October 1, 2014

Ms. Sylvia Bender
Deputy Director, Energy Assessments Division
California Energy Commission
1516 9th Street
Sacramento, California

RE: Publicly Owned Utilities Assessments of Energy Storage Resources

Dear Ms. Bender:

The California Municipal Utilities Association (CMUA), the Northern California Power Agency (NCPA), and the Southern California Public Power Authority (SCPPA) are pleased to submit this letter, which provides context and background information regarding the efforts of publicly owned utilities (POUs) to comply with the requirements of Assembly Bill 2514 (Skinner, 2010) regarding the development of energy storage procurement targets. All POUs have gone through the AB 2514 process and some, including Los Angeles Department of Water & Power (LADWP), Glendale Water and Power (GWP), and the City of Redding, Redding Electric Utility (REU), are establishing storage targets, while others are not.

Prior to the passage of AB 2514, many POUs were engaged in assessing the viability and value of energy storage resources to meet the needs of their utility systems. Since the bill became law, POUs have increased their efforts to evaluate energy storage technologies and the role these resources could play in their respective resource plans. POUs have completed collective and individual studies, issued RFPs for energy storage projects, dedicated countless hours to analyses of outside studies, and worked with industry experts to evaluate utility-specific potential for energy storage resources in their service territories.

This letter provides an overview of the analyses undertaken by POUs, to highlight key findings of those analyses, and to discuss the near-term actions public power will be taking regarding energy storage development. The differences among the state's POU service territories and system needs, as well as the differential energy usage patterns of customers, prevents a meaningful 'one size fits all' determination regarding the cost-effectiveness and viability of the suite of existing and emerging energy storage resources available in today's market. Based on the POUs' assessments of the best-available information, it is clear that the value and benefits of energy storage resources vary by technology, by utility, and from customer to customer.

At this time, energy storage resources are not a cost-effective and viable option for most POUs. Despite this initial determination, we do acknowledge the potential of energy storage resources to play a vital role in the operation of the grid and the management of utility distribution systems. POUs will continue to make investments in Research Development & Demonstrations (RD&D) regarding energy storage systems, even with a determination that energy storage resources are not cost-effective and viable solutions to meet their needs today – and therefore the adoption of energy storage procurement targets are not warranted at this time. Such a determination should not be viewed as final, as evaluation of the cost-effectiveness and viability of energy storage resources will be an ongoing effort.

BACKGROUND

The term "energy storage system" encompasses a range of technologies. For the purposes of AB 2514, the legislation included a broad definition, which is now contained in §2835 of the Public Utilities Code.[1] In brief, "energy storage system" means commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter discharging the energy for delivery to load. Storage can be either centralized or distributed – and installed at multiple points across the transmission and distribution system. The statute is explicit that in order for a technology to meet the definition of an "energy storage system" for the purposes of AB 2514, it must be cost-effective.

AB 2514 established different requirements for Investor Owned Utilities (IOUs) and POUs. For IOUs, §2836 (a)(1) requires the CPUC to determine appropriate targets, if any, for each load-serving entity to procure viable and cost-effective energy storage. For POUs, the determination of appropriate targets is the responsibility of each POU's governing board. Section 2836 (b) identifies specific deadlines for POU actions:

1. By March 1, 2012, POUs must open a proceeding to determine if any "viable and cost-effective" energy storage systems are available for their respective system
2. By October 1, 2014, the governing board of each POU is to adopt energy storage system procurement targets – if, between March 2012 and October 2014, the POU determined there are any viable and cost-effective energy storage systems available to the POU that are deemed to be "appropriate."

In addition, Section 9506 directs POUs to report to the CEC by January 1, 2017, and again by January 1, 2021, on their energy storage procurement targets and policies.

POU PROGRAMS & CONSIDERATIONS

At the time that AB 2514 became law, a number of POUs were already pursuing energy storage technologies and determining how these resources could meet operational and customer needs in their service territories. POU interest in energy storage is motivated by state policies driving a transition to lower-carbon resources and utility portfolios, as well as the growing need to integrate intermittent renewable energy sources. In addition, there are a number of services energy storage technologies have the potential to provide to improve the operation of the distribution system, including backup power, peak load reduction, mitigation of electrical vehicle charging loads, and deferment of distribution investments.

Historically, POUs have pursued storage technologies for improvement and optimization of electric system operations. Thermal Energy Storage (TES) has been of particular interest for years to utilities with high air

[1] Unless otherwise noted, all section references are to the California Public Utilities Code.

conditioning loads that drive their peak demand and lower their system load factors. For example, the City of Redding and seven of SCPPA's member utilities currently have TES installations in their service territories. Pumped hydroelectric storage is arguably the most proven and widely-used of the energy storage technologies; LADWP currently operates a 1,255 MW pumped storage facility at Castaic Lake and Sacramento Municipal Utilities District (SMUD) is considering development of the Iowa Hill Pumped Storage Project, a 400 MW facility that very likely will be added to their Upper American River Project. The presence of some or all of these systems can impact the cost-effectiveness or viability of additional storage resources.

Since 2012, POUs have increased their efforts to evaluate the cost-effectiveness and viability of energy storage systems in their respective service territories to determine whether procurement targets are appropriate at this time. Several evaluations have been performed to review the energy storage systems' cost-effectiveness and viability in order to meet the October 1, 2014 deadline. Many POUs enlisted the support and assistance of third party consultants and industry experts to develop their respective targets.

This letter represents an overview of the many individual POU submittals to the CEC on their energy storage evaluation results. In these filings, POUs discuss the range of issues and conditions that have been assessed to determine if any (or how much) cost-effective and viable energy storage systems exist for their utility. The analyses for each POU are different because no two utilities will have the same operational needs or find the same storage technologies to be cost-effective. It is imperative for all utilities to assess their individual system operations to evaluate which storage system(s), if any, are best able to meet those specific needs cost-effectively. Regardless of the outcome of the initial findings, POUs recognize the important role storage can play in electric systems in the (near) future and are committed to the continued evaluation and re-assessment of energy storage resources.

TECHNICAL CONSIDERATIONS

Presented below is an overview of the technical considerations and the economic evaluation processes employed by POUs in their assessment of potential energy storage procurement targets. Energy storage developers have been working for many years to improve on existing technologies plus create "new" storage media and equipment, including:

- Advanced chemistries for batteries
- Thermal energy storage applications
- Compressed air developments
- Flywheel technologies
- Pumped hydro sites

Each of these technologies can provide distinct functions or services to help electric utilities improve their system operations at one or more "levels" of the electric system:

- Utility-scale, transmission-connected
- Distribution-scale, distribution-connected
- Customer-scale, behind-the-meter.

Energy storage systems provide a variety of services, including frequency regulation, voltage support, spinning and non-spinning reserves, and black start. In addition, storage can offer load-following/ramping functions to integrate both large-scale, intermittent renewable resource generation to the grid and variable, distributed generation, such as roof top solar, to the distribution system. Among the principal storage candidates that are able to provide short-duration ancillary services are batteries and flywheels. Bulk storage systems – such as pumped hydro, compressed air, and thermal storage – in many cases can also provide these services, and can reduce or shift peak demands that are overloading the system or creating load/resource imbalances. These bulk storage systems are typically larger in scale and size than batteries and flywheels – and provide longer durations of energy cycling of as many as ten or more hours.

Many energy storage systems can be used for behind-the-meter applications, as well as long-term peak load shifting and load balancing services for system operating efficiency improvements. In addition to system operational benefits for the utility, the customer can receive value from energy and/or peak demand charge savings and power quality improvements. Utilities have considered a range of partnerships with customers because of the potential mutual benefits of behind-the-meter energy storage.

Batteries and thermal storage are the most common storage technologies being deployed behind-the-meter for end-user/customer applications.

Pumped hydro energy storage is a mature technology that is typically developed at utility-scale with relatively large capital costs and potentially significant environmental impacts or costs. Compressed air systems are a developing technology that, like pumped storage, are typically designed at scale and used to provide bulk system services including the time-shift of energy and as well as capacity.

Flywheels are ideally suited to provide instantaneous frequency response and regulation support for utilities. However, their cost may be prohibitive for wide-scale application at this time and there are possible safety issues related to their operation that continue to drive up the cost of the flywheels, and particularly the necessary containment vessels.

Thermal energy storage can provide some of the operational services or functions identified above, including bulk load shifting and supply capacity, potentially some ancillary services, T&D system upgrade deferral(s) and customer-sited storage applications. However, these functions do not include black start capacity because the thermal systems do not directly store or discharge electricity.

INDIVIDUAL POU RESOURCE NEEDS

Energy storage systems that are found to be cost-effective and viable in one POU service territory, may not be when applied in another service utility. The application of specific energy storage systems is dependent on the operating conditions within each utility system to determine their use at the generation, transmission, distribution, or behind-the-meter level of system operations.

For example, SCPPA's twelve members exist within three separate balancing areas. Eight members are part of the California Independent System Operator (CAISO) balancing area, three members are in the Los Angeles Department of Water and Power's (LADWP's) balancing area, and the Imperial Irrigation District operates its own balancing area in the desert southwest corner of the state. Similarly, twelve NCPA Members interconnect to the CAISO and two others are part of the Balancing Authority of Northern California (BANC), which also includes SMUD and the Modesto Irrigation District. Based on these relationships, only a few POUs have responsibility for transmission system operation and reliability, including, but not limited to, frequency regulation. This is an important factor because it impacts the need and ability of the POUs to deploy certain energy storage technologies.

Similarly, each POU has a distribution system with unique configurations, capacities, voltages, and vintages. POUs also have varying levels of solar photovoltaic and other distributed generation installations in their territories, as well as a quickly growing number of electric vehicles. Typically, these conditions were not anticipated when the existing distribution systems were planned, designed and built and because of these regulatory, market and technological changes, distribution voltage control can be a very challenging task for the utilities.

In addition, each POU also has a different load/resource balance:

- Unlike the IOUs, most POUs have fully resourced portfolios[2];
- Some may rely on the market to meet peak demand and energy requirements;
- Some have high annual system load factors; and
- Some have relatively low annual load factors.

Further distinction between POUs, which impacts the need for and cost-effectiveness of energy storage, is weather and climate. California POU service territories span twelve of the State's sixteen different climate zones.

Customer energy usage behavior and needs also drives demand for energy storage resources. Customers in Redding, where air conditioning load constitutes a significant portion of their monthly bill, will derive a much greater benefit from shifting peak-load with thermal energy storage than a similarly situated customer in Palo Alto. In addition, a battery storage installation at a datacenter in Anaheim provides uninterruptible power supply services to meet the facility's needs that a supermarket across the street will not have. An evaluation of the viability and cost-effectiveness of energy storage technologies must consider the operational characteristics of a utility and the energy usage behavior of the customer.

Energy storage technologies demonstrate the potential to improve and/or optimize electric utility operations at the transmission level, on the distribution systems, and possibly, "behind-the-meter" at customer sites. However, the technologies that provide "instantaneous" regulation, control, or other ancillary services are vastly different from those that can shift "hours" of peak demand to off-peak periods. Based on these factors and using the most-current and best available information, POUs have performed comprehensive and thorough evaluations on their respective utility systems to determine the appropriate amount of cost-effective and viable energy storage that is currently commercially available, and could be procured to meet electric system needs.

Research, Development, and Demonstration Efforts

Recognizing the potential long-term value of storage, POUs support further research, development, and demonstration (RD&D) of energy storage technologies as a necessary step in the future development and expansion of the energy storage market. RD&D efforts can lead to technology advances that will serve to improve the cost-effectiveness and application of energy storage in POU electric systems statewide. The results of RD&D investments, as well as pilot programs that better characterize the role and value of the energy storage systems in actual utility operations, will be factored into POUs' continued monitoring and assessment of the storage market.

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[2] This is principally because POUs were not forced to divest their generation resources during the California deregulation in the 1990s.

Joint Power Agencies also play key roles in the assessment of energy storage targets and facilitating POU RD&D efforts. NCPA and SCPPA serve as regular forums for their members to discuss and share their individual efforts and findings regarding energy storage systems – as well as a number of other distributed energy resources including energy efficiency, rooftop solar, demand response, low-income support, and electric vehicle charging. CMUA is another venue in which experiences, efforts and findings are shared for the benefit of all the participating POUs. Through these group settings, the collective knowledge and experience of California's POUs is shared thereby greatly expanding the resources available to each individual utility. NCPA, SCPPA, and CMUA can help to facilitate energy storage RD&D projects, as has been the case for energy efficiency, distributed solar, and electric vehicle charging infrastructure projects.

For example, SCPPA has administered a long-running research and demonstration program of thermal energy systems in the service territories of seven members. This program has led to continued activity and development of these storage resources in Southern California with a combined peak load shifting capacity of more than 4 MW.

In addition to these collaborative efforts, a number of POUs are currently engaged in RD&D activities and many more have expressed interest in future energy storage RD&D and pilot projects. Below are a few examples of POU investments and interest in supporting the development of energy storage systems.

SMUD has invested over $30 million dollars in research to understand and prepare SMUD and its customers for the eventual deployment and utilization of energy storage. SMUD staff has conducted various field demonstrations, studies, and assessments of different storage technologies, used for different applications ranging from transmission scale to distribution scale to customer scale systems. On technical issues, the research assessed technology performance including such factors as efficiency, reliability, and durability. On economic issues, the research assessed capital costs, installation costs, operation costs, value, and cost effectiveness. Additionally, SMUD staff assessed grid integration issues and strategies for interconnecting, aggregating, visualizing and controlling storage systems from grid planning and operations perspectives.

The City of Riverside (RPU) has been very proactive in incentivizing specific customer-installed energy storage projects. In 2013, RPU contributed a grant for $1 million dollars to the University of California, Riverside for its 2.5MW Thermal Energy Storage project. Recently, RPU began talking with a thermal energy system provider to initiate its own 1MW pilot program in its service territory. In addition, RPU is currently evaluating a number of grant proposals from local technology providers and educational institutions for battery storage demonstrations. As shown by the aforementioned efforts, RPU is committed to partner with the local community in support of energy storage developments and will continue to look for feasible and cost-effective ways to strategically integrate energy storage applications into RPU's system.

The City of Santa Clara, Silicon Valley Power (SVP), has also been approached by energy storage companies that are interested in testing and evaluating their technology in cooperation with SVP. For SVP, these projects provide an opportunity to study different energy storage projects, their impacts on the utility system, and their cost effectiveness. These might include future projects to evaluate Vehicle-Grid Integration (VGI) options to utilize electric vehicle batteries as a storage option to support the distribution system or distributed solar projects combined with an energy storage component. Since SVP does not know if or when these opportunities might arise, these are currently not incorporated into a specific energy storage procurement target.

The City of Palo Alto Utilities (CPAU) lacks the resources to conduct robust RD&D in energy storage on their own. However, CPAU believes that, in the long term, energy storage is expected to have an important role in the statewide electric power system, and hence staff may propose that some funds be allocated to an energy storage pilot project in order for CPAU to gain experience with utility-owned energy storage installation and operation. A pilot program could be implemented within the parameters of the City's existing Demand Response program initiatives, maximizing value of electric vehicle storage capabilities, or optimizing use of solar photovoltaic (PV) output. As such opportunities arise, CPAU staff may recommend projects to the City Council for consideration and approval.

The City of Redding, REU, has been actively investing in energy storage through the installation of thermal energy storage systems for nearly 10 years. Redding is ideal for technologies such as thermal energy storage due to its peak summer temperatures. REU began its program with a few RD&D installations in 2005, growing to 3MW of load shifting by 2012. More recently, REU contracted with its main supplier of thermal energy storage systems, Ice Energy, Inc., to evaluate what level of commercial capacity could be adopted within REU's service area. A city-wide survey of REU's commercial customers was completed which demonstrated that expansion of REU's existing thermal energy storage program could be achieved. REU's energy storage targets of 3.6 MW by 2016 and 4.4 MW by 2020 are reflective of this analysis.

On behalf of the California POUs, we thank you for this opportunity to highlight the activities of POUs in complying with AB 2514 and assessing their individual need for energy storage system development. We look forward to meeting with CEC staff to further discuss the most recent AB 2514 filings and future energy storage considerations.

Regards,

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cc: John Mathias, Electricity Supply Analysis Division, California Energy Commission