BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Modernize the Electrical Grid for a High Distributed Energy Resources Future.	Rulemaking 21-06-017

ELEXSYS ENERGY USA INC. OPENING COMMENTS IN RESPONSE TO ORDER INSTITUITNG RULEMAKING TO MODERNIZE THE ELECTRIC GRID FOR A HIGH DISTRIBUTED ENERGY RESOURCES FUTURE

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I. INTRODUCTION

Pursuant to Rule 6.2 of the Rules of Practice and Procedure of the California Public Utilities Commission ("Commission"), eleXsys Energy respectfully submits these opening comments in response to Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources ("DER") Future, issued at the Commission on June 24, 2021.

A high Distributed Energy Resource future requires a 100% two-way electricity grid, allowing energy to travel in all directions, from many different sources, always finding the most efficient path from generation to load source.

This two-way grid poses physics challenges that grid engineers have long struggled to overcome with cost-effective solutions:

- Generation exported onto the distribution network causes voltage level rise, forcing network operators to curtail the amount of export or to complete expensive distribution grid upgrades to contain voltage within statutory limits.
- Reverse power flows upset the voltage grading of the one-way network, as the existing distribution grid has been designed to boost or buck the voltage to maintain statutory limits under high-load and low-load conditions. This voltage grading traditionally takes the form of transformer tap changers to manage voltage levels on the one-way network.
- Concern of identification, location, and isolation of network faults. Most DER generation is currently limited to its output rating plus 10%, and will continue to feed rated current even when there is a fault on the distribution network, provided the voltage doesn't collapse. So, in cases where high-impedance faults occur and the voltage doesn't collapse, DER generation will continue to feed the fault.

eleXsys Energy commends the CPUC for opening discussions on modernizing the electric grid for a high distributed energy resource future. We appreciate that this OIR attempts not to set policy on the overall number of DERs but rather on preparing the grid to capture as much value as possible in a high DER future, identify new technological solutions, and mitigate unintended negative impacts.

This comment intends to enlighten California policy makers, stakeholders, and the IOUs of our valuable experiences developing innovative solutions for enabling high saturations of DER throughout the world, detailing the widespread issues that have arisen in Australia and will surely continue to rise in California. We will also introduce our transcendent, AI-driven eleXsys device, capable of creating the world's first 100% two-way distribution grid and thereby making it possible to cost-effectively capture the full value of distributed energy resources, enabling a future grid powered by high saturations of distributed energy and allowing for global decarbonization through the Electrification of Everything.

II. DESCRIPTION OF PARTY

eleXsys Energy is a globally recognized thought leader in the distributed renewables space, understanding first-hand the challenges imposed on electricity networks globally as high saturations of distributed energy are interconnected. Founded in Australia, which maintains the highest installed solar PV capacity per capita in the world, our eleXsys Energy team of 60+ staff including 10 PhDs and over 300 years in utility engineering experience is focused on developing innovative solutions that unlock the complete value of DER while enabling the quick and cost-effectively decarbonization of electricity networks globally.

As a power electronics technology & engineering company, eleXsys Energy is solving the global barriers to Distributed Energy Resource use to achieve global decarbonization. From solar generation connection, network integration to service delivery and maintenance, our team has a deep history in utility management and research. With established offices in Australia, APAC, UK, and North America, our eleXsys technology has a global reach and the capabilities to deliver.

III. COMMENTS

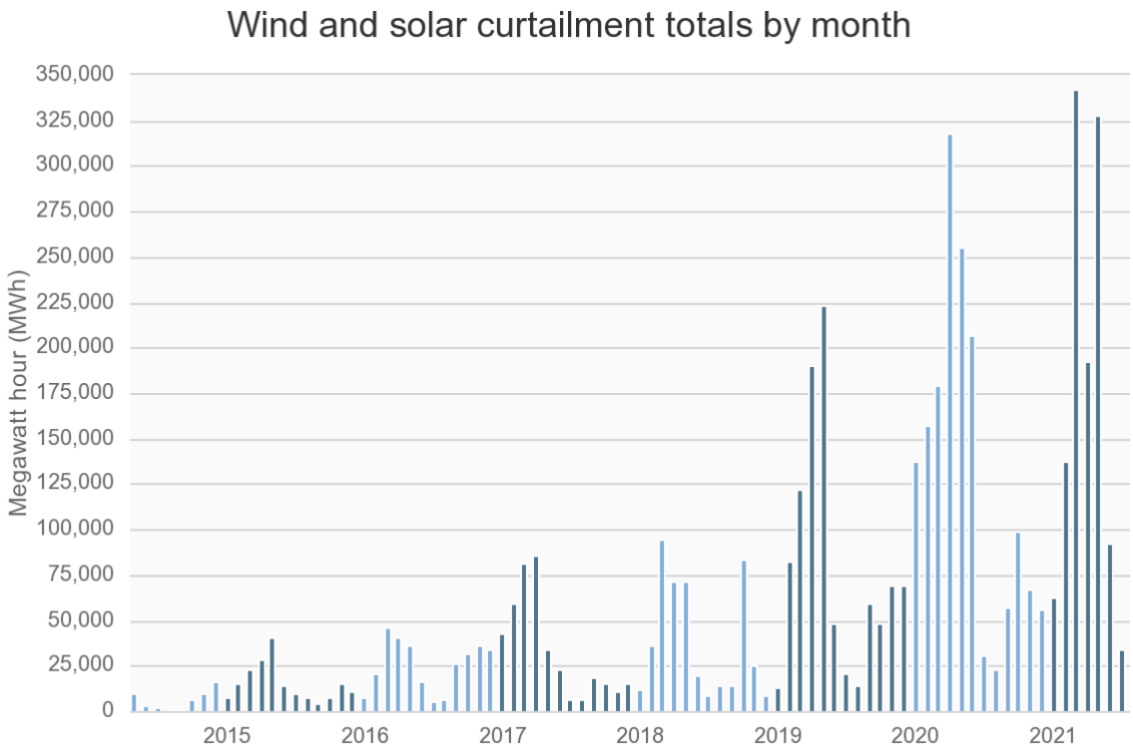
A) Australia's Grid is where California's will be in 5 years or less — there is a lot that can be learned

With two times more residential rooftop solar penetration per capita than Hawaii and ten times more than California, Australia's grid reached its "solar hosting capacity" long ago – providing a real-world example of what will happen as US grids become "saturated" with distributed generation. Traditionally, there are three main methods utilities and operators use to mitigate the unintended voltage volatility and power quality issues that arise from a high DER penetration: curtailment, advanced smart PV inverters, or distribution grid upgrades.

1. Curtailment of excess energy generated by DERs limits any attempt to optimize larger rooftop solar systems because the loss of generated electricity export disrupts the economics with intermittent revenue streams. The loss of valuable community DER renewable energy will delay reaching the carbon neutral targets set by government.
2. Advanced Smart Inverters with Volt-VAR and Volt-Watt capabilities can provide some voltage regulation depending on the locations of the PV inverters however, this solution can cause social inequity issues. Customers located at the back-end of feeders will be providing the majority of VARs to the detriment of real power, whereas customers at the front end of the feeder will be supplying little or no VARs and maximum power.
3. Expensive distribution grid upgrades offer a temporary solution to increasing solar hosting capacity, but only until more DER is added onto the grid and limits are again reached. Distribution grid upgrades are unsustainable, with the costs passed onto customers, either directly for large installations or indirectly through the utilities rate base allocation for residential PV installations. Regardless, these grid upgrade costs inevitably worsen a renewable energy projects economic viability, create an inequitable cost shift burdening non-solar customers and overall, inhibit DER deployment and the States transition to clean energy. Intermittent revenue caused by solar curtailment, or the risk of curtailment makes commercial-scale rooftop solar and virtual power plants (VPPs) no longer bankable via third-party financing. This third-party financing is crucial to overcoming the tenant/landlord split incentive problem that has traditionally limited the uptake of distributed energy in the commercial, industrial, and residential rental markets.

California & Hawaii are already experiencing many of the same issues that Australia ran into last decade. California solar and wind curtailment levels continue to grow drastically and even reached

record levels in 2021. As we push for net-zero policies and the Electrification of Everything, curtailment levels will only continue to rise.



http://www.caiso.com/informed/Pages/ManagingOversupply.aspx

It is important to note that even after years of curtailment, DER penetration continues to grow in Australia. Exponential cost decreases in solar PV and energy storage have provided homeowners economic viability to generate and store their own energy while providing resiliency benefits that cannot be matched by centralized power stations. As more and more consumers continue to adopt local generation and storage, they demand less energy from traditional, centralized generation sources. The cost of rooftop solar in Australia is less than $1.00 per watt installed. The LCOE of rooftop solar is AU$0.9-0.13/kWh depending on latitude. This cost compares very favorably with utility costs of AU$0.20-0.25/kWh, hence the continuing preference of DER compared with large scale solar in Australia.

This demand shift is now starting to affect large-scale renewables. As a clear example, just last month Australia's New Energy Solar sold two utility scale solar PV projects for $223 million, the

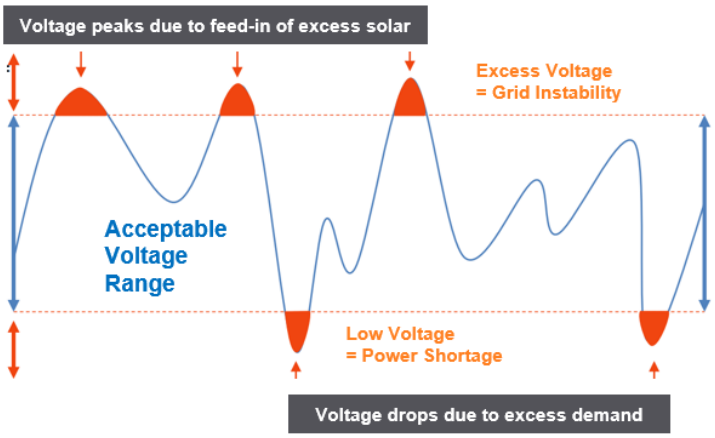
111 MWdc Beryl and 56 MWdc Manildra plants. New Energy sold these plants at a financial loss because of the negative impacts of curtailment caused by grid constraints that have emerged near the site, New Energy Solar said themselves. As customers continue to install local, distributed generation the demand from centralized renewables sources will lessen, causing the economic viability of these powerplants to be strained. The net result playing out in Australia and projected to worsen over the coming decades is the very real prospect of having trillions of dollars in centralized generation and transmission assets stranded over the next 20-30 years.

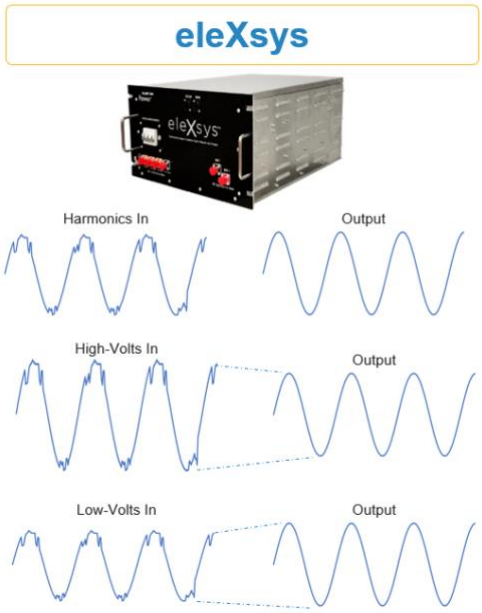
Simple physics provides the reasoning for this. Electrons will take the most efficient path to the load source, with local generation always beating traditional generation because it doesn't have to travel the far distances through transmission network. During times of low demand and oversupply, utility-scale generation will inevitably be curtailed in areas of high DER penetration. It is our core belief that Distributed Energy Resources will continue to win the day by providing cheaper, more resilient generation than centralized sources can offer.

This is a core understanding that is missing from the current California DPP (Distribution Planning Process); we must prepare a cost-effective two-way grid for the high DER future.

B) Innovative AI eleXsys dStatcom Unit Enables the Two-Way Grid

The eleXsys device is an advanced power electronics unit integrating a suite of artificial intelligence (AI) proprietary software applications enabling next-generation two-way smart grids. Our hardware and AI based software autonomously manages the stability and resilience of distributed solar generation on-site. It unlocks the full potential of electricity networks to integrate distributed solar energy and battery storage, either standalone or in a grid-connected microgrid ensuring the most efficient, lowest-cost delivery of clean energy and network stability services.





An eleXsys proprietary distribution static synchronous compensator (dStatcom), combines several critical elements required to manage voltage (solar inverter; voltage control; power factor correction; battery charger and speed control). It is 3-phase, 4-wire, and grid-forming, employing silicon carbide mosfets (metal oxide semiconductor field effect transistor) creating a high voltage, high frequency device. This provides cost advantages and allows for the product to be smaller and more compact than current conventional technologies whilst still capable of being "scaled" to suit much larger renewable energy installations.

A major differentiating factor of eleXsys in its design and application is its smart and industry leading proprietary software algorithms and artificial intelligence (AI) that have been specifically designed to address many of the electricity network problems, namely:

• Voltage management, and in particular voltage rise due to generation in the lower voltage levels of an electricity network

• Voltage fluctuations and intermittent generation

• Fault identification and location

• Voltage phase imbalance

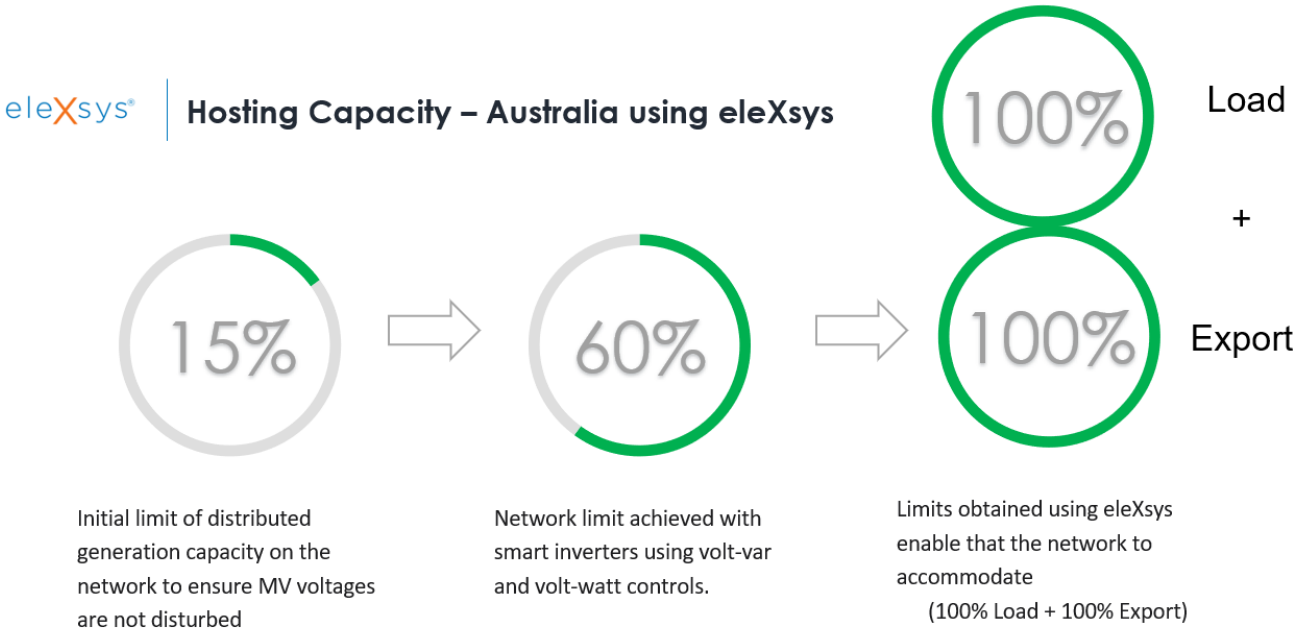
• Harmonic mitigation and electricity network reliability

C) eleXsys devices enable the quickest, most cost-effective way to decarbonize California's electrical grid

Electricity networks all around the world are required to be designed to ensure that voltage levels are sufficient and lie within statutory limits in all areas of their network. This requirement is to make sure that electricity supply to all customers is safe and of a high enough quality standard to operate modern appliances and enable people's modern lifestyles. Up until recently, all network planning has been undertaken based on electricity flow being in one direction, from power stations to businesses and homes.

Connecting solar PV on to rooftops and generating power into the grid reverses the historical 'one way' power flow, causing the voltage to increase at times of high solar generation and times of low customer demand. These high-generation times have been known to cause voltage levels to exceed the established statutory limits requiring intervention from network operators to ensure safe and reliable supply of electricity. Utilities and network operators' responses to date have involved managing this risk of network voltages reaching excessively high levels by applying what is known as the 15% rule, or similar measures that give the same effect. Such measures limit the uptake of embedded solar distributed energy resources to 15% of the total feeder rating.

By dynamically and autonomously managing the voltage volatility caused by distributed generation, eleXsys devices radically increase the grids hosting capacity to DER. This in turn allows projects to overcome unnecessary distribution upgrade costs as well as potential curtailment risk, eliminating two large hurdles that often destroy the viability of large DER projects while radically increasing the utilization of existing electrical infrastructure.



As we have already experienced in Australia, exporting distributed generation causes dangerous voltage level rise and power quality issues on the distribution grid, limiting the amount of DER that can safely be interconnected. Alongside the overarching 15% rule, Australian network operators have responded to these voltage level rises, historically, by curtailing exported energy back onto the grid. California will inevitably face the same widespread issues as we continue to increase DERs penetration. eleXsys was built to address & manage these voltage level rises and power quality issues on the distribution grid autonomously, thereby cost-effectively increasing the distribution grids hosting capacity to DER and mitigating the risk of energy curtailment.

Eliminating the risk of curtailment, thus, allows solar developers to optimize solar systems far greater than site consumption as excess energy can be exported safely and consistently, powering our local communities with cheap, clean, resilient energy.

As seen in Australia, once you mitigate curtailment risk & cost-effectively avoid major distribution grid upgrades, large scale solar + storage systems become bankable assets. This in turn provides third-party asset owners the confidence that they now have a consistent, forecastable revenue stream for the 20 or 30-year asset lifetime. In doing so, a brand-new asset class is created. This allows customers, third-party institutional investors, and utilities alike to invest in and own these large urban rooftop power stations, creating a win-win-win for everyone involved.

An example of a large-scale rooftop solar project that quickly and cost-effectively decarbonizes the grid is the innovative IKEA eleXsys Microgrid in Adelaide, South Australia.

This grid-connected virtual power plant microgrid is 10x larger than what otherwise would have been installed given currently available technology and the distribution grid's hosting capacity limitations -- all achieved without the need for costly grid upgrades. The eleXsys technology allows IKEA to be powered by 100% onsite renewables, reducing power costs by approximately 25% and hedging against grid-power price increases.

The project also allows IKEA to demonstrate its corporate leadership while adding resiliency to its operations, and the investor -- which is one of Australia's largest pension funds -- secures strong project returns for the 20-year contract. Revenue streams consist of selling energy directly to IKEA

through a standard power purchase agreement (PPA) while also exporting the excess energy from the solar and storage, participating in wholesale arbitrage markets to power the local community with cheap, clean energy at times of need while also providing valuable grid value through frequency control and ancillary services. Most important, this project achieves a 10x larger reduction in greenhouse gas emissions than what would otherwise have been possible.

This project serves to demonstrate that with a 100% two-way distribution grid requiring no, or very little grid upgrades, it becomes possible to achieve the state's Transportation Electrification ("TE") and decarbonization goals powered by local renewables, allowing the full value of DER to be provided to the grid and excess clean energy to be consumed within our communities. Not only does this maximize the efficiency and utilization of our electricity networks by siting generation in the load centers, but it also helps to keep electricity prices low and offers an equitable pathway for all customers to benefit from clean energy - not just those who can afford on-site renewables.

In addition to continuing to provide reliability, this creates the opportunity to provide an unmatched level of grid resiliency, as well as enabling third parties to deploy billions of dollars in project capital, while lowering electricity prices for all. These types of projects create a new business model that sets the stage for redesigning our electricity networks to quickly and cost-effectively decarbonize while also providing the greatest benefit to society. Furthermore, by managing voltage volatility and creating a 100% two-way smart grid, eleXsys creates the foundation to apply innovative clean-energy applications such as vehicle-to-grid, transactive energy markets and virtual power plants capable of providing their complete customer, grid, and societal value.

D) Eliminating the Cost-Shift Burden and allowing Clean, Equitable Energy for Disadvantaged Communities

The conventional thinking has always been that large, utility-scale, or centralized generation provides the cheapest and fastest way to meet renewable energy goals. This notion is primarily due to the economies of scale and the misconception that local solar and storage is too expensive and will increase electricity costs. In reality, this way of thinking is flawed. Although utility-scale renewables do have a role to play, the grid of the future can and will be powered by large amounts of local renewable energy, as well as utility-scale generation.

As we continue progressing toward the TE and decarbonization goals, we should expect to see a 3-4x increase in local energy consumption. This means we will become progressively more reliant on electricity in nearly all aspects of our lives, further solidifying how important it is that we have a safe and reliable electricity grid.

Adding more complexity to the challenge is the fact that achieving 100% renewables powered by wind and solar farms will require an expansive buildout of transmission infrastructure. The US currently has about 200,000 miles of high-voltage transmission lines, with reports estimating that to achieve 100% renewables would require double this amount. Adding 200,000 miles of new high-voltage transmission would cost roughly $700 billion and take at least 10 years. The reality is, regardless of cost, we don't have 10-plus years to wait for new transmission infrastructure to be constructed. The climate emergency is occurring today.

One of the main arguments against the DER future is the “Cost-Shift Burden” where disadvantaged communities bear the weight of increased electrical rates because these communities cannot afford solar systems to offset expensive bills like the neighboring affluent communities. As higher income communities install more solar and decrease their demand for grid energy, utilities will have to upgrade the distribution grid to increase DER hosting capacity while passing those grid upgrade costs onto the entire utility rate base, which becomes disproportionately relied upon by non-solar customers. There are more cost-effective solutions to provide equitable, solar proliferation. We need other procurement methods for DER that better allow for the optimization of resources to benefit the grid, reducing concerns about the cost shift.

eleXsys devices mitigate large portions of distribution grid upgrade costs and exponentially increase hosting capacities on feeders. Therefore, with eleXsys, households and businesses can add solar onto their properties without harming their non-solar neighbors.

E) Identifying the OpFlex Limiting Factors in the ICA Maps

eleXsys identifies the ICA maps as a valuable planning resource for expanding DER penetration. Public access to such information allows for developers to analyze large data sets quickly and conveniently on potential project areas and the corresponding feeder lines. As we continue to build a 100% two-way grid, these data sets demonstrate which ‘old’ grid infrastructure is limiting solar development. As a whole, the ICA data and maps must continue to be updated to increase the

accuracy of information that is provided to the public in a transparent way. One specific amendment to the ICA maps that would prove to be helpful is when looking at a feeder data set, it is unclear how to identify which ICA category is limiting (thermal, voltage, protection, or reverse power flow) the OpFlex amount. Identifying what category is the limiting factor on that feeder would allow developers to understand which market solutions they would need to deploy to overcome the hosting capacity limitations.

According to SCE's *Enhanced Integration Capacity Analysis Final Report*:

> The IOUs implemented a consistent criterion for Operational Flexibility (OpFlex ICA) in which strategic devices across the distribution system, such as SCADA operated switch points and voltage regulators, limited the amount of generation for all downstream nodes to the load downstream of the strategic device. While removing the OpFlex ICA limitation category would significantly increase the Integration Capacity, higher levels of DER on the distribution system could create significant issues to reliability, safety, and/or power quality. Additional exploration of different methodologies is required to determine how this limitation may further be modified to allow higher levels of ICA without compromising safety, reliability, or power quality. SCE proposes to maintain this limitation due to the low level of visibility and control of DERs. At such time when SCE has adequate visibility of the resources and sufficient control, this limitation may no longer be applicable.

Technologies and developers that ensure reliability, safety, and/or power quality should therefore be considered when developing an OpFlex ICA limitation category. Once tested and proven by the Commission and IOUs, new innovative technologies should be considered when establishing the OpFlex amounts that limit integration capacity.

IV. CONCLUSION

eleXsys Energy, respectfully, provides these comments as insight into the issues that will arise on the distribution grid from a high DER energy future and in an attempt to educate regulators on the solutions that are already prepared to enter the market. Regulation and policy should be created with both the issues and solutions in mind.

eleXsys Energy greatly commends the work of the CPUC in proliferating DERs throughout the state of California. We are honored to provide these comments and to be a party to the proceeding. We look forward to future participation in the proceeding and are excited to offer our knowledge and expertise to assist in modernizing the grid in future comments and workshops.

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