Docket No.: R.13-12-010

Exhibit No.: ______________

Date: September 24, 2014

Witness: Janice Lin

TESTIMONY OF JANICE LIN
ON BEHALF OF THE CALIFORNIA ENERGY STORAGE ALLIANCE
CONCERNING LONG TERM PROCUREMENT
PLANNING, PHASE 1a

Q: Please state your name and business address.

A: My name is Janice Lin. I am Executive Director of the California Energy Storage Alliance ("CESA"). I am also Managing Director of Strategen Consulting, LLC. My business address is David Brower Center, 2150 Allston Way, Suite 210, Berkeley, CA 94704

Q: Please summarize your professional and educational background.

In my capacity as Managing Director of Strategen Consulting, LLC, and Co-Founder and Executive Director of CESA, I am actively involved in helping clients market distributed grid connected energy systems to a wide range of potential customers. I provide strategic and technical support to CESA member companies and end users of energy storage to deploy new energy storage projects, and accomplish their business objectives. Prior to founding Strategen and CESA, I served as Vice President of Business Development and Vice President of Product Strategy at PowerLight Corporation, a leading designer and installer of large-scale grid-connected solar electric systems and energy efficiency services (now SunPower Systems). I hold an MBA from the Stanford Graduate School of Business, a BS from the Wharton School of Business and a BA in International Relations form the University of Pennsylvania's College of Arts and Sciences.

Q.: Have you ever testified before this Commission?

A: Yes.

Q: On whose behalf are you testifying?

A: I am testifying on behalf of CESA. CESA is a broad advocacy coalition that is committed to advancing the role of energy storage to promote the growth of renewable energy and a more efficient, affordable, clean, and reliable electric power system.

CESA's members are a diverse mix of energy storage technology manufacturers, renewable energy component manufacturers, developers and systems integrators. CESA is a technology-neutral and business model-neutral association of members who share a common mission, the promotion of energy storage solutions to the energy infrastructure, and is supported solely by the contributions and coordinated activities of its members.[1]

Q. What is the purpose of your testimony?

A: The purpose of my testimony is to explain how and why energy storage should be expressly considered in determining future system reliability needs, including the need for flexible resources in this proceeding, and in its beneficial role to help achieve the state's emissions reduction goals.

1. The Commission should emphasize the game changing importance of energy storage in utility procurement.

The grid today is not the grid that we've known for the last 50 years. The grid of today has a less constant supply profile, and significant amounts of variable generation that has entered and will continue entering the system between now through 2020 and beyond. Today's grid also has a more variable demand profile, especially with the widespread use of electronic devices and the electrification of transportation, including electric vehicles. Looking forward, this evolving grid requires increasing flexibility, intelligence, and diversity to remain reliable, sustainable, efficient, and effective. Energy storage is a crucial asset in this energy future - and thus it needs support and emphasis at all levels, as advocated for by utilities such as San Diego Gas & Electric Company:

> "Storage Technology (ST) can also be used with DR [Distributed Renewables] and DG [Distributed Generation] to provide dispatchable

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[1] *See*, "About Us – Overview." *California Energy Storage Alliance,* http://www.storagealliance.org/about.html.

> energy and capacity, ramping, voltage support, and frequency control. The most advanced ST can provide capacity, instructed energy, and other CAISO services in order to obtain greater revenue. Location on the grid is also a possible NPV/BCR driver, particularly to remedy specific grid constraints. Strategically located ST may directly reduce T&D costs. *ST is similar to DR but provides even greater optionality* (Emphasis added)". [2]

These multiple capabilities of energy storage will allow California to optimize and more efficiently utilize the assets that we have as well as new assets that are developed. This includes the generation, transmission, distribution, and consumption segments of the energy system. As a point of reference, California's load factor currently stands at 51.4%,[3] meaning that we have nearly double the installed capacity that would be needed if the annual consumption of electricity total were spread out evenly throughout the year. While energy storage cannot completely eliminate this discrepancy, it can improve California's load factor and system performance by block loading and dispatching only the most efficient existing gas power capacity. Through this characteristic and others, deployment of energy storage will result in greater utilization of our existing assets - both conventional and renewable energy facilities, transmission and distribution infrastructure, and consumption-level resources - leading to savings for ratepayers and a more secure, resilient electric system.

[2] "Integrated Demand-Side Management (IDSM) Cost-Effectiveness Framework White Paper." Prepared by Black & Veatch Corporation for San Diego Gas & Electric Company, May 12, 2011. Pg. 8.

[3] "Preliminary California Energy Demand Forecast" Mark Ciminelli, et. al., California Energy Commission Draft Staff Report, August 2011. http://www.energy.ca.gov/2011publications/CEC-200-2011-011/CEC-200-2011-011-SD.pdf. Peak load trends from 1990-2022 (projected) in Fig. 1-4, pp. 17-18. Annual consumption & peak load figures on pg. 12; Load factors for 2010 calculated using:

$$Load\ Factor = \frac{\left[\frac{Annual\ Energy\ Consumption\ in\ MWh}{365 * 24h}\right]}{Peak\ Demand\ in\ MW}$$

Energy storage can also be a highly effective tool to facilitate other energy policy goals, such as implementing the Renewables Portfolio Standard ("RPS"), and as we move beyond the RPS with increased renewables penetration that is needed to stay in line with the AB 32 emissions reduction trajectory targets for 2030-2050. The breadth of energy storage deployment capabilities is reflected in the entire asset class's multiple benefit streams, which include load leveling, energy time transfer, energy reserve capacity, and voltage regulation, among others. These benefit streams may be applied in multiple flexible situations to further a number of policy goals, from infrastructure investment management to emissions reduction. For example, the Commission will be working over the next several decades to reduce California's energy-based carbon footprint. Energy storage enables a smarter, more flexible, more optimized electric power system and that will enable us to use more and more renewable energy sources. Further, because of the difference between the emissions and variable cost of base/intermediate load and peak generation facilities, energy storage helps reduce emissions and avoids variable cost by facilitating reduced as well as more efficient use of gas-fueled power plants; similar savings are also achieved because of differences between transmission and distribution losses during the night and daytime.

Ultimately, the Commission's emphasis on energy storage in procurement will enable the benefits of this versatile asset class to be realized sooner. Once the market is seeded with actual procurement for distributed and bulk energy storage, the industry and stakeholders will respond. This will stimulate further investment, which will create jobs, drive down costs in general, and start building the system of investors, manufacturers, and installers that are needed to create a healthy industry. The more mature that system becomes, the lower the cost, the wider the use, and the greater the benefits will all be.

2. The Commission's long-term procurement planning analysis for Phase 1b should include energy storage.

The grid is a very dynamic and constantly evolving system, and if our goal is to envision and plan for the best-functioning future grid with reduced carbon at the lowest cost, we must understand how every beneficial technology can be integrated into it going forward. Energy storage represents a very broad and useful technology class that is currently in its early stages of adaptation for grid-use (with the exception of pumped hydro which is already the most widely deployed energy storage technology, with over 135,000 MW[4] installed globally). There is no question that energy storage can provide operating and flexibility attributes essential for a reliable electric grid. Incorporating energy storage into all stages of the planning process, including the most immediate timetables, will facilitate the development of both the energy storage industry and a resilient, dynamic grid that meets our vision. CESA therefore strongly urges that some of the scenarios to be considered expressly factor in the potential of this very broad asset class. In fact, CESA recommends a very strong emphasis on energy storage in all planning scenarios that will be evaluated in Phase 1b of this proceeding. The benefits of increased levels of energy storage will thus be directly observable in the results of the analysis in the form of a cost-effective over-generation solution and to maximize the emissions reduction potential of preferred resources. Additionally, modeling will likely

[4] Alstom

demonstrate the increased flexibility and capacity value of the preferred resources when integrated with the addition of energy storage.

CESA recommends that both Southern California Edison ("SCE") and the CAISO run sensitivity scenarios in Phase 1b with incremental energy storage added. CESA recommends running at least two sensitivities using quantities and configurations of energy storage, similar to that which was modeled by NREL for the recent California 2030 Low Carbon Grid Study.[5] Each of the sensitivities should be modeled as part of other portfolio scenarios, including the High Case, Trajectory Case, 40% RPS, and Expanded Preferred Resources scenarios.

Storage Sensitivity Scenario One should add 1000 MW of pumped energy storage to the grid resource mix modeled by SCE and the CAISO.

Storage Sensitivity Scenario Two should add 1000 MW of pumped energy storage to the grid resource mix, as above, as well as 1200 MW of bulk and distributed energy storage.

Storage Sensitivity Scenario Three is an optional sensitivity that would evaluate 1200 MW of bulk and distributed energy storage.

The amount of pumped energy storage requested to be modeled is highly viable. Several CESA members are actively developing projects in numerous locations in and just outside of California that total well beyond 1,000 MW. These projects are a source of cost and performance data for the Low-Carbon Grid Study. Those developers are able to provide actual cost and performance data for the Commission's analysis in this proceeding.

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[5] http://www.lowcarbongrid2030.org.

These scenarios and the recommended modeling modifications will allow the Commission to identify the degree to which varying levels of energy storage can provide system benefit by facilitating GHG emissions reduction, supporting system reliability, and making the best use of California's renewable energy portfolio. The data will support future planning and decision-making around capacity and over-generation options.

Energy storage with multiple benefit streams is already being included in long-term grid projections at the national level. NREL, in projections allowing high grid penetration of renewable generation, recognizes the necessity of energy storage and its related expansion to the success of tomorrow's grid. Under the 80%-renewable scenarios for 2050 outlined in NREL's recent Renewable Energy Futures Study (a separate study unrelated to the LCGS), energy capacity expands to 100-152 gigawatts ("GW") nationwide for energy flexibility ("the ability to shift bulk energy over several hours or more") alone, depending on the specific scenario studied.[6] As much as 10-20 GW of this capacity is projected for California,[7] including other applications – power quality and regulation, bridging power, etc., – will expand this capacity further. As important, NREL in the Futures Study projects a front-loading of capacity installation, especially in the early-2020s to early-2030s, with extremely active years in 2022-2023.[8]

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[6] "Renewable Energy Futures Study. Volume 2: Renewable Electricity Generation and Storage Technologies" Hand, M.M. et. al. (ed.) *National Renewable Energy Laboratory*. Figure 12-7: Deployment of Energy Storage Technologies in 2050 under 80% RE Scenarios. Pg. 12-29. http://www.nrel.gov/analysis/re_futures/.

[7] NREL. Vol. 2, Figure 12-13. "Regional deployment of storage in the contiguous United States in the constrained flexibility scenario." Pg. 12-28.

[8] NREL. Vol. 2, Figure 12-12. "Deployment of energy storage technologies in the constrained flexibility scenario." Pg. 12-27.

Achieving much-needed levels of energy storage deployment in California's energy system portfolio will be significantly easier if industry expansion and energy storage deployment begin immediately. Starting now will facilitate much-needed industry growth, which will in turn lead to lower costs and greater annual installation capabilities. It is also imperative that the Commission recognize the urgency and necessity of including energy storage, both in terms of achieving statewide goals and in doing so cost-effectively. CEERT, for example, concurred with this point this in its Reply Comments:

> "At a time when the Commission and the California Independent System Operator (CAISO) are focused on renewable integration and the potential need for 'flexible capacity,' any standard planning assumptions or scenarios should recognize that demand response [of which storage is included] can provide 'balancing capabilities faster and more cost-effectively than traditional generation.'"[9]

Acting now will smooth out the overall incorporation of energy storage into the grid, lowering average annual costs and allowing for more effective integration with other technologies.

3. Emissions and Avoided Cost Value of Energy Storage

The planning focus of these studies must recognize and incorporate state policy emanating from the California Air Resources Board's ("CARB's") GHG reduction goals, and convert them into rational and effective electric sector procurement scenarios through 2030. In recent past LTPP cycles, achieving 33% RPS compliance has been a critical consideration, which has been successfully achieved. However, procurement to meet the CARB's 2030 goals, on its trajectory to 2050 goals[10], requires carbon-free primary

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[9] "Reply Comments of the Center for Energy Efficiency and Renewable Technologies on Energy Division's Standard Planning Assumptions Straw Proposal," June 11, 2012.

[10] CARB Goal to reduce California CO_2 emissions by 80% from 1990 levels.

energy that amounts to approximately 55% renewable energy penetration.[11] In addition to zero carbon energy generation needs, meaningful procurement of bulk energy storage is important to achieve the level of reliable cost-effective firm energy required beyond 2020 to be compliant with the CARB's GHG reduction goals. The scope and nature of this study should aim to recognize the full scale of carbon-free resources required by 2030, and the important role for bulk energy storage.

A strong study example that should be considered is The LCGS. NREL is conducting the modeling work. This study "explores how the California electric sector can cost-effectively support deep reductions in GHG emissions. According to Phase I modeling results, the California electric grid can reduce emissions by more than 50% below 2012 levels by the year 2030 with minimal rate impact, minimal curtailment to renewables, and without compromising reliability. These findings are significant because they illustrate an affordable, reliable, and practical trajectory toward meeting California's ambitious 2050 GHG emission reduction goals."[12] The Target case in this study effectively lowers electric sector emissions from 78 MMT to 40 MMT (compared to the Baseline case), a total emissions reduction of 58% below 2012 GHG levels (63% below 1990 levels). The Target Case, in order to stay on the ARB target for 2030, requires 177 TWh of zero-carbon energy additions, a 67 TWh increase from the Baseline Case.

In addition to its strong time shifting capability and as an over-generation solution, there is also a huge opportunity for distributed and bulk energy storage and strategically sited distributed energy storage, to displace a very significant portion of the inefficient high heat rate peaking plant dispatch, and also to displace the lesser efficient

[11] Note California 2030 Low Carbon Grid Study ("LCGS"). http://www.lowcarbongrid2030.org.
[12] http://www.lowcarbongrid2030.org.

CCGT plants. There are substantial CO_2 emissions reductions, and increased economic value through avoided variable cost of the inefficient gas generators. This occurs simply by charging during off-peak hours and nominally increasing the capacity factor of the most efficient marginal gas power that will be economically dispatched when needed. This avoids the on-peak emissions of the otherwise dispatched gas capacity that is normally highly polluting with a high variable cost due to its very high heat rate, and inefficient dispatching cycles. [13]

4. The Commission should continue to reiterate the importance of procuring established energy storage technologies like pumped energy storage and stress that its energy decision was not intended to discourage the development of such projects.

The Commission's energy storage decision mandating the procurement of energy storage projects of less than 50 MW will likely drive the development of new and increasingly cost-effective energy storage technologies. That decision went out of its way to suggest that the Commission recognize the important role that pumped energy storage should play going forward.

> "We emphasize that our decision to limit the size of pumped storage projects in the decision is not to discourage large-scale pumped storage projects. On the contrary, these types of projects offer similar benefits as all of the as all of the emerging storage technologies targeted by this program; it is simply their scale that is inappropriate for inclusion here. *We strongly encourage the utilities to explore opportunities to partner with developers to install large-scale pumped storage projects where they make sense within the other general procurement efforts underway in the context of the LTPP proceeding or elsewhere.* (Emphasis added)"[14]

[13] See Alton Energy's Comments in the recent CAISO Energy Storage Roadmap for further analysis.

[14] D 13-10-040 at 36.

The Commission should continue to infuse this message in these proceedings, including, as noted above, by including sensitivity analyses that include realistic energy storage scenarios as noted above.

5. Bulk Storage Value and Role in the LTPP

Bulk energy storage, including pumped hydro, is a cost-effective, proven, reliable energy storage technology able to integrate the magnitude of low cost carbon-free wind and solar energy needed to meet the growing zero-carbon energy requirements. California is fortunate to have available several large-scale cost-effective pumped energy storage projects that are well along in the development process. These are of high importance for meeting the CARB's GHG emission reduction goals, and procurement is needed near-term to allow for a rational timeframe for construction and availability before 2024.

An advanced bulk energy storage procurement framework needs to be adopted to allow for the procurement of large-scale resources from the Commission's LTPP process[15]. Planning studies need to evaluate and support this initiative, and interagency collaboration is critical in order to design a procurement methodology and interconnection process that is suitable to support valuable long-life assets such as pumped hydro.

We feel it is critical that a proper valuation tool and methodology be designed that effectively quantifies the economic benefits of bulk energy storage projects. This tool

[15] Longer-duration bulk dispatchable technologies that are able to cost-effectively compete directly with gas, such large-scale pumped hydro storage, have been excluded from the energy storage proceeding (above 50 MW), but the Commission has encouraged pumped hydro procurement, particularly in the context of the LTPP.

would properly quantify the potential ancillary service value, capacity value, renewables integration value, avoided T&D value, TOD factors, and avoided emissions and variable cost value. From the quantification of this value, it will be clear that bulk energy storage adds far more economic benefit to the ratepayer than it does cost. Although the true benefits of energy storage generally occur on the aggregate system level, this type of cost/benefit analysis methodology on a project level could help to establish an adequate valuation that feeds into the establishment of competitive long-term contracts that allow bulk energy storage plants to be financed and built. This project valuation tool could then be incorporated into a system model with the proper input parameters to demonstrate the net system value with and without the bulk energy storage project. This cost-benefit analysis is important for establishing a procurement methodology for large capital-intensive bulk energy storage assets, which can exceed 1000 MW.

The real rationale and justification for long-term contracts is not just project bankability, but most importantly it is to procure long-life valuable assets that avoid substantial cost, and to create long-term environmental and economic value that far exceeds the cost to the ratepayer. Over the course of the 75+ year operational life of a pumped energy storage plant, analysis shows that the total avoided cost and economic benefits to the system and ratepayer is very substantial. This needs to be converted into a methodology and basis for entering into long-term contracts with these valuable system assets.

Long-term planning procedures must also account for the increased capacity value available from renewables if substantial energy storage is deployed, and thus encourage the continued development of renewables as a fundamental value towards capacity, reserves, and lowest carbon ancillary services. In addition to proper valuation needed for the many ancillary service and fast ramping flexible capacity attributes of bulk energy storage, we urge the Commission and other agencies and utilities to consider bulk energy storage as a powerful tool for avoiding emissions and variable costs. It is also important to evaluate the avoided T&D cost associated with bulk energy storage projects that could replace the need for otherwise costly T&D investments.

6. The Commission should direct the CAISO to allow battery energy storage to count toward the 25% regional generation requirement constraint.

In order to optimize the GHG and operational benefits of energy storage, CESA requests that the CAISO include battery energy storage in the 25% regional generation requirement indicated in Dr. Lui's testimony in the 40% RPS case. It is CESA's view that the addition of appropriately located and specified battery energy storage can provide the frequency response needed to support the NERC requirements indicated in Dr. Lui's testimony, without the need to run traditional generators in a suboptimal manner. The constraint, as modeled, was responsible for 39% of the over-generation in the 40% RPS scenario. Because battery energy storage can support NERC reliability standards without running additional thermal generation at an inefficient pMin, this modification will greatly reduce system over-generation in cases where energy storage is added to the resource mix.

Q: Does this conclude your testimony?

A: Yes it does.