

**UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION**

<b>One-Time Informational Reports on</b>	)	<b>Docket No. RM22-16-000</b>
<b>Extreme Weather Vulnerability</b>	)	<b>AD21-13-000</b>
<b>Assessments Climate Change, Extreme</b>	)	
<b>Weather, and Electric System Reliability</b>	)	

**ONE-TIME INFORMATIONAL REPORT OF  
THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION**

The California Independent System Operator Corporation (CAISO) responds to the Commission’s June 15, 2023 directive requiring transmission providers to submit a one-time informational report on their extreme weather vulnerability assessment policies and processes.<sup>1</sup> Under the functional model administered by the North American Electric Reliability Corporation, the CAISO is registered as a Balancing Authority, Transmission Operator, Planning Authority and Reliability Coordinator. As a Balancing Authority and Transmission Operator, the CAISO operates wholesale electricity markets for the benefit of approximately 80 percent of electric demand in California and small portion of electric demand in the state of Nevada. The CAISO also serves as the market operator for the Western Energy Imbalance Market, which provides real-time market services to participating balancing authorities throughout the Western Interconnection. In its role as a Planning Authority, the CAISO plans for and approves additions to the CAISO controlled grid and as RC West, the CAISO serves as the Reliability Coordinator for 41 balancing authorities and transmission operators in the

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<sup>1</sup> See One-Time Informational Reports on Extreme Weather Vulnerability Assessments, *Climate Change, Extreme Weather, and Electric System Reliability*, Order No. 897, 183 FERC ¶ 61,192, P 115 (2023) (“Order No. 897”).

western United States. As this report explains, the CAISO plans and prepares for extreme events, including extreme weather events.

## I. Background

Climate change and extreme weather events have increased the frequency and unpredictability of electric demand as well as generation and transmission outages. In June 2021, the Commission and its staff convened a technical conference to address the specific challenges posed to electric system reliability by climate change and extreme weather.<sup>2</sup> The technical conference brought together experts to discuss the near, medium, and long-term challenges facing the regions of the country, how decision makers in the regions are evaluating and addressing those challenges, and whether further action from the Commission is needed to help achieve an electric system that can withstand, respond to, and recover from extreme weather events.<sup>3</sup>

The CAISO participated in the Commission's technical conference and submitted written comments in the docket on how long-term planning can assess and mitigate the risk of climate change and extreme events.<sup>4</sup> In its comments, the CAISO encouraged the Commission to take action to help identify and rethink strategies for the electric industry to prepare for, adapt to, and mitigate the threat to electric system reliability

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<sup>2</sup> See, e.g., Notice of Technical Conference, Docket No. AD21-13 (Mar. 5, 2021).

<sup>3</sup> See, e.g., Supplemental Notice of Technical Conference, Docket No. AD21-13 (May 27, 2021).

<sup>4</sup> See Comments of the California Independent System Operator Corporation, Docket No. AD21-13 (Apr. 15, 2021); Post-Technical Conference Comments of the California Independent System Operator Corporation, Docket No. AD21-13 (Sept. 27, 2021); Transcript of Technical Conference to Discuss Climate Change, Extreme Weather & Electrical System Reliability, June 1, 2021, Docket No. AD21-13 (July 22, 2021) (transcribing the testimony of Neil Millar, Vice President, Infrastructure & Operations Planning at the California ISO).

posed by climate change and extreme weather events.<sup>5</sup> The CAISO, however, also cautioned against adopting standards that do not account for regional and local differences in the effects of climate change and the occurrence of extreme events. The CAISO recommended the Commission consider regional differences, the need for regional flexibility, and the efforts already underway in the various regions to address the threat posed climate change and extreme weather events.<sup>6</sup> The CAISO reiterates this point in Part II, below, and explains how the State of California is addressing the effects of climate change and the occurrence of extreme events to provide the Commission insight into the level of coordination at the local and regional level.

After the technical conference, the Commission issued a Notice of Proposed Rulemaking (“NOPR”) proposing transmission providers report on current or planned efforts to assess the vulnerabilities of their jurisdictional transmission assets and operations to extreme weather events.<sup>7</sup> The Commission explained that the reports would enhance transparency, provide opportunities for sharing best practices among transmission providers, and contribute to the Commission’s ability to fulfill its obligations under the FPA.<sup>8</sup> On June 15, 2023 the Commission issued its Final Rule, designated as Order No. 897, and required transmission providers to submit a one-time informational report on whether, and if so how, they establish a scope, develop inputs,

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<sup>5</sup> See, e.g., CAISO Pre-Conference Comments at 3-5.

<sup>6</sup> See, e.g., Transcript 134:7-137:3 (explaining the need for each transmission provider to assess its own system’s resilience to unique risks and cautioning that “a one size fits all approach might address problems that we don’t have and miss the boat on the problems that we do have.”

<sup>7</sup> One-Time Informational Reports on Extreme Weather Vulnerability Assessments Climate Change, Extreme Weather, and Electric System Reliability, Notice of Proposed Rulemaking, 179 FERC ¶ 61,196 (2022) (“NOPR”).

<sup>8</sup> See NOPR at P 9.

identify vulnerabilities and exposure to extreme weather hazards, and estimate the costs of impacts in their extreme weather vulnerability assessments, as well as how they use the results of those assessments to develop risk mitigation measures.<sup>9</sup> The CAISO responds to the Commission’s questions in Part III of this report.

## **II. Efforts Already Underway in the State of California to Address the Threat Posed by Climate Change and Extreme Weather Events**

The CAISO’s planning and operations are, in part, a product of local and regional efforts to strengthen the system’s ability to withstand extreme events in the region. Understanding the scope of extreme weather events arising from climate change, the vulnerabilities they create, and how to adapt to or mitigate them is an evolving process that involves multiple perspectives.<sup>10</sup> This is true with respect to electric grid reliability separate and apart from other infrastructure or areas of the economy. The CAISO has encouraged the Commission to identify strategies for the electric industry to prepare for, adapt to, and mitigate the threat to electric system reliability posed by climate change and extreme weather events.<sup>11</sup> In doing so, it is essential that the Commission consider “regional differences, the need for regional flexibility, and the efforts already underway in the various regions to address the threat posed climate change and extreme weather events.”<sup>12</sup> To enable the Commission to consider such differences, the CAISO

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<sup>9</sup> Order No. 897 at P 3.

<sup>10</sup> See, e.g., “Is That Climate Change? The Science of Extreme Event Attribution.” Congressional Research Service (June 2023), *available at* <https://crsreports.congress.gov/product/pdf/R/R47583#:~:text=Climate%20change%20attribution%20is%20the,likely%20they%20are%20to%20occur>.

<sup>11</sup> See, e.g., CAISO Pre-Conference Comments at 1; CAISO Post-Technical Conference Comments at 1.

<sup>12</sup> See *id.*

provides additional detail on the climate adaptation and mitigation work underway in the State of California in Part II of this report.

### **A. California's Climate Change Assessments Are the Foundation for Adaption and Mitigation Pathways**

As a state, California has taken a number of climate adaptation and mitigation steps,<sup>13</sup> from setting ambitious greenhouse gas reduction goals,<sup>14</sup> to investing in actionable climate science and investing place-based,<sup>15</sup> community driven adaptation and resilience actions.<sup>16</sup> California's Climate Change Assessments contribute to the scientific foundation for understanding climate-related vulnerability at the local scale and informing resilience actions, while also directly informing state policies, plans, programs, and guidance, to promote effective and integrated action to safeguard California from climate change. The California Governor's Office of Planning and Research (OPR) is leading this work in partnership with the California Energy Commission (CEC),

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<sup>13</sup> As a foundational matter, climate adaptation, mitigation and resilience are related, but distinct concepts. Climate adaptation generally refers to actions that reduce physical climate risk in preparation for the changing climate. A series of adaptive steps contribute to resilience, which describes a state of readiness to face climate risks. Climate mitigation generally refers to actions to reduce emissions and stabilize the level of GHG in the atmosphere. SB 100, providing for greenhouse gas reductions, is an example of climate mitigation.

<sup>14</sup> See, e.g., California Assembly Bill 32 (2006) (providing for GHG reductions); California Senate Bill SB 350 (2015) (same); California Senate Bill 32 (2016) (same); California Senate Bill 100 (2018) (same).

<sup>15</sup> See, e.g., California Assembly Bill 1482 (2015) (providing for the development of climate adaptation response); California Senate Bill 379 (2015) (same); California Assembly Bill 2800 (2016) (providing for climate response in infrastructure planning); California Senate Bill 246 (2016) (providing for the development of climate mitigation response); California Senate Bill 30 (2018) (same).

<sup>16</sup> See, e.g., California Assembly Bill 1279 (2022) (providing for climate response consistent with equity); California Assembly Bill 2108 (2022) (providing for environmental justice considerations).

California Natural Resources Agency (CNRA), and California Strategic Growth Council (SGC).<sup>17</sup>

### **1. California Climate Change Assessments Support Climate Adaptation and Mitigation Strategies at the State and Local Level**

California's Fourth Climate Change Assessment, released in 2018, advances actionable science that serves the growing needs of state and local-level decision-makers from a variety of sectors.<sup>18</sup> As a data-driven project, the Fourth Climate Change Assessment reviewed numerous global climate models, identified a smaller sub-set of models appropriate for the state, and performed critical downscaling that produced localized assessments to support specific adaptation and mitigation actions.<sup>19</sup>

California's Fifth Climate Change Assessment is underway. It aims to produce a suite of original climate research to equip communities and leaders across the state with the best available science to inform their adaptation planning and decision-making processes.

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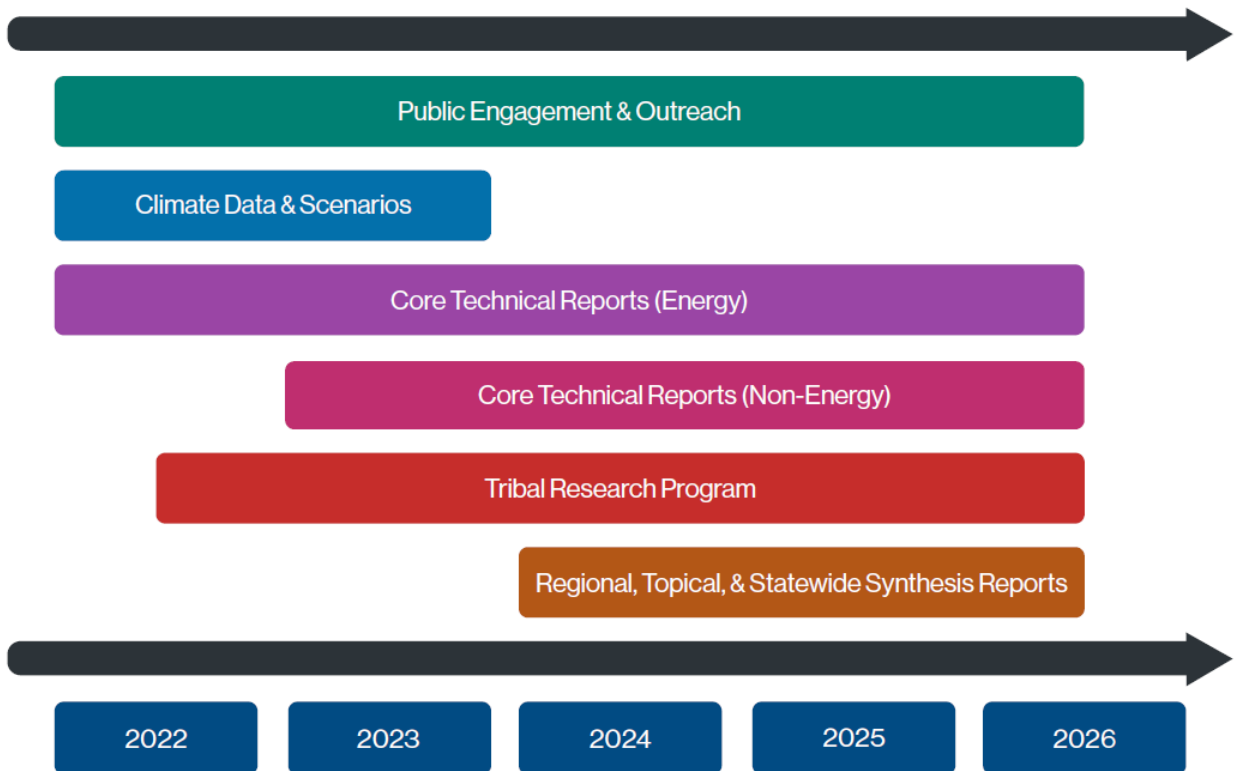
<sup>17</sup> Additional information is available at: <http://opr.ca.gov/climate/icarp/>.

<sup>18</sup> The Fourth Climate Change Assessment, together with the accompanying research reports, is available at <http://www.climateassessment.ca.gov/>.

<sup>19</sup> Climate science, and the underlying models, is rapidly advancing. The Fourth Assessment used CMIP5 models, identifying ten models for analyses that could not support simulations using the full-suite of thirty-two models. These ten models were then downscaled for three spatial domains, including (a) 45 km x 45 km - Western North America region, (b) 9 km x 9 km - Western Electricity Coordinating Council (WECC) region, and (c) 3 km x 3 km - California region. Cal-Adapt presents research developed under California's climate change assessments, with Cal-Adapt 2.0 focusing on California's Fourth Climate Change Assessment, including datasets portraying sea level rise, wildfires, droughts, storms, and extreme heat events. Data sets can be accessed at <http://cal-adapt.org/data/>

Below is a timeline for the development of the Fifth Assessment:

### TIMELINE OF CALIFORNIA'S FIFTH CLIMATE CHANGE ASSESSMENT



## 2. Tools and Resources to Support Climate Action in California

California's Fourth Climate Change Assessment funded the development and enhancement of a set of six tools and resources to support climate action.<sup>20</sup> Weather data used in the assessments, including but not limited to, temperature and precipitation

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<sup>20</sup> The tools supported by the Fourth Climate Change Assessment are available at <http://www.climateassessment.ca.gov/tools/>. Another tool is Pyregence, an open source fire science tool that was developed as part of the CEC EPIC program. See <http://www.pyregence.org>.

have been made publicly available through Cal-Adapt and are available for the state's agencies to leverage to develop the state's demand and resource forecasts. As California works to produce the Fifth Climate Change Assessment, these tools will likely evolve substantially to offer a more comprehensive solution for the energy sector's highly technical and data-intensive needs.<sup>21</sup>

Cal-Adapt is a foundational resource of California's climate response, operating with the goal of making data portraying climate change in California more accessible and actionable for a broad audience, with an emphasis on energy sector stakeholders and local governments. Each tool in Cal-Adapt shows climate outcomes for two plausible greenhouse gas scenarios, including a high-emissions trajectory in which greenhouse gas emissions continue to rise over the twenty-first century ("RCP 8.5") and a lower-emissions trajectory in which the greenhouse gas emissions level off around the middle of the century and are lower than 1990 levels by the end of the century ("RCP 4.5").

The California Natural Resources Agency funded the development of the California Heat Assessment Tool for local and state health practitioners to better understand dimensions of heat vulnerability driven by climate changes and where action can be taken to mitigate the public health impacts of extreme heat in the future.<sup>22</sup> This tool looks at Heat Health Events, with each local area heat event categorized on specifics unique to its climate and the historical sensitivity of people in that area to past

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<sup>21</sup> The expanded Cal-Adapt enterprise will include: a powerful data platform and Cal-Adapt Analytics Engine, a revamped suite of web tools, analytical tools and computational resources for working with the next generation climate data, and a new Historical Observations data platform. See <http://cal-adapt.org/blog/expanded-caladapt-enterprise>.

<sup>22</sup> More information is available at <http://www.cal-heat.org/>.



heat events. In addition to frequency, the dataset also includes average maximum and minimum daily temperature and maximum and minimum daily relative humidity for the heat events. Projections in Cal-Heat reflect a subset of the Localized Constructed Analogs (LOCA) downscaled projections developed by the Scripps Institute, including the twenty-four models that provide daily minimum and maximum relative humidity in addition to daily minimum and maximum temperature, developed for both the business as usual scenario (RCP 8.5) and a moderate mitigation scenario (RCP 4.5).

The Fourth Climate Change Assessment funded an expansion of the United States Geological Survey (USGS) Coastal Storm Modeling System (CoSMoS), which makes detailed predictions of storm-induced coastal flooding, erosion, and cliff failures over large geographic scales.<sup>23</sup> CoSMoS models all the relevant physics of a coastal storm (*e.g.*, tides, waves, and storm surge), which are then scaled down to local flood projections for use in community-level coastal planning and decision-making.

Projections of multiple storm scenarios (daily conditions, annual storm, 20-year- and 100-year-return intervals) are provided under a suite of sea-level rise scenarios ranging from 0 to 2 meters (0 to 6.6 feet), along with an extreme 5-meter (16-foot) scenario.

The USGS Western Geographic Science Center Hazards Vulnerability Team creates and maintains estimates of community exposure to these hazards. They are available through the Hazard Exposure and Reporting Analytics (HERA) website.

The Adaptation Capability Advancement Toolkit (Adapt-CA) is designed to aid local governments in rapidly identifying opportunities to improve existing capabilities in

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<sup>23</sup> Information about the CoSMoS model and its capabilities is available at <http://www.usgs.gov/centers/pcmssc/science/coastal-storm-modeling-system-cosmos>.

order to pursue climate change adaptation initiatives more effectively and holistically.<sup>24</sup>

This toolkit has allowed numerous cities, counties, and other local governmental authorities in California to develop adaptation plans that follow an evolutionary path toward more advanced, institutionalized, and continuously improving capabilities.

The California Emergency Response Infrastructure Climate Vulnerability Tool (CERI-Climate) is a decision-support tool that helps evaluate the flood, wildfire, and climate change risks facing California's 600 critical response facilities.<sup>25</sup> An interactive natural hazard and critical infrastructure visualization tool, CERI-Climate is used by California's Office of Emergency Services and partner agencies to understand how this exposure might change over time due to climate change, and how vulnerable different types of state infrastructure are to disruption and damage from different types of hazards.

## **B. California's Climate Adaptation Strategy**

The state's Climate Change Assessments reflect the best available climate science, which, in turn, support development of the state's Climate Adaptation Strategy.<sup>26</sup> California is statutorily required to release an updated climate adaptation strategy every three years, with the next update scheduled for release in 2024.<sup>27</sup> The current California Climate Adaptation Strategy is organized around six outcome-based priorities: (a) strengthen protections for climate vulnerable communities; (b) bolster

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<sup>24</sup> Information about Adapt-CA and the associated resources are available at <http://arccacalifornia.org/adapt-ca/>.

<sup>25</sup> The CERI-Climate tool is available at [http://public.tableau.com/profile/rand4185#!/vizhome/CJ302-1000\\_CERI-Climate\\_20180625/Title](http://public.tableau.com/profile/rand4185#!/vizhome/CJ302-1000_CERI-Climate_20180625/Title).

<sup>26</sup> See California Assembly Bill 1482 (2015) (requiring a state climate adaptation strategy).

<sup>27</sup> Information about California's Climate Adaptation Strategy and the 2024 update is available at <http://climateresilience.ca.gov/>.

public health and safety to protect against increasing climate risks; (c) build a climate resilient economy; (d) accelerate nature-based climate solutions and strengthen climate resilience of natural systems; (e) make decisions based on the best-available climate science, and (f) partner and collaborate to leverage resources.<sup>28</sup>

The Climate Adaptation Strategy Implementation Report, published in 2023, reviews California’s work in line with the six priorities outlined in the Climate Adaptation Strategy.<sup>29</sup> One key success highlighted in the report is the CPUC’s decision to direct its regulated utilities to submit Climate Adaptation and Vulnerability Assessments (CAVAs), which is in line with the state’s strategy to make decisions based on the best available climate science.<sup>30</sup> As part of the CAVA analysis, California utilities are required to consider a range of variables, some of which extend beyond extreme weather, but generally include the use of forward-looking climate change projections of ambient conditions such as increasing temperatures, changes in precipitation patterns, and other extreme weather events such as wildfires.<sup>31</sup> CAVAs document climate vulnerabilities and realistic adaptation and mitigation solutions for the short, mid, and long-range planning cycles.

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<sup>28</sup> Information and detail on these priorities is set forth at <http://climateresilience.ca.gov/priorities/>.

<sup>29</sup> The strategy report is available at [http://climateresilience.ca.gov/overview/docs/20240405-Climate\\_Adpatation\\_Strategy\\_Report\\_2023.pdf](http://climateresilience.ca.gov/overview/docs/20240405-Climate_Adpatation_Strategy_Report_2023.pdf).

<sup>30</sup> *Id.* at 12-13.

<sup>31</sup> The CPUC initiated Rulemaking (R.) 18-04-019 to “address[] how energy utilities should plan and prepare for increased operational risks due to changing climate conditions and heightened risks from wildfires, extreme heat, extreme storms, drought, subsidence and sea level rise, among other climate change phenomena.” The CPUC maintains a landing page for their Climate Adaptation activities. See <http://www.cpuc.ca.gov/industries-and-topics/electrical-energy/climate-change>.

### **C. California’s Scoping Plan to Achieve Carbon Neutrality by 2045**

Adaptation and mitigation are two complementary strategies to respond to climate change. As discussed above, California’s adaptation strategies have focused on anticipating the adverse effects of climate change and taking action to prevent or minimize the identified hazard. California’s mitigation strategies seek to lessen the severity of climate change impacts by preventing or reducing the emission of greenhouse gases.

The California Air Resources Board (CARB) is the lead agency of the state’s Scoping Plan.<sup>32</sup> Under this Scoping Plan, decarbonizing the electricity sector is a crucial pillar, particularly as the Scoping Plan recognizes that the role of electricity in powering the economy will grow in almost every sector.<sup>33</sup> The CAISO’s planning and operational processes play a key role in supporting achievement of the Scoping Plan.<sup>34</sup>

### **D. California’s Clean Energy Reliability Investment Plan**

Pursuant to legislative direction, the California Energy Commission (CEC), in consultation with CARB and the CPUC, developed California’s Clean Energy Reliability Investment Plan (CERIP).<sup>35</sup> The CERIP, published in March 2023, takes into account the anticipated demand and supply needs for near- and mid-term reliability, in line with

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<sup>32</sup> The 2022 Scoping Plan for Achieving Carbon Neutrality lays out a path to achieve targets for carbon neutrality and reduce anthropogenic greenhouse gas emissions by 85 percent below 1990 levels no later than 2045, as directed by Assembly Bill 1279. The Scoping Plan is available at <http://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents>.

<sup>33</sup> See, e.g., 2022 Scoping Plan at 8 (describing the energy and technology transitions).

<sup>34</sup> *Id.* at 204-205.

<sup>35</sup> The CERIP, developed pursuant to California Senate Bill 846 (2022), is available at <http://www.energy.ca.gov/publications/2023/clean-energy-reliability-investment-plan>.

state emission reduction targets.<sup>36</sup> Acknowledging the complementary responsibilities of each of the CEC, CPUC, and the CAISO, the CERIP identifies four areas requiring improved planning processes: (1) improvements for demand forecast and reliability models to better assess different scenarios of weather variability and develop additional tools to improve the state's ability to account for climate change in planning; (2) improvements for resource adequacy planning and procurement to align with most up-to-date demand forecasts; (3) ensuring that transmission planning results in sufficient transmission to support new resources; and (4) enhancing community engagement and incorporating equity into the clean energy transition.<sup>37</sup> The CEC is coordinating with other agencies, including the CPUC, CARB, the Department of Water Resources (DWR), as well as the CAISO, to ensure alignment of CERIP with existing programs.

#### **E. California's Joint Reliability Planning Assessments**

In accordance with legislative directive, the CEC and CPUC have begun a quarterly publication of a joint-agency reliability planning assessment document.<sup>38</sup> The CEC developed an extensive overview of reliability as part of its 2022 Summer Stack Analysis, covering topics such as the impacts of drought, wildfire, and extreme heat events; resource adequacy; imports; and new project development.<sup>39</sup> Through this

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<sup>36</sup> *Id.*

<sup>37</sup> *Id.* at 7-8.

<sup>38</sup> The Joint Agency Reliability Planning Assessment addresses requirements for electric system reliability reporting, as required by Senate Bill 846 (2022). The Joint Reliability Planning Assessment, and the quarterly updates, are published by the CEC and are available at <http://www.energy.ca.gov/resources/all-publications>.

<sup>39</sup> The California Energy Commission's Stack Analysis Tool is used to identify the potential for a shortfall in planned resources and the amounts and duration of contingency resources that may be needed. More information is available at <http://www.energy.ca.gov/publications/2021/2022-summer-stack-analysis-update>.

extensive analysis and outreach, the CEC identified three critical challenges that are affecting the state’s reliability situation: planning, resource scaling, and extreme events. The Joint Reliability Planning Assessment examines the progress towards meeting the identified challenges. As the Joint Reliability Planning Assessments have confirmed, California’s energy system runs reliably without issue most of the time.<sup>40</sup> The state’s greatest energy reliability concerns are driven by a small number of hours during increasingly historic heat events when demand for electricity increases to unprecedented levels and available supply is constrained.<sup>41</sup> The assessment recommends that the CAISO, CEC, and CPUC develop a common approach to incorporate climate change into system planning, including consideration of a set of climate scenarios.<sup>42</sup> The CAISO coordinates regularly with the CEC and CPUC on enhancements to incorporate the state’s climate adaptation and mitigation into demand forecasts and supply-side models through joint agency meetings.

### **III. Required Report of the CAISO**

Order No. 897 requires the CAISO to file a one-time informational report describing its current or planned policies and processes for conducting extreme weather vulnerability assessments and mitigating identified extreme weather risks.<sup>43</sup> The Commission explained that the report should include explanations of “any analysis that identifies where and under what conditions jurisdictional transmission assets and

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<sup>40</sup> See, e.g., Joint Agency Reliability Planning Assessment at 7 (Feb. 2023).

<sup>41</sup> See, e.g., Joint Agency Reliability Planning Assessment, Third Quarter Report at 10-12 (Aug. 2023).

<sup>42</sup> See Joint Agency Reliability Planning Assessment at 59 (Feb. 2023).

<sup>43</sup> See Order No. 897 at P 1.

operations are at risk from the impacts of extreme weather events, how those risks will manifest themselves, and what the consequences will be for transmission system operations.”<sup>44</sup>

**Q1) As a threshold matter, state whether the transmission provider conducts extreme weather vulnerability assessments, and if so, how frequently it conducts those assessments.**

Yes, as a threshold matter, the CAISO conducts extreme weather vulnerability assessments on a periodic basis, with such assessments taken a variety of forms. In addition, the CAISO is participating in a new, three-year global research initiative established by the Electric Power Research Institute (EPRI) that is designed to create and provide grid operators, utilities, regulators and policymakers the most comprehensive framework available to help establish a more resilient power system as we continue to experience an increase in extreme weather events.<sup>45</sup> The Climate READi: Power initiative will facilitate analysis and application of appropriate climate data among all stakeholders to enhance the planning, design and operation of a resilient power system.<sup>46</sup> The CAISO looks forward to continuing collaboration with scientific researchers to develop an industry-accepted, risk-informed approach to physical climate risk assessment and resilience planning.

During recent summers, the CAISO system has experienced significant impact from climate change events, including fires and heat waves. In August 2020, extreme,

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<sup>44</sup> *Id.* at P 52.

<sup>45</sup> Additional detail on the CAISO’s collaboration in Climate READi is available at <http://www.caiso.com/about/Pages/Blog/Posts/CAISO-joins-cross-collaborative-initiative-to-strengthen-power-sectors-approach-to-climate-risks>.

<sup>46</sup> Additional information about the Climate READi initiative is available at <http://www.epri.com/research/sectors/readi>.

prolonged heat across much of the West led to the first rotating power outages in almost 20 years; the Bootleg Fire in July 2021 took out transmission pathways serving our grid, bringing the grid perilously close to rotating outages; and a 10-day heat wave in August and September of 2022 again created supply scarcity and a call for utilities to prepare for outages on the most challenging day of the event.<sup>47</sup> Through Joint Reliability Planning Assessments referenced above, the CEC and the CPUC perform quarterly assessments of supply and demand for the next 10 years under different risk scenarios, in consultation with the CAISO.<sup>48</sup> In addition, the CAISO undertakes a coordinated approach to plan for uncertainties, including extreme events through weather and demand forecasting, outage management, and operational look-ahead studies from seven days out through the operating day.<sup>49</sup> Our experience reveals that the combination of circumstances we cannot predict, like the location of wildfires, extreme heat, and resource outages, create residual risk for the grid.

Recognizing that grid reliability is a shared regional responsibility, the CAISO, along with the Reliability Coordinator (RC West), neighboring balancing areas, load-serving entities, and participants in the Western Energy Imbalance Market (WEIM),

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<sup>47</sup> In response to these events, the CAISO, along with the CEC and the CPUC, took actions to prepare for future events of similar magnitude. These steps included enhancing coordination before each summer, updating demand forecasts to account for climate change, ordering unprecedented amounts of procurement, and identifying additional contingency resources — both generation and demand reduction — that could come online in the event of another extreme event. See Joint Agency Reliability Planning Assessment at 10 (Feb. 2023).

<sup>48</sup> Further details on the Joint Reliability Planning Assessments is discussed *supra* Part II.E.

<sup>49</sup> The CAISO processes for operation of various emergency resources are detailed in the CAISO's Emergency Procedure 4420, which is afforded confidential treatment. The CAISO has developed a public summer playbook, which provides detail on CAISO timelines for operational coordination and communication channels for CAISO emergency notices, which trigger the use of various emergency resources. The publicly-available playbook is available at <http://www.caiso.com/Documents/SummerHeatEvent-ProcessandCommunications.pdf>.



participate in tabletop exercises in advance of summer to ensure effective communication and coordination during extreme weather events and emergencies.<sup>50</sup>

The CAISO also works closely with state officials to facilitate in-synch responses to extreme events as they occur.

The CAISO conducts numerous assessments to understand the impacts of extreme events on the planning and operation of the CAISO-controlled grid. These assessments have taken a variety of forms, but in general have focused on the following:

- **Seismic:** The CAISO's 2012-2013 Transmission Planning Process (TPP) undertook an extreme event assessment in the San Francisco Peninsula area. Given the high-density urban load, geographic and system configuration, potential risk of outages and challenging restoration times, the assessment identified an extreme event contingency that, if triggered, would result in potential impacts for the majority of San Francisco and the northern San Francisco Peninsula. The CAISO published the San Francisco Peninsula Extreme Event Reliability Assessment in 2013. Following this assessment, the CAISO adopted within the ISO Planning Standard section 7.0 related to extreme events and in particular 7.1, which recognizes the unique characteristics of the San Francisco Peninsula area requiring consideration of corrective action plans to mitigate the risk of extreme events.<sup>51</sup> The ISO Planning Standard also indicates the CAISO may consider other areas of the system on a case-by-case basis as a part of the transmission planning assessments. Like the risk of extreme weather events, the risk of an extreme seismic event that results in the contingencies to the electric system is arguably low, but the impacts of such events would be significant.

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<sup>50</sup> The CAISO hosted its third annual virtual Summer Readiness Leadership Roundtable in May 2023 to discuss the outlook for summer operations. Senior executives from more than 30 utilities and other entities in California and across the West met to outline the supply-and-demand picture and anticipated summer weather and grid conditions. The CAISO also conducted a summer readiness training in May 2023 for its market participants. See, e.g., <http://www.caiso.com/Documents/Presentation-Summer-Readiness-2023-Training-May25-2023.pdf>.

<sup>51</sup> The CAISO has established additional ISO Planning Standards that are beyond the requirements of NERC and WECC to support reliability at a level appropriate for the California system. <http://www.caiso.com/Documents/ISO-Planning-Standards-Effective-Feb22023.pdf>.

- Extreme heat:** The CAISO publishes an annual series of “Summer Loads and Resources Assessment” reports that analyze the system’s resilience under extreme operating conditions.<sup>52</sup> The 2023 Summer Assessment builds on the CAISO’s traditional probabilistic operational risk analysis, which considers the latest available information on annual conditions such as weather, supply and demand forecasts, and adds a focus on the year-over-year advances of new resource development and progress towards meeting resource planning targets.<sup>53</sup> The CAISO publishes the Summer Assessments each year and shares the results broadly with state regulatory agencies, industry participants, and stakeholders. The CAISO’s summer assessments have evolved considerably since they began. In these assessments, the CAISO recognizes the vulnerability that extreme weather events can present to the electricity grid and the importance of connecting new resources to the system, and discusses key actions and emergency programs intended to address extreme grid conditions. The CAISO’s Summer Assessments are one part of a broader collaborative effort the CAISO takes with its stakeholders to prepare for potential extreme weather events. The CAISO also performs additional seasonal and daily operational analyses to understand system impacts and plan to address the forecast for extreme conditions, including those arising from extreme weather.<sup>54</sup>
- Drought:** During drought years, the availability of hydroelectric generation production can be severely limited. The CAISO considers drought conditions hydroelectric generation projects supporting identified local capacity requirement areas in developing its base case assumptions for use in transmission planning and local resource adequacy technical analysis.<sup>55</sup> In the CAISO’s annual transmission planning process consideration of potential drought conditions are included in the dispatch of generation in the transmission planning assessments as reflected in section 2.7.4 of the 2022-2023 Transmission Planning Process Unified Planning Assumptions and Study Plan.<sup>56</sup>

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<sup>52</sup> The 2012 Summer Loads and Resources Assessment is available at [http://www.caiso.com/documents/briefing\\_summerloads\\_resourcesoperationspreparednessassessment-report-mar2012.pdf](http://www.caiso.com/documents/briefing_summerloads_resourcesoperationspreparednessassessment-report-mar2012.pdf).

<sup>53</sup> The 2023 Summer Loads and Resources Assessment is available at <http://www.caiso.com/Documents/2023-Summer-Loads-and-Resources-Assessment.pdf>.

<sup>54</sup> See, e.g., CAISO Operating Procedure 1210, § A.3.1.1 (providing for additional three day out results review).

<sup>55</sup> The CAISO’s 2022-2023 Transmission Planning Process United Planning Assumptions and Study Plan is available at <http://www.caiso.com/InitiativeDocuments/Final-Study-Plan-2023-2024-Transmission-Planning-Process.pdf>.

<sup>56</sup> *Id.* at Section 2.7.4 (explaining how drought conditions are considered for local capacity zones).

- **Wildfire:** As part of the 2020-2021 transmission planning process, the CAISO conducted studies to assess the impact of various Public Safety Power Shutoff (PSPS) scenarios in the Pacific Gas & Electric (PG&E) service territory.<sup>57</sup> The objective of this assessment was to identify load at risk and potential system reliability risks under various PSPS scenarios and to develop potential mitigations to alleviate impact of future PSPS events from a long-term planning perspective. This standalone study recognized that the analysis extends beyond the existing NERC, WECC and CAISO standards. The assessment did not identify a need for any new transmission upgrades nor performance deficiencies in most areas for plausible scenarios. The CAISO worked closely with PG&E to identify critical facilities that significantly reduce load loss when excluded from PSPS events.

The CAISO performed a similar analysis in the 2021-2022 transmission planning process to assess the impact of PSPS events in the Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) service territories and to update the PG&E assessment to reflect updates in the North Coast and North Bay local areas.<sup>58</sup> The CAISO did not identify any opportunities for transmission projects to mitigate the impacts of PSPS events but continued its collaborative work with the utilities to identify critical facilities as part of wildfire mitigation plans. The additional operational analysis the CAISO performs as the operating day approaches allows the CAISO to plan and prepare the means for reliable system operations during a wildfire event.<sup>59</sup>

- **Solar Eclipse:** With the increased amount of solar resources in the West, known extreme weather events can also pose reliability challenges. On August 31, 2023, the CAISO published its Solar Eclipse Technical Bulletin in preparation for the October 14, 2023 annular solar eclipse and detailed its expected impacts on generation and ramping.<sup>60</sup> This bulletin prepared the Western region for the event by detailing the expected impact of the solar eclipse, as well as the risks and possible measures to be taken by the CAISO, the WEIM, the Reliability Coordinator, and other balancing

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<sup>57</sup> The CAISO's 2020-2021 Transmission Plan is available at <http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=CB726A4E-F414-47B0-829D-A843AA1EB0A9>.

<sup>58</sup> The CAISO's 2021-2022 Transmission Plan is available at <http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=08F98ACE-2944-455A-A15C-0DBDF54C6670>.

<sup>59</sup> See, e.g., CAISO Operating Procedure 1210, § A.3.1.1 (providing for additional three day out results review).

<sup>60</sup> The eclipse bulletin is available at <http://www.caiso.com/Documents/Technical-Bulletin-October-Solar-Eclipse-Sep52023.pdf>. In addition to publishing the technical bulletin, the CAISO held two informational calls and published a series of FAQs. See <http://www.caiso.com/about/Pages/News/SolarEclipse/Default.aspx>.

authority areas (BAAs), as well as market participants and stakeholders, to address the loss of solar generation during the eclipse. The CAISO's Solar Eclipse Technical Bulletin details the CAISO's coordination with affected entities to ensure stable market operations to support reliable operations on the eclipse day.

#### **A. Scope**

- Q2) A description of the types of extreme weather events for which the transmission provider conducts, or plans to conduct, extreme weather vulnerability assessments, if any. For transmission providers that conduct, or plan to conduct, such assessments, a description of how the transmission provider determined which extreme weather hazards to include in the assessment (e.g., extreme storms such as hurricanes and the associated flooding and high winds, wildfires, extreme prolonged heat or cold, or drought conditions).**

As noted in response to the previous question, the CAISO conducts analysis for extreme events including seismic, heat, drought, wildfire, and solar eclipse. In selecting which extreme weather hazards to include in its analyses, the CAISO has relied on prior actual events as well as the science-based decision making at the state level originating from the analysis produced through California's Fourth Climate Change Assessment, discussed *supra* in Part II.A. In general, these assessments identify how increasing temperatures and changing precipitation patterns will alter the generation mix and load profile as weather patterns change and thus provide a projection into the types of climate hazards (e.g., wildfire, heatwave) for each of California's nine regions. The Fourth Climate Change Assessment concludes that adapting and mitigating the impacts of climate change will require a significant amount of new generation from carbon-free resources in order to meet the increased demands for cooling a warming climate and supporting the exponential load increases with the electrification of additional sectors (e.g., transportation and buildings). In short, significant amounts of new, diverse

generating capacity and the transmission upgrades to support reliable delivery are necessary to decarbonize California's economy across all seasons of the year.

The CAISO is planning and preparing accordingly. In recognition of the challenges ahead, through its 20-Year Transmission Outlook<sup>61</sup> and the 2022-2023 transmission planning process, the CAISO has coordinated with state agencies, load-serving entities and other key stakeholders to incorporate identified climate change adaptation and mitigation actions in the most cost-effective and efficient way possible.<sup>62</sup> The CAISO developed a 20-Year Transmission Outlook for the grid in collaboration with the CPUC and the CEC with the goal of exploring the longer-term grid requirements and options for meeting California's greenhouse gas reduction and renewable energy objectives reliably and cost-effectively. The objective of the 20-year outlook is to provide a long-term conceptual plan of the transmission grid in 20 years, meeting the resource and electric load needs aligned with state agency input on integrated load forecasting and resource planning, which themselves incorporate climate and weather data.

The 2022-2023 Transmission Plan is noteworthy for the new, more proactive approach it takes to better synchronize power and transmission planning, interconnection queuing and resource procurement to reflect California's climate adaptations and mitigations.<sup>63</sup> To reflect the new generation resources needed to

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<sup>61</sup> The 20-Year Transmission Outlook is available at <http://www.aiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf>.

<sup>62</sup> The 2022-2023 Transmission Plan received approval of the CAISO Board of Governors on May 18, 2023 and is available at <http://www.aiso.com/InitiativeDocuments/Revised-Draft-2022-2023-Transmission-Plan.pdf>.

<sup>63</sup> The CAISO entered into a Memorandum of Understanding ("MOU") with the state agencies regarding transmission and resource planning in December 2022, which is available at

serve increased demand, the CAISO relied on the CPUC's integrated resource portfolio planning efforts to identify resource portfolios for the 10-year planning horizon. The CAISO, the CEC, and parties to the CPUC's proceedings have all provided input in the development of those resource portfolios. To reflect the impact of changing weather patterns on load and generation, the CAISO relies on the CEC to develop demand forecasts prepared as part of the CEC's Integrated Energy Policy Report (IEPR) processes. These forecasts incorporate the impacts of electrification and the impacts of climate change.

The CAISO understands that the industry is now well into an inflection point marking a significant escalation in the rate of growth in renewable resources and renewable integration resources. To contextualize this increase, it is helpful to compare the recent resource plans. The CAISO's 2020-2021 transmission plan was based on state forecasts calling for approximately 1000 MW of additional generating capacity per year over the next 10 years. The following year, this forecast increased to a projection calling for adding 2700 MW of generating capacity per year. In the 2022-2023 plan, the ten-year projection calls for adding more than 4000 MW per year, with the portfolios for next year's plan identifying resource requirements of approximately 7000 MW per year.<sup>64</sup> The continuing growth in these numbers will, by next year, represent a sevenfold increase in annual requirements from the 2020-2021 transmission plan approved in March 2021.

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<http://www.aiso.com/Documents/ISO-CEC-and-CPUC-Memorandum-of-Understanding-Dec-2022.pdf> ("Planning MOU").

<sup>64</sup> CAISO Stakeholder Presentation at Slide 11, at <http://www.aiso.com/InitiativeDocuments/Day2Presentation-2022-2023TransmissionPlanningProcessSep27-28-2021.pdf>.

The increase of resource projection arises, in large part, by the increased electrification occurring in other sectors of the economy, most notably in transportation and the building industry. The CAISO relies on the CEC to provide it with load forecasts and load modifier forecasts that are prepared as part of the CEC's Integrated Energy Policy Report (IEPR) processes. The rapid deployment of behind-the-meter rooftop generation in particular has driven changes in forecasting, planning and operating frameworks for both the transmission system and generation fleet. Further developments related to load electrification due to fuel switching and electric vehicle deployment have also led to a significant increase in energy and demand forecasts starting in the year 2028 and beyond. The combined effect of changing customer load patterns and evolving load modifiers is particularly important and has driven the need for far more attention not only on peak loads and total energy consumption, but also on the shape of the aggregate customer load on an hourly, daily, and seasonal basis.

The CAISO's 2022-2023 transmission plan is a transitional step, recognizing the CAISO and industry at-large are not yet positioned within this single planning cycle to address the full impact of the pivot to these new challenges. The path to total decarbonization of the grid entails greater volumes of solar photovoltaic resources and battery storage, as well as greater diversity beyond the current focus on those resource types. Geothermal resources, new out-of-state renewable resources and offshore resources are all expected to play greater roles. This will create unique challenges in planning and operations and meeting those challenges requires adaptations and enhancements to existing processes and efforts to ensure reliability in normal system operations and resilience against extreme events. The CAISO is actively engaged with

its regional, state, and local partners to adapt to the effects of climate change and to plan and prepare system operations that can withstand, to the greatest extent possible, the increasing threat of extreme events including extreme weather events.

**Q3) A description of how the transmission provider defines an extreme weather event for the purposes of its extreme weather vulnerability assessment, including what thresholds it uses relative to historical measurements or probabilities of occurrence, if applicable.**

The CAISO does not have a formalized structure by which it defines an extreme weather event for purposes of performing additional extreme weather vulnerability analyses.

Above, the CAISO discussed how it plans for extreme weather events. From an operational perspective, the CAISO approaches the extreme weather challenges through a resilience lens. At an operational level, the CAISO's view of an "extreme" weather event is shaped by the impact the weather will have on resources, loads, and transmission lines. The CAISO's forecasting team, composed of trained meteorologists, generates and broadcasts alerts in the event of extreme weather conditions to assist system operators in assessing uncertainty and risk to transmission and supply. The alerts generated by the forecasting team include alerts for extreme weather events including, but not limited to, extreme heat, extreme cold, and heavy rain. They augment the CAISO's continuously updated seven-day outlook that projects the current and forecasted capacity (including renewable capacity), demand, and reserves.<sup>65</sup>

The CAISO's solar eclipse analysis demonstrates how the CAISO attempts to assess and manage an extreme weather-related event. Solar eclipses are predictable,

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<sup>65</sup> The CAISO's seven-day outlook is made available at <https://www.caiso.com/TodaysOutlook/Pages/default.aspx>.



but their impact can be extreme when there is a significant amount of weather-dependent generation (e.g., solar) supporting the loads on the system. As discussed in response to Question 1, the CAISO performed analysis and released a technical bulletin to prepare for the October 14, 2023 annular solar eclipse over the western United States including California, Oregon, Nevada, Utah, Arizona, Colorado and New Mexico.<sup>66</sup> As the bulletin details, the effects of the extreme weather event presented from approximately 8:05 a.m. to 10:57 a.m. while the sun was 89% obscured in Northern California spanning to 68% along the Southern California coast. This reduction in solar radiation directly affected the output of solar generating facilities, including behind-the-meter rooftop solar, as well as load, within the CAISO and within the WEIM. Given the widespread and significant impact of the eclipse, the CAISO conducted stakeholder outreach, held informational meetings, and published the technical bulletin in order to provide a clear plan of coordinated action to ensure the continued reliable operation of the grid during this extreme weather event.

The CAISO's summer assessments are another example of the CAISO's work to assess how extreme weather events can affect operations and to manage their impact. The Summer Assessments analyze the expected summer supply and demand conditions to understand the sufficiency of the resource fleet and whether it is likely to meet summer peak loads at the time of highest system stress, considering necessary operating reserve margins. The Summer Assessments review how system resources,

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<sup>66</sup> The record of the CAISO's discussions and materials for the 2023 annular solar eclipse is available at [http://www.caiso.com/about/Pages/News/SolarEclipse/Default.aspx#:~:text=On%20Saturday%2C%20Oct%2014%202023,Energy%20Imbalance%20Market%20\(WEIM\).](http://www.caiso.com/about/Pages/News/SolarEclipse/Default.aspx#:~:text=On%20Saturday%2C%20Oct%2014%202023,Energy%20Imbalance%20Market%20(WEIM).)

working together with emergency resources, can support reliability if a California balancing authority, such as the CAISO, declares an emergency the most likely of which is caused by extreme heat. Other routine preparatory activities include coordinating meetings on summer preparedness with the Western Electricity Coordinating Council (WECC), California Department of Forestry and Fire Protection (Cal Fire), natural gas providers, utilities, transmission operators, and neighboring balancing areas to, among other things, identify any potential extreme weather events. Where extreme weather events are identified, such as heat waves and wildfires, the CAISO performs operational analysis to determine any real-time operational actions that can mitigate the impacts of the extreme event. The CAISO's close coordination with the load serving entities in real-time to manage the impact of their public-safety and fire-hazard prevention plans is one example of this work.

The CAISO outlined the scope of extreme weather events in its Root Cause Analysis of the Mid-August 2020 Extreme Heat Wave, which examined both the August and September extreme heat events.<sup>67</sup> Taking into account 35 years of weather data, the extreme heat wave experienced in August was a 1-in-30 year weather event in California. The September heat wave event was roughly a 1-in-70 event for that month. During this period, California experienced four out of the five hottest August days since the CEC began tracking these data in 1985, as measured by the daily average temperature composite used to predict electricity consumption across the CAISO region. The only other period on record with a similar heat wave was July 21–25, 2006,

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<sup>67</sup> The Root Cause Analysis prepared by the CAISO, CPUC, and CEC is available at <http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf>.

which included three days above the highest temperature in August 2020. Between August 14 and August 19, 2020, the entire western United States experienced an extreme heat wave. In total, 80 million people fell within an excess heat watch or warning from the National Weather Service. These factors supported defining the scope as an extreme heat event.

The observed frequency, intensity, and duration of some extreme weather events have been changing as the climate system has warmed. Climate models simulate the changes in extreme weather events, but the extent to which climate change influences an individual extreme event is more difficult to determine. Advances in climate science and modeling methods may lead to better estimates in how much climate change affects the frequency or intensity of an individual event. Through collaborative efforts, the CAISO intends to continue working with its partners in the West to understand the regional risks of climate change and, to the extent necessary, expand its consideration of extreme weather events.

**Q4) A description of how the transmission provider selects, or plans to select, the set of assets and operations that will be examined.**

The CAISO selects the set of assets and operations by assessing the potential impact of extreme events on such assets. As explained above, the seismic risk in the San Francisco Peninsula Area supported examining those assets within the local area. In contrast, the annular solar eclipse impacted large areas of the Western United States and the impact analysis reflected area-wide assets and operations.

With respect to long-range planning, the CAISO includes all impacted assets and operations within its analysis. As explained in response to Question 2, the CAISO's new long-range planning process relies on input from California state agencies. State

agencies continue to enhance methodologies for incorporating impacts of climate change and extreme weather into forecasting and planning processes, in consultation with the CAISO. These inputs inform planning for all assets and operations. As explained *infra*, both the ten-year transmission plan and the 20-Year Transmission Outlook provide a set of assumptions and planning standards that identify the set of assets and operations that will be examined.

The CAISO also conducts additional extreme event assessments on an as-needed basis. These extreme event analyses take the form of additional studies within the transmission planning process when specific concerns are identified in the course of the development of the each year's study plan. For example, in 2020 stakeholders strongly supported the CAISO conducting additional planning analysis centered on the wildfire mitigation plans of the state's investor-owned utilities. The CAISO conducted such additional analysis in the course of the 2020-2021 transmission planning process and analyzed PG&E's wildfire mitigation plans. Based on an identified need and with stakeholder support, the CAISO conducted a similar analysis the following year to analyze the wildfire mitigation plans of additional investor-owned utilities. These additional case-by-case studies allowed the CAISO to develop scenarios to study by isolating the transmission lines that transmission owners could de-energize under a set of circumstances. The CAISO prepared a fire threat map that overlaid fire threat zones and the transmission system and identified the specific transmission lines that pass through these fire threat areas. The CAISO assessed scenarios by performing simulations that de-energized combinations of different voltage facilities and/or facilities within various levels of fire threat zones. Once scenarios were developed, the CAISO

was able to perform reliability assessments of the scenarios to identify whether transmission upgrades could mitigate the impact of the de-energized lines. If the need for future case-by-case analysis arises, whether related to wildfires or other extreme events, the CAISO's annual transmission study plan development process provides a mechanism for the CAISO to conduct additional analysis.

**Q5) A description of whether and to what extent the transmission provider considers, or plans to consider, external interdependencies, such as interconnected utilities, other critical infrastructure sectors (e.g., water, telecommunications) and supply chain-related vulnerabilities, in the assessment.**

The work of the CPUC and the CEC, in turn, reflects close coordination with CARB as the lead agency for California's Scoping Plan to Achieve Carbon Neutrality by 2045. As discussed above in Section II.C, the Scoping Plan put forward a pathway that considers multiple interdependencies, including but not limited to, interconnected utilities, other critical infrastructure sectors, and supply chain-related vulnerabilities.

The CAISO also undertakes coordination with natural gas pipeline operators, as natural gas-fired resources remain critical to balance weather-dependent generation and imports while maintaining system reliability. Given the interdependency of the natural gas markets and delivery systems that support electric generation, the CAISO has invested substantial resources in coordinated activities to improve grid reliability. This has resulted in coordinated efforts for outage planning, demand forecasting, daily electric generation gas burn reporting, situational awareness, emergency procedures, the creation of natural gas generation operational zones, and gas curtailment rules.

**Q6) A description of whether and to what extent the transmission provider coordinates, or plans to coordinate, with neighboring utilities and/or entities in other sectors that could potentially be relevant to the assessment.**

In addition to its inter-regional coordination obligations under Order No. 1000 and other Commission directives supporting regional and interregional coordination and planning, the CAISO also coordinates closely with the state's energy regulatory authorities to address extreme weather vulnerabilities. As discussed above in Section II.E, the CAISO is working closely with the CEC and the CPUC through California's Joint Reliability Planning Assessment to determine if there is a common approach to incorporating climate change into system planning, including a set of climate scenarios to be considered. The CAISO also works closely with its participating transmission owners to understand climate adaptation or mitigation plans including, but not limited to, those included within the CAVA reports that the CPUC will approve for each of SCE, PG&E, and SDG&E.

With respect to adjacent and neighboring balancing authorities across the Western Interconnection, the CAISO actively engages with those entities in various industry forums and dialogs. The increased frequency of extreme weather events is likely to spur deeper conversations among utilities and their regulators throughout the Western United States about how best to coordinate planning efforts to mitigate the impacts of these events. As a result, the CAISO expects it will need to refresh assumptions on a regular basis and continue to assess how best to coordinate within new paradigms.

- Q7) A description of whether and to what extent the transmission provider engages, or plans to engage, with stakeholders in the scoping phase of the assessment, including the processes used to identify and engage relevant stakeholder groups and incorporate stakeholder feedback into the extreme weather vulnerability assessment, including all affected communities.**

The CAISO's annual transmission planning process is an open and transparent process with considerable stakeholder engagement, including the development of the study plan that may include various scenarios for each planning cycle. The CAISO's processes rely heavily on stakeholder input at all stages, from scoping the study plan to performing any vulnerability assessments. Any stakeholder may participate in the CAISO's stakeholder processes, including affected communities.

#### **B. Inputs**

- Q8) A description of methods and processes the transmission provider uses, or plans to use, to determine the meteorological data needed for its assessment. In particular, how the transmission provider determines whether it can rely on existing extreme weather projections, and if so, whether such projections are adequately robust.**

As discussed above in Section II.A, the State of California has evaluated the relevant climate models and has selected the models most appropriate for California. The Fourth Climate Change Assessment reviewed the methods by which the models were downscaled to allow for the development of regional analyses. The state's primary energy planning and regulatory entities, in turn, reflect the appropriate meteorological data sets through the CEC demand forecast and the CPUC assessment of resource needs. These are inputs into the CAISO's annual transmission planning process and reflected in the most recent 2022-2023 transmission plan.

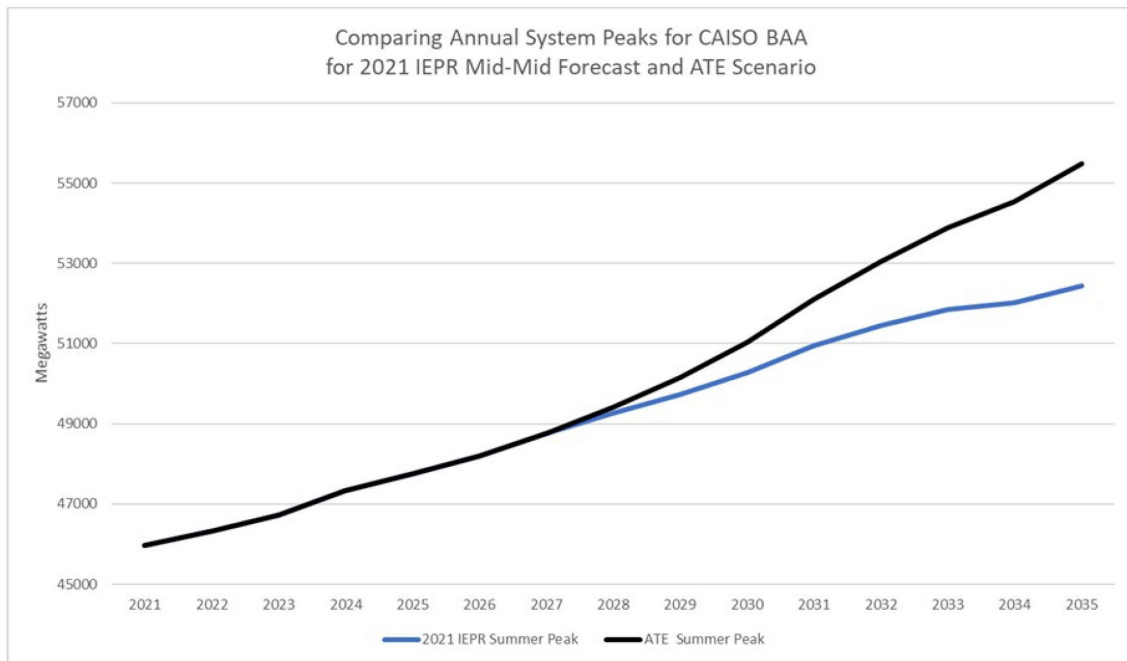
Broadly speaking, California has established a long-term resource planning process, known as the Integrated Resource Planning (IRP) process. Under IRP, the

CPUC models what portfolio of electric resources are needed to meet California's Greenhouse Gas (GHG) reduction goals while maintaining reliability at the lowest reasonable costs in the three- to ten-year time horizons. The CPUC then approves plans of the jurisdictional LSEs to procure resources to meet those needs. In the most recent ten-year transmission planning process, the CPUC provided the CAISO a base case and sensitivity portfolio reflective of climate adaptation and mitigation. The base case, provided for reliability and policy-driven study, meets the 46 million metric ton GHG emissions target by 2032. In transferring the sensitivity portfolio, the CPUC called on the CAISO to (1) study a 30 million metric ton High Electrification policy-driven sensitivity portfolio and (2) continue studying the deliverability needs and corresponding transmission needs related to out-of-CAISO long-lead time resources, such as out-of-state wind and geothermal resources beyond the CAISO's balancing area authority. These portfolios also took into account the announced retirements of approximately 3,700 MW of gas-fired generation to comply with state requirements for thermal generation relying on coastal water for once-through cooling, and the announced retirement of the Diablo Canyon nuclear power plant. For the 2022-2023 transmission plan, the base resource portfolio provided to the CAISO projects that California needs to add more than 40 gigawatts (GW) of new resources over the next 10 years, and a sensitivity study reflects the potential for increased electrification in other sectors of the economy and projects 70 GW by 2032.

The CEC develops and adopts long-term electricity and natural gas demand forecasts every two years as part of the IEPR process. The CEC develops and adopts new forecasts in odd-numbered years, with updates in the intervening years. The



various IEPR workshops conducted throughout each year provide a forum for public presentation and discussion of the inputs, assumptions and methods used to develop these forecasts. On July 1, 2022, the CEC and the CPUC submitted a letter to the CAISO requesting it use in this year's Transmission Plan the 2021 IEPR Additional Transportation Electrification scenario developed by the CEC, which has higher loads than the 2021 IEPR forecast the ISO had originally planned to use. The CAISO included the 2021 IEPR Additional Transportation Electrification scenario in its 2022-2023 transmission plan, depicted by the black line in the figure below.



The CPUC's portfolio, as well as the CEC's forecasts, are consistent with California's Scoping Plan to Achieve Carbon Neutrality by 2045, as discussed in Section

II.C. The CPUC.<sup>68</sup> and CEC.<sup>69</sup> continue to enhance methodologies to incorporate the impacts of climate change and extreme weather into demand forecasting and resource planning used in CAISO transmission planning processes.

**Q9) A description of how the transmission provider determines whether to use scenario analysis, and if so, whether to do so with multiple scenarios.**

As discussed above in response to Questions 1 and 4, when the CAISO performed the wildfire mitigation assessment as part of the 2020-2021 Transmission Planning Process it developed multiple scenarios to evaluate the impact of de-energizing some, all, or a combination of the transmission lines in the various fire zones within the PG&E area. Scenario development was a critical part of the assessment, as the range of scenarios selected needs to represent a reasonable set of boundary conditions based on a fact-based framework. The scenarios also need to be feasible and the number of scenarios under consideration needs to be manageable within the study timeline. The 2020-2021 wildfire assessment developed five scenarios for each planning area.

When the CAISO performed the assessment for a potential seismic event discussed above in response to Question 1, the CAISO likewise developed a series of

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<sup>68</sup> See, e.g., CPUC Energy Division Presentation on Climate-Informed Forecasting for Integrated Resource Planning, Slides 31-47, available at <http://www.cpuc.ca.gov/-/media/cpuc-website/industries-and-topics/meeting-documents/climate-adaptation/20231002-slide-deckclimate-adaptation-phase-ii-workshop.pdf>.

<sup>69</sup> The CEC's Climate Data and Analysis Working Group (C-DAWG) is a forum for technical discussion regarding issues at the nexus of climate change and California's energy system. It informs planning and execution of applied research that supports development of climate projections, wildfire and hydrologic scenarios, quality-controlled historical weather data, and analyses that contribute to a resilient transition to a 100% clean energy system. More information is available at <http://www.energy.ca.gov/programs-and-topics/topics/research-and-development/climate-data-and-analysis-working-group-c-dawg>.

scenarios to understand the risks and potential adaptations for the San Francisco Peninsula system in order to determine the potential impact of an extreme event and to identify any necessary mitigation. This assessment looked at the likelihood that an event affects various types of facilities on the San Francisco Peninsula, as well as the duration of service outages resulting from such an event. The CAISO developed a set of scenarios to assess should a seismic event occur in the area, including co-located facility failures and third party actions, assessed the alternatives to mitigate the reliability concerns identified, and finalized a mitigation plan.

**Q10) The extent to which it reviews neighboring transmission providers' extreme weather vulnerability assessments, if available, to evaluate the consistency of extreme weather projections between transmission providers. Further, for RTOs/ISOs, a description of how it accounts for differences between transmission owner members' extreme weather vulnerability assessment assumptions and results.**

As part of its regional coordination efforts, the CAISO maintains close communication with all of its neighboring transmission providers. If made available, the CAISO would review any neighboring transmission providers' extreme weather vulnerability assessments to evaluate consistency of extreme weather projections. The CAISO and neighboring transmission providers coordinate through the WEIM as well as through RC West. This coordination includes meetings in advance of the summer season. In addition, the recently approved WEIM Assistance Energy Transfer product allows for additional optimization of resources, if enabled, when a balancing area is experiencing an extreme event.

As discussed above in Section II.B, the CPUC has directed each of SCE, PG&E, and SDG&E to submit vulnerability assessments for approval. While this process has only begun, the CAISO anticipates that the CPUC will account for differences between

transmission owner members' vulnerability assessments in a manner that allows the CAISO to reflect the necessary outcomes in the applicable planning cycle.

**Q11) The timeframe(s) and discount rate(s) selected for the extreme weather vulnerability assessment**

As discussed above, the CAISO undertakes extreme event assessments, in various forms. For example, the CAISO's annual Summer Assessments focus on the near-term while the CAISO's 20-Year Transmission Plan focuses on the longer-term. The CAISO does not utilize discount rates in its assessments.

**Q12) A description of the methods and processes the transmission provider uses, or plans to use, to create an inventory of potentially vulnerable assets and operations**

Each of the CAISO's extreme event assessments includes a description of the methods and processes the CAISO uses to plan and prepare for extreme events and the methods and processes the CAISO uses to mitigate any identified impacts. The CAISO does not have a separate description of the methods and processes it uses to create an inventory of potentially vulnerable assets and operations.

**C. Vulnerabilities and Exposure to Extreme Weather Hazards**

**Q13) A description of how the transmission provider identifies the transmission assets or operations vulnerable to the extreme weather events for which it conducts assessments.**

The CAISO works with state energy agencies, its participating transmission owners, and other stakeholders to identify any transmission assets or operations vulnerable to extreme weather events that require assessment and additional study

within its long-range planning processes. The seismic and wildfire assessments, discussed above, are two such examples.

In addition, each Summer Assessment examines weather, supply, and demand to assess grid vulnerabilities.<sup>70</sup> As the 2023 Summer Assessment reported, the CAISO's assessment of resource development demonstrates sound progress towards meeting the conventional "one day every 10 years" ("1-in-10") loss of load events target.<sup>71</sup> The 2023 Summer Assessment also reports the results of CAISO's deterministic assessment of the sufficiency of the resource fleet to meet summer peak loads at the time of highest system stress, considering necessary reserve margins. This resource stack analysis of the fleet expected online at the time the system is most stressed provides insight regarding resource development. Finally, the 2023 Summer Assessment provides a more detailed comprehensive probabilistic analysis focusing on the summer months to assess operational risks. This analysis is based on year-over-year comparisons. Based on conditions at the time of the assessment, including hydro conditions, the analysis demonstrated an expected increase in reliability with the addition of new resources including energy storage and improved hydro conditions with the residual risk concentrated more narrowly in the early evening hours after the solar output drops off. The 2023 Summer Assessment also identifies emergency programs

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<sup>70</sup> The CAISO maintains a landing page dedicated to providing easy access to reports, news releases, briefings, and initiatives related to grid operations in the summer of 2022 – including challenges, solutions, and areas for improvement. See <http://www.aiso.com/about/Pages/News/2022-Summer-Readiness.aspx>.

<sup>71</sup> The 2023 Summer Loads and Resources Assessment is available at <http://www.aiso.com/Documents/2023-Summer-Loads-and-Resources-Assessment.pdf>.

and actions that can be taken to provide grid support during extreme events. The CAISO will perform a similar analysis in advance of future summer seasons.

**Q14) A description of how the transmission provider uses, or plans to use, screening analyses to test for potential vulnerabilities, as well as how the transmission provider examines, or plans to examine, the sensitivities of the transmission assets and operations being studied to types and magnitudes of extreme weather events.**

The CAISO examines sensitivities associated with planning transmission assets and operations in accordance with the Unified Planning Assumptions and Study Plan published annually as part of the transmission planning process. The CAISO's Planning Standards allow for case-by-case assessments of extreme weather events based on a need to study those events.

#### **D. Cost of Impacts**

**Q15) A description of the methodology or process, if any, the transmission provider uses, or plans to use, to estimate the potential costs of extreme weather impacts on identified vulnerable assets and operations.**

The CAISO has not adopted a specific methodology or process to estimate the potential costs of extreme weather impacts on identified assets or operations. Estimates of the potential costs of extreme weather impacts together with the methodologies used to compute such estimates are published by California state entities,<sup>72</sup> as discussed above in Sections II, and where applicable, by the CAISO through its long-range planning processes.<sup>73</sup>

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<sup>72</sup> Recent years have seen an increasing number of energy sector bankruptcies associated with high-cost climate disasters, including PG&E's bankruptcy after the 2018 Camp Fire in Northern California.

<sup>73</sup> See, e.g., 2021-2022 Transmission Plan (identifying the projects that were most cost-effective to meet the needs of the area after considering all relevant factors, including extreme weather events).

**Q16) If the transmission provider estimates such potential costs, a description of the types of: (a) direct costs, such as replacements or repair costs, restoration costs, associated labor costs, or opportunity costs of lost sales, and (b) indirect costs, such as costs associated with loss of service to electric customers and other utilities that purchase power from the transmission provider, including equipment damage, spoilage, and health and safety effects, in calculating the costs of extreme weather impacts.**

See response to Question 15.

### **E. Risk Mitigation**

**Q17) A description of how the transmission provider uses, or plans to use, the results of its assessment to develop measures to mitigate extreme weather risks, including:**

- i. How the transmission provider determines which risks should be mitigated and the appropriate time horizon for mitigation;**
- ii. How the transmission provider determines appropriate extreme weather risk mitigation measures, including any analyses used to determine the lowest-cost or most impactful portfolio of measures.**

As explained above, the CAISO performs a variety of extreme event analysis, including extreme weather assessments, to understand the impact of extreme weather events on resources, loads, and transmission lines. The CAISO works in close coordination and collaboration with California state agencies, as discussed in Part II, to assess the lowest-cost and most-impactful portfolio of measures for climate adaptation and mitigation. As the most-recent ten-year transmission plan demonstrates, the CAISO identified a methodology for reflecting the state's climate adaptation and mitigation actions in its long-range planning efforts, where the CAISO also assesses extreme events such as drought. The CAISO's summer assessments identify near-term reliability risks due to summer heat conditions and document how the CAISO will

mitigate such risks during the summer season.<sup>74</sup> The CAISO's wildfire assessments, and coordination with relevant partners during wildfire events, including participating transmission owners and Cal Fire, reflect the steps it takes to mitigate the impact of wildfires.

**Q18) A description of how the transmission provider informs, or plans to inform, relevant stakeholders—such as neighboring transmission providers, RTOs/ISOs of which the transmission provider is a member, electric customers, all affected communities, emergency management agencies, local and state administrations, and state utility regulators—of identified extreme weather risks and selected mitigation measures.**

The CAISO has devoted substantial efforts to ensure communications of extreme weather risks and mitigation measures are communicated effectively. CAISO Operating Procedure 4420 sets forth a detailed procedure, including an order of steps and specific communications and alerts. In addition, the CAISO monitors its demand forecast seven days out, and continuously assesses resource adequacy, system conditions, weather, and other potential grid impacts, and plans for next possible steps. The CAISO has taken steps to make information about forecasted extreme weather or actual events available on its website. The CAISO actively promotes awareness through traditional and social media channels as well as in coordination with utilities and state agencies, including through the California Governor's Office of Emergency Services. For example, the CAISO has established a robust communications and coordination plan to

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<sup>74</sup> See e.g., CAISO 2023-Summer Loads and Resources Assessment, available at: <https://www.caiso.com/Documents/2023-Summer-Loads-and-Resources-Assessment.pdf>.



prepare for summer heat events as detailed in CAISO's emergency playbook.<sup>75</sup> To prepare entities for possible conservation efforts and free up additional supply, the CAISO may initiate communications with multiple entities, including market participants, neighboring balancing authorities, federal, state and local officials and members of the public.<sup>76</sup>

**Q19) A description of the extent to which the transmission provider incorporates, or plans to incorporate, identified extreme weather risks and mitigation measures into local and regional transmission planning processes.**

The CAISO has incorporated extreme weather risks and mitigation measures into its transmission planning processes, as explained in response to Question 2.

**Q20) A description of how the transmission provider measures, or plans to measure, the progress and success of extreme weather risk mitigation measures (e.g., through reduced outages) and how it incorporates these observations into ongoing and future extreme weather risk mitigation actions.**

The CAISO has not adopted specific metrics to measure the progress and success of extreme weather risk mitigation measures. As the Commission's question suggests, monitoring generator and transmission de-rates and outages that occur in connection with an extreme weather event may be one data point that the CAISO can incorporate into future planning efforts. Other data points may include the occurrence,

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<sup>75</sup> The CAISO maintains a list of potential actions in the event of an extreme heat event. See <http://www.caiso.com/Documents/SummerHeatEvent-ProcessandCommunications.pdf>.

<sup>76</sup> In the context of transmission and operations planning, the CAISO must treat certain information as confidential and, where relevant, CEII, and in some situations the CAISO does not publicly disclose specific operational steps it would take to mitigate impacts of an extreme event given the system security of such plans.

duration, frequency and severity of Energy Emergency Alerts, the availability of weather-dependent sources of supply during the extreme weather event, available import supply from other balancing authorities, and expected performance of demand-side management and conservation in response to extreme weather events.

Respectfully submitted,

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October 25, 2023

## CERTIFICATE OF SERVICE

I certify that I have served the foregoing document upon the parties listed on the official service list in the captioned proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California this 25th day of October, 2023.

/s/ Martha Sedgley  
Martha Sedgley