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Pacific Gas and Electric Company Comments in Response to the April 2, 2009 IEPR Workshop on Energy Storage Technologies and Policies Needed to Support California's Renewable Portfolio Standard (RPS) Goals of 2020

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Pacific Gas and Electric Company (PG&E) appreciates the opportunity to participate in the California Energy Commission (CEC) staff's discussion of issues surrounding energy storage technologies and deployment. PG&E also appreciates the hard work that the CEC and other stakeholders have done to contribute to this dialogue and to address these issues.

Energy storage technologies have the potential to increase the reliability and dispatchability of California's energy supply. Renewables and greenhouse gas reduction goals are driving the need to procure more renewable resources. Intermittent renewables such as solar and wind, however, do not coincide with demand, making it difficult to plan for consistent energy generation. Additional ancillary services and backup conventional capacity (peaking plants) are also needed with intermittent resources. Energy storage addresses the intermittency of renewables by storing the energy when it is generated and shifting the energy to higher value hours or for use in maintaining system reliability. By converting solar and wind into firm, dispatchable resources, energy storage enables a higher penetration of renewables. Energy storage can also provide ancillary services to support renewables integration. The fast ramp rates of storage devices are particularly suitable to support the integration of large amounts of intermittent renewables (particularly wind) when compared to the traditional CAISO dispatch of conventional fossil plants with slower ramp rates.

The Smart Grid of the future will need energy storage to integrate intermittent renewables, provide ancillary services, manage peak demand, as well as relieve transmission and distribution congestion. As there is no technology that is superior in all functional categories, storage solutions that provide multiple benefits will ultimately be more cost-effective. Consequently, PG&E believes a portfolio of storage options will be necessary to address California's energy system challenges. Since many emerging technologies are not proven on a utility scale, PG&E strives to balance the development of newer, distributed storage technologies (e.g. batteries, flywheels) with the development of proven, large-scale, but long lead time technologies such as pumped storage, as well as promising technologies such as Compressed Air Energy Storage (CAES).

A major public policy challenge facing energy storage deployment is that there is currently no "one-stop shop" to manage the economic and policy issues of storage. Cost recovery falls under multiple jurisdictions, and there does not exist a mechanism to recover some costs under FERC and some under CPUC. Hence, the benefits of energy storage are often undervalued. Successful deployment of energy storage will depend on factors such as: 1) technology readiness, 2) improved cost economics and understanding of the benefits of energy storage, 3) funding for the demonstration of emerging technologies, 4) funding for established, long lead-time technologies, 5) the formalization of market rules and policy recognition for storage, and 6) federal and state incentives to offset the significant capital requirements of storage projects. Addressing these issues will help enable more storage deployment in California.

PG&E has prepared written responses to the questions posed in the workshop notice below.

1. **What barriers and/or obstacles have prevented large, utility scale electricity energy storage systems from being installed in California and the nation?**

   The following are some technical, economic, and policy challenges to storage deployment:

   - *Technology readiness*: No storage technology is superior in all functional areas. Consequently, a portfolio of storage options will be required to meet California's grid challenges. Most technologies are still in a demonstration phase.
   - *Cost economics and understanding of benefits*: Costs are still upwards of $1,500/kW and many benefits are difficult to quantify and allocate.
   - *Funding for demonstration of emerging technologies*: Utilities can help emerging storage technologies accelerate their adoption to market by supporting demonstrations projects. These projects, however, will require public funding, as utilities do not have adequate RD&D budgets to support these demonstrations.
   - *Funding for established, long lead time technologies*: In addition to supporting emerging technologies, utilities must also strive to accelerate the lead time of proven, large-scale technologies such as pumped storage and CAES, which offer the greatest potential to integrate large amounts of renewables. Funding is necessary to explore appropriate geology, conduct environmental studies, and support the permitting and licensing review process.
   - *Cost recovery under multiple jurisdictions*: Energy storage can provide both transmission and generation/ancillary services benefits. Current regulatory policies, however, do not allow for some cost recovery through FERC and some through CPUC. Regulators can shape policies to better define how costs should be allocated among different jurisdictions. Furthermore, streamlining siting and permitting review for pumped storage and CAES will enable utilities to more quickly leverage these solutions to integrate renewables.
   - *Market rules and policy recognition of storage*: Market rules are still being written for energy storage participation in the ancillary services market. The CAISO is currently in the process of designing a Storage Pilot Program to enable short duration energy storage to compete in the regulation market.
   - *Expedited ratemaking needed for ARRA matching funds*: The American Recovery and Reinvestment Act (ARRA) is potentially supporting 50% cost share for utility-scale "shovel-ready" energy storage demonstration projects. CPUC expedited ratemaking for these federal matching funds is needed to accelerate the deployment of storage projects.

- *Investment Tax Credit needed for energy storage*: Per the ARRA (Section 1302. Credit for Investment in Advanced Energy Facilities), extension of the 30% Investment Tax Credit to energy storage facilities can also accelerate storage deployment.

2. **How does energy storage affect the ramping and regulation of renewable energy sources?**

   Energy storage can smooth the potentially abrupt characteristic of renewable resources that has the potential to increase the system spinning reserve requirement. The use of energy storage to smooth the abrupt rise and drop of intermittent resources can theoretically decrease the need for spinning reserve resources to pick up the load.

3. **What value does a large scale electric energy storage system provide the integration of large amounts of renewable resources as compared to other backup or intermittency support alternatives?**

   The quicker response rates of most energy storage technologies can reduce the regulation requirements. This reduction could potentially be on the order of 2 to 1 which would represent a significant savings to customers.

4. **Where should large, utility scale electric energy storage systems be deployed to have the greatest beneficial impact on meeting the RPS goals of 2020?**

   Pumped storage and CAES are sited in locations with the appropriate geology. Distributed energy storage (e.g. batteries) has the greatest value and impact for renewables integration by being placed near load centers. Placement near load allows the energy storage to act as a buffer between the intermittent grid supplied resources and the load. In this configuration, regardless of the source of power, the load is serviced with constant power. If the energy storage were to be placed with resources, then the energy storage only supports that specific resource. In addition, energy storage placed near load centers would signal a dramatic improvement in operational flexibility and voltage characteristics.

5. **What is the cost of ownership of electrical storage systems, what benefits will be accrued, and how will they be distributed?**

   The cost of most electrical storage systems are above $1,500/kW, making the economics challenging unless multiple value streams are captured.

   Absent any formal rules for storage valuation, the benefits of energy storage are generically assumed to include the following:

   - *Renewables integration value*: Increased benefits from renewables capacity firming, avoided costs from displacing peaking plants, and reduced greenhouse gas emissions are some potential benefits that can be captured by using energy storage in conjunction with renewables.

- *Load leveling/shaping value*: Energy storage can be used to level or shape aggregate loads by storing energy during low cost times and discharging energy during high cost periods. The benefit is derived from the difference between off-peak and on-peak energy prices.
- *Avoided cost of adding new generation capacity*: If the energy storage system is sited in an area where capacity is tight, it has the potential to offset the need to purchase and install new generation or "rent" generating capacity in the wholesale electricity market. In such cases, the resulting cost reduction (or avoided cost) is the benefit associated with this application.
- *Increased benefits from providing ancillary services to the CAISO*: Energy storage systems can be used to generate benefits by providing the CAISO with ancillary services such as frequency regulation, spinning/non-spinning reserve, black start capability, and voltage control. Energy storage revenues could displace revenues from conventional sources.
- *Deferral of transmission and distribution upgrades*: In transmission and distribution (T&D), energy storage can be strategically placed to reduce congestion and increase utilization of the system, thereby delaying large investments in substations, lines, and equipment upgrades. If the energy storage is cheaper than the carrying charges of the T&D upgrades, the benefits ultimately accrue to ratepayers in the form of reduced costs, increased asset utilization, and optionality to use capital for other important projects.
- *Improved service reliability and power quality*: Benefits associated with improved service reliability and power quality accrue if storage reduces financial losses associated with outages and power fluctuations. This benefit can be end-user-specific and applies primarily to commercial and industrial customers for which power interruptions cause moderate to significant losses.

6. What are the challenges and solutions to having the costs associated with energy storage systems be recouped from those who benefit from the technology when the benefits are expected to be provided to multiple beneficiaries?

The costs associated with energy storage should be spread as broadly as possible given that improved reliability and dispatchability of the energy supply benefits all customers.

7. What actions are being taken by the electric energy storage industry to bring down the overall costs of large, utility scale electric energy storage systems?

PG&E will not provide a response to this question, as it seems more directed towards the energy storage industry.

8. **What incentive programs or other economic stimulus alternatives can be proposed that will encourage the deployment and fielding of more large, utility scale electric energy storage systems in California?**

   General incentives for qualifying deployments that focus on state needs are helpful. Since much of the potential value streams are still being quantified, providing more clarity on rate recovery for utility scale projects would allow utilities greater flexibility to explore applications that address these value streams. Furthermore, it is important for incentive programs to have a longer term focus. Many technologies are not "shovel ready". Development and commercialization will span many years, and short-term incentives will not be sufficient to encourage large capital investments. A recovery mechanism to address "dry hole" risk should also be considered in shaping storage incentive programs.

9. **What research is needed on energy storage in order for the California Grid to be capable of supporting the RPS goal of 33 percent renewables by 2020?**

   At higher penetration levels of renewables, the regulation and spinning reserve requirements will continue to increase in a non-linear manner. Research is needed to more fully understand this relationship and its impacts on the operational and planning criteria that are used to run and plan the electric system.

   The CAISO is currently re-estimating or confirming the integration needs of intermittent resources for 20%. The CAISO also plans to estimate the integration requirements of 33% RPS. These studies are needed to determine the incremental need for regulation, load following, and other ancillary services needed for 20% and 33% RPS levels, which should better define the need for new integration resources, including storage alternatives, and help quantify their benefits.