trends_and_fundamentals_in_us_transmission_and_electricity_infrastructure.pdf?1437147799, at 6-7.
[92] Available at http://www.cg-la.com//documents/Maximizing-the-Job-Creation-Impact-of-%241-Trillion-in-Infrastructure-Investment.pdf.
[93] Available at https://www.aep.com/newsroom/resources/docs/AEP_Interstate_Project-Technologies.pdf.
[94] Available at https://www.nerc.com/pa/RAPA/tads/Key_TADS_Documents/TADS%20Dashboard%20RAW%20Data.xls.

Recent analysis identifies transmission improvements as some of the lowest-hanging fruit for improving system resilience.[95]

	High Value		Low Value
Grid operator, reliability coordinator	Interconnection rules Schedule coordination Fuel coordination Emergency planning and drills System & asset models Situational awareness		Generation capacity payments
T&D, Genco Capital	Distribution pole hardening Additional transmission paths and loops Back-up communications Transmission automation Distribution automation	T&D undergrounding Generator weatherization	Coal & nuclear subsidies
T&D, Genco O&M	Tree trimming Cyber security & secure communications networks Physical security Mutual assistance Strategic spare equipment & mobile substations Situational awareness, system monitoring, PMUs Emergency planning and drills Outage management system		Fuel supply guarantees
Customer	Distributed generation, back-up generators Emergency supplies More efficient building shells Community critical infrastructure hardening	Insurance Distributed storage	

The reliability cost of inadequate transmission can be quite high. The 2003 blackout in the Northeast U.S. and Canada, which largely resulted from a congested transmission system and inadequate transmission maintenance, and partially resulted from loop flows and a lack of control that could have been alleviated through power flow control devices, caused an estimated $7-10 billion in economic losses. A congested transmission system with poor coordination in transmission system planning and operations was also a contributing factor to the 2011 blackout that affected parts of Southern California and Arizona.[96]

A stronger transmission system provides other benefits that increase reliability and resilience and keep electricity costs low for consumers. Transmission allows the grid to operate

[95] Available at https://gridprogress.files.wordpress.com/2018/05/customer-focused-resilience-final-050118.pdf, at 63.
[96] Available at https://www.ferc.gov/legal/staff-reports/04-27-2012-ferc-nerc-report.pdf .

equally reliably with fewer power plants, by allowing the sharing of planning and operating reserves across the power system and with neighboring power systems. Grid operators keep power plant capacity in reserve to ensure there is sufficient power supply to handle fluctuations in electricity supply and demand over the course of a day (operating reserves) and from year-to-year (planning reserves). On large power systems and over larger geographic areas, those fluctuations in supply and demand tend to cancel each other out, allowing grid operators to keep a smaller share of plants in reserve. The geographic diversity benefit is particularly large for inter-regional transmission and as renewable resources provide an increasing share of generation, due to the diversity in weather and climate across large areas.

SPP found $1.354 billion in net present value benefits, around 8 percent of the total benefits of its transmission upgrades, were due to transmission enabling a 2 percent reduction in the need for planning reserves. A previous iteration of MISO's transmission upgrade analysis, conducted when load growth was expected to drive a need for new power plant capacity, found net present value savings of $1 billion to $5.1 billion from reduced planning reserve needs, and $33 million to $116 million from reduced operating reserve needs.[97] The aggregation of power plants into the large grid operating areas of MISO and PJM, enabled by existing transmission, respectively saves $2 billion to $2.5 billion and $1.1 billion to $1.4 billion annually on planning reserves, while operating reserve savings are around $100 million annually.[98] An Xcel Colorado analysis found that 200 MW of transmission ties with neighboring Balancing Authorities enabled a reserve margin reduction from 19.2% to 16.3% while meeting the same standard for LOLP.[99]

H. Transmission infrastructure makes the power system resilient to uncertainty.

[97] Available at https://cdn.misoenergy.org/2011%20MVP%20Portfolio%20Analysis%20Full%20Report117059.pdf, at 57

[98] Available at https://www.misoenergy.org/about/miso-value-proposition/, http://www.pjm.com/about-pjm/value-proposition.aspx.

[99] Available at https://www.xcelenergy.com/staticfiles/xe/PDF/Attachment%20AKJ-2.pdf, at 391.

As utilities and grid operators confront growing uncertainty due to an increased reliance on volatilely-priced fuels, uncertain policy changes, rapid technology improvements, and large changes in the generation mix, transmission provides valuable flexibility to respond to unexpected changes.

Transmission is an important mechanism to protect consumers against the inherent but unpredictable volatility in the price of fuels used to produce electricity. Transmission can alleviate the negative impact of fuel price fluctuations on consumers by making it possible to buy power from other generators and regions and move it efficiently on the grid. This increased flexibility helps to modulate swings in fuel price, as it makes demand for fuels more responsive to price as utilities can respond to price signals by decreasing use an expensive fuel and instead importing cheaper power produced from other sources.

Analysis has shown the optionality value of transmission to be very large,and found that standard deterministic transmission planning greatly underestimates the value of transmission. Specifically, analysis by Dr. Ben Hobbs at Johns Hopkins University and his graduate student Francisco Espinoza shows that current transmission planning methods, which at best use several deterministic scenarios to highlight ranges of future outcomes for the power system, are "a weak tool for decisions under uncertainty" and "don't account for flexibility."[100] Probabilistic methods that quantitatively account for uncertainty in the transmission planning process result in a larger and more optimal transmission build, saving consumers tens of billions of dollars relative to deterministic methods that fail to account for the value of transmission in providing flexibility. Moreover, the probabilistic method saved hundreds of billions of dollars relative to some deterministic planning methods that greatly underbuilt transmission.[101]

[100] Available at https://www.sciencedirect.com/science/article/pii/S1040619015001025, http://energy.gov/sites/prod/files/2013/09/f2/1-2013RMReview-Hobbs.pdf.
[101] Available at http://hobbsgroup.johnshopkins.edu/docs/FD_Munoz_Dissertation.pdf, at 102.

Focusing on the transmission system would have other benefits as well, such as ensuring rates are just and reasonable by promoting market competition. As the Commission explained in Order 890, some power plant owners "can have a disincentive to remedy transmission congestion when doing so reduces the value of their generation or otherwise stimulates new entry or greater competition in their area. For example, a transmission provider does not have an incentive to relieve local congestion that restricts the output of a competing merchant generator if doing so will make the transmission provider's own generation less competitive."[102] A large body of studies have confirmed that investments in transmission more than pay for themselves by promoting competition and providing consumers with access to lower-cost energy.[103]

I. Next Steps: How FERC Can Help.

The Commission has asked for suggestions on how resilience could be enhanced using market-based constructs, operating procedures, NERC reliability standards, or planning processes.[104] We appreciate the opportunity to share recommendations with the Commission and respectfully suggest that there are several steps that could be taken that would enhance resilience. Each of these steps recognizes and builds upon the Commission's core commitment to competition and wholesale markets: (1) continuing to promote the development of competitive wholesale markets, particularly in the West; (2) furthering regional and interregional transmission planning; (3) improving interregional, market-to-market operations and transactions, so as to facilitate the sales of electricity; and (4) providing compensation for essential reliability services, such as voltage support and primary frequency response.

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[102] Available at http://www.nerc.com/files/order_890.pdf.
[103] For example, see available at https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf, https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf, http://files.brattle.com/files/6112_recommendations_for_enhancing_ercot%E2%80%99s_long-term_transmission_planning_process.pdf.
[104] Grid Resilience Order at P 27.

First, the Commission should continue to promote the development of competitive wholesale markets in the West. As the Commission has recognized, markets offer enormous benefits to consumers "by 'providing more supply options, encouraging new entry and innovation, spurring deployment of new technologies, promoting demand response and energy efficiency, improving operating performance, exerting downward pressure on costs, and shifting risk away from consumers.'"[105] RTOs/ISOs enhance reliability and resilience in a myriad of ways, as indicated by the comments of the each of the RTOs/ISOs in response to the Commission's Grid Resilience Order. Similarly, the Energy Imbalance Market in the West has helped CAISO address the steep evening ramp illustrated by the proverbial duck curve, while saving consumers $330.53 million since November 2014, reducing renewable energy curtailment by 586,277 MWh, and dropping carbon emissions by 250,845 tons.[106] We recognize that FERC does not require transmission utilities to join RTOs/ISOs, but FERC nevertheless can provide support to stakeholders who are considering a regional market, facilitate discussions and convene stakeholders on an as-needed basis, address potential concerns or questions that might arise regarding markets, and be open to reasonable incremental steps that advance the goal of creating a competitive western wholesale market.

Second, the Commission should improve transmission planning for both regional and interregional projects under Order No. 1000. In their comments, all the RTOs/ISOs recognize the importance of transmission in promoting a reliable and resilient grid. Power flows from one region can provide invaluable support to another that is experiencing peak load conditions or recovering from a severe weather event. RTO/ISO experience shows that investments in transmission provide multiple value streams, including economic, reliability, and resilience

[105] *Id*. at P 11 (quoting Wholesale Competition in Regions with Organized Electric Markets, Order No. 719, FERC Stats. & Regs. ¶ 31,281, at P 1 (2008)).
[106] California ISO, Western EIM Benefits Report First Quarter 2018, at 3, 13 (2018), available at https://www.westerneim.com/Documents/ISO-EIMBenefitsReportQ1_2018.pdf.

benefits. In SPP, for example, a transmission line that was built to bring low-cost, renewable energy to market "supported resilience by creating and strengthening alternate paths within SPP."[107] In MISO, "the majority of transmission Multi-Value Projects ("MVPs"), approved in 2011 to address the large-scale emergence of wind resources in the MISO footprint, support future grid resilience."[108] FERC held a technical conference on Order No. 1000 in late June 2016,[109] and now that almost two years have passed since the technical conference and a new Commission is in place, we would respectfully suggest that the time is ripe for the Commission to lay the groundwork for remedying flaws in the interregional transmission planning process.

We once again urge the Commission to begin a rulemaking process or, at a minimum, to hold a follow up technical conference on the interregional planning processes under Order No. 1000. In 2016, AWEA and others strongly encouraged "the Commission to act with a sense of urgency to improve regional and interregional transmission planning."[110] We observed that Order No. 1000 had not yet produced significant interregional projects.[111] Little progress has occurred since then, and it is no coincidence that the big interregional projects are merchant in nature. We renew the recommendations we made in 2016, which are as valid today as they were when they were made:

- The Commission require greater consistency and standardization between neighboring regions regarding interregional processes, such as the planning analyses used between the regions; the application of cost allocation and benefit metric provisions (economic, reliability, and public policy benefits) across the seams, even if

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[107] Comments of Southwest Power Pool, Inc, at 8, Docket No. AD18-7-000.
[108] Responses of the Midcontinent Independent System Operator, Inc., at 3-4. AD18-7-000.
[109] FERC, Supplemental Notice of Technical Conference and Request for Speakers, Docket No. AD16-18-000 (May 10, 2016).
[110] Post-Technical Comments of Americans for a Clean Energy Grid and Other Interested Parties, at 2, Docket No. AD16-18-000 (Oct. 4, 2016).
[111] *Id*.

those benefits are not considered in their regional process; and reliability criteria and modeling assumptions.

- Interregional economic transmission projects must only meet the benefit-to-cost ratios of each region, and not an additional interregional cost-benefit ratio. In the alternative, benefit-to-cost thresholds for interregional tests should be no more stringent than those required in each region.
- Interregional processes not exclude upgrades below certain voltage levels or project sizes, as they could help increase interregional transfer capabilities and provide other benefits.
- Cost allocation of interregional projects reflect the benefits recognized in the interregional benefit calculation. Those benefits should fully reflect the economic, reliability, policy and other quantifiable benefits that will accrue.
- Neighboring regions use common models in their interregional analyses. Currently, different regions use different models, assumptions, and tests to identify and evaluate interregional projects. Common modeling practices and evaluation methods would promote greater consistency between regions in identifying projects and determining whether they should be included in regional plans.
- Neighboring transmission regions identify and jointly evaluate alternative projects proposed by interregional transmission developers that may meet the needs of one or more planning region more effectively or cost-effectively.
- Planners consistently consider broad rather than narrow categories of benefits when evaluating interregional transmission projects. The Commission should develop detailed technical guidance for planners to accelerate the development and adoption of common approaches among regions. Limiting interregional projects to narrowly

> defined categories or types (e.g., reliability, economics, etc.) limit the project benefits that are considered. Interregional transmission projects by their nature deliver broad and diverse benefits to large geographic regions.[112]

With respect to regional transmission planning processes, we recognize that some progress has been made in individual regions. Nevertheless, a divergence of planning processes has arisen that to a significant extent continues the "patchwork" of planning practices and outcomes. Two years ago, we said the time was ripe for the Commission to develop a more robust record to remedy persistent regional transmission planning issues in order to realize Order No. 1000's full potential and policy objectives. This is still true today. Moreover, we urge the Commission to act on the recommendations we made in 2016:

- Regional transmission planning must be proactive – both anticipatory, given the long lead times and piecemeal planning occurring in some regions, and implemented in a way that addresses environmental regulation, technological challenges, and the foreseeable, rapidly changing generation mix.
- The regional transmission and generation interconnection process should be united, instead of two separate and distinct processes as currently exists. The two processes should be linked and holistically resolved in transmission planning region tariffs.
- The Commission needs to act in order to ensure public policies are actually considered in a meaningful way. The Commission should require that all policies impacting transmission at least get a hard look during the planning process. The Commission should issue an interpretive rule or policy statement as to what it

[112] *Id*. at 3-4.

means by "consider" – ensuring that public policies impacting transmission are given adequate consideration in regional planning processes.[113]

Proactive regional transmission planning, integrating interconnection and transmission planning processes, and ensuring that public policies are considered in a meaningful way would be far more efficient and effective than the status quo, streamline processes that currently occur on separate tracks, and provide greater regulatory certainty for investment in new generation.

Third, given the importance of interregional power flows and the support resources in one region can provide to another, the Commission should focus on seams coordination and look for ways to facilitate interregional operations and transactions. As NYISO explains, "[m]aintaining and protecting existing interconnections between neighboring regions and continually assessing opportunities to improve interregional transaction coordination can bolster the resiliency of the grid throughout an interconnected region."[114] While progress has occurred between some RTOs,[115] much more work remains to be done. We recommend that the Commission convene a technical conference to identify issues and to explore potential solutions. Seams issues between some RTOs/ISOs have persisted for more than a decade, and, absent FERC's engagement and leadership, are likely to persist. The overarching principle is a simple one: that power should be dispatched from one RTO/ISO to another as if they were a single integrated market. The transaction should be that seamless. Managing seams will unlock important economic, reliability, and resilience benefits for consumers, as it allows load in one region to access a more diverse set of resources in another whenever it is economically efficient to do so. Finally, the Commission should ensure that there is an adequate supply of essential reliability services.

[113] *Id*. at 5.
[114] Response of the New York Independent System Operator, Inc., at 12, Docket No. AD18-7-000.
[115] See, e.g., Responses of the Midcontinent Independent System Operator, Inc., Docket No. AD18-7-000, at 45 (March 9, 2018) ("The maximization of the use of the transmission system (e.g., contract path sharing at the MISO-PJM border) has become the model for seams operations.");

These services include frequency and voltage support.[116] As the Commission has recognized, advances in power electronics allow non-synchronous generators to provide both primary frequency response and reactive power support in an efficient and cost-effective way. The Commission can incentivize resources to furnish such services by providing them with adequate compensation that recognizes their contribution to the grid. In PJM, MISO, ISO-NE, and NYISO, generators are compensated for reactive power capability; in SPP and CAISO they are not. PJM has noted, however, that "[h]aving additional reactive reserves on the system – over and above current reserves – would contribute to resilience mitigation."[117] Similarly, the Commission has the opportunity to create a market for primary frequency response, with a premium fast service. SPP has noted that "Primary Frequency Response is not currently targeted or procured, though it is being considered for future applications."[118] CAISO has relied on transferred frequency response, though it also recognizes that this "is a compliance instrument and does not involve the provision or exchange of physical services."[119]

In sum, this proceeding gives the Commission the opportunity to focus its attention on ways of enhancing the reliability and resilience of the grid. In doing so, the Commission can build upon its long-standing commitment to competitive wholesale markets, improving regional and interregional transmission planning under Order No. 1000, minimizing seams between RTO/ISO markets to promote economic efficiency and resilience, and using market-based approaches to ensure that essential reliability services are provided to the grid. We respectfully suggest that the time is ripe for the Commission to make progress in each of those areas.

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[116] NERC, Essential Reliability Services: Whitepaper on Sufficiency Guidelines, at iv-vi (Dec. 2016).
[117] Comments and Responses of PJM Interconnection, L.L.C., Docket No. AD18-7-000, at 70 (March 9, 2018).
[118] Comments of Southwest Power Pool, Inc. on Grid Resilience Issues, Docket No. AD18-7-000, 17 (March 9, 2018).
[119] Comments of the California Independent System Operator Corporation in Response to the Commission's Request for Comments about System Resiliency and Threats to Resilience, Docket No. AD18-7-000, at 144 (March 9, 2018).

III. CONCLUSION

WHEREFORE, for the reasons set forth above, AWEA and ACORE respectfully request that the Commission consider these comments in any actions or decisions taken pursuant to this docket.

Respectfully submitted,

/s/ Gene Grace

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CERTIFICATE OF SERVICE

I hereby certify that I have this day served 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 9th day of May, 2018.

/s/ Gene Grace