Gloria D. Smith
Managing Attorney
Sierra Club Environmental Law Program
85 Second Street, Second floor
San Francisco, CA 94105
(415) 977-5532
gloria.smith@sierraclub.org

STATE OF UTAH

Public Service Commission

In the Matter of:	Docket No. 15-035-04
Rocky Mountain Power's Integrated Resource Plan	

Sierra Club hereby submits the following preliminary comments regarding PacifiCorp's need to address energy storage technology in its 2015 IRP. These comments were prepared with the technical assistance of Chris Edgette, Senior Director at Strategen Consulting, LLC, located in Berkeley, California.

Introduction

During the 2015 Integrated Resource Planning Process, it has become clear that PacifiCorp has not conducted, and is not planning to conduct, modeling of energy storage.[1] Given recent cost effective procurement of energy storage by other utilities and independent power producers, Sierra Club believes that the omission of energy storage from the current IRP process may overlook significant benefits to ratepayers that might be gained from energy storage integration.

As modeling in other regions has shown, energy storage provides ratepayer benefits through its flexibility and speed as a multiuse grid asset. [2] Used appropriately, energy storage can increase

[1] To the purposes of this letter, we are considering energy storage as a resource that absorbs energy from the grid or a renewable generator, stores the absorbed energy, and discharges the stored energy to affect the state of the grid by: (a) directly supplying energy to the grid or (b) directly or indirectly reducing load on the grid.
These forms of energy storage can include thermal resources such as heated or chilled water, electrochemical resources such as batteries, and mechanical resources from flywheels to pumped hydroelectric storage.
[2] EPRI, *Cost-Effectiveness of Energy Storage in California* (June 2013)
http://www.cpuc.ca.gov/NR/rdonlyres/1110403D-85B2-4FDB-B927-5F2EE9507FCA/0/Storage_CostEffectivenessReport_EPRI.pdf

grid efficiency, reduce the delivered cost of energy and ancillary services, increase reliability, and reduce infrastructure requirements. Compared to traditional generation or transmission resources, energy storage is typically highly accommodating with regard to sizing, siting, and permitting, so it can be located closer to load, or closer to grid congestion points, than other options. Recent energy storage procurement has shown that costs are lower than anticipated, and energy technology costs continue to fall as production and integration of resources increases.[3]

In order to better understand the benefits of energy storage within PacifiCorp's system, we request that energy storage be comprehensively evaluated as part of the utility planning process and incorporated into future Integrated Resource Plans.

Broadly, we see three areas where energy storage could provide benefit to PacifiCorp's customers. Those areas may be categorized by their primary system benefit.

Energy Storage Providing Capacity and Additional Services

The first area is focused on energy storage procured primarily for capacity, though capacity-focused systems may also provide a variety of additional services, including ancillary services, fast ramping, and improved reliability. Capacity-based energy storage resources are able to provide peaking power and renewables integration in cost effective form. Unlike traditional generators, advanced energy storage startup costs are negligible, and storage resources have are no minimum operational levels, allowing these units to provide tremendous flexibility for grid operators. The dispatchable charging of energy storage resources can provide additional benefit by capturing excess renewable generation and by allowing less flexible resources to avoid short duration shutdowns.

Pumped storage systems have been providing these benefits around the world for decades. Though they pose difficulties in siting and environmental permitting in many cases, pumped storage has demonstrated the value that may be provided by different forms of energy storage. The development of more advanced energy storage technologies has increased the options available to utilities and utility customers. These new resources include batteries, thermal units, and mechanical resources that can provide high speed response, dramatic cost reductions, and highly scalable sizing. As a result of this innovation in technology, other utilities are actively developing capacity-focused advanced energy storage systems. Imperial Irrigation District recently procured a 20 MW battery resource for flexibility and capacity.[4] AES' Laurel Mountain project delivers 32 MW of regulation and wind smoothing in West Virginia.[5] Southern

[3] Aachen University, *Battery Storage for Grid Stabilization* (October 2014)
http://www.iea.org/media/workshops/2014/egrdenergystorage/Leuthold.pdf
[4] PV Tech, *California community-owned utility goes for battery to integrate 50MW of PV* (January, 2015)
http://storage.pv-tech.org/news/california-community-owned-utility-goes-for-battery-to-integrate-50mw-of-pv
[5] Forbes, *The World's Largest Lithium-Ion Battery Farm Comes Online* (October 2011)
http://www.forbes.com/sites/uciliawang/2011/10/27/worlds-largest-lithium-ion-battery-farm/

California Edison ("SCE") recently commissioned a 32 MW battery unit in Tehachapi, California, and is currently contracting for a 100 MW energy storage unit in Long Beach, California.

As part of its 2013 capacity procurement SCE evaluated multiple types of advanced energy storage to provide generation capacity, while further accounting for additional services that could be provided by these resources:

"SCE developed an ES evaluation model that co-optimized the off-peak/on-peak energy arbitrage and ancillary service benefits of an ES resource, while accounting for the proposed variable O&M costs for discharged energy, the round-trip efficiency impacts (i.e., charging-discharging energy losses), and effects of proposed constraints (e.g., maximum cycling per day, maximum discharging MWh per year) on such energy and ancillary services benefits. This model was still under development when SCE received indicative offers; thus, ES indicative offers were only valued by SCE from a capacity price and value standpoint. Sedway Consulting has its own ES model and used that to estimate energy benefits in the indicative offer evaluation. Both SCE and Sedway Consulting had the requisite modeling in place for the full evaluation of the energy and ancillary services benefits of final offers. In both instances, capacity benefits were calculated using the forward prices for capacity and the ES resource's calculated RA capacity… All benefits were netted with the proposed contract capacity payments, debt equivalence costs, and (in the case of final offers) transmission costs that were based on each offer's transmission cost cap. [6]

Within the context of SCE's mostly thermal generation system, SCE's optimization resulted in significant draws of potential advanced energy storage resources:

"The optimization tool created a selection set consisting of 25 draws in 25 MW increments of between 1,900 and 2,500 MW. While all draws were consistent with the specified targets, the resources selected in each of the draws caused some concerns from a best-fit perspective. All draws contained significant amounts of [In Front Of the Meter Energy Storage] (Draw 1 had over 400 MW and Draw 25 had over 900 MW)." [7]

As a result, SCE not only authorized the 100 MW Long Beach battery energy storage resource, but additionally procured 160 MW of customer sited energy battery and thermal storage, all of which will be located in the capacity constrained Los Angeles Basin. The new energy storage resources will allow SCE to add additional local capacity to its system without incurring

[6] Testimony of Southern California Edison Company on the Results of Its 2013 Local Capacity Request for Offers (LCR RFO) For the Western Los Angeles Basin (November 2014)

[7] Testimony of Southern California Edison Company on the Results of Its 2013 Local Capacity Request for Offers (LCR RFO) For the Western Los Angeles Basin (November 2014)

transmission, siting, and interconnection costs that might have been required by traditional resources.

As indicated by SCE in its analysis, it was necessary for the company to update its capacity based procurement evaluation to account for all the value that could be provided by advanced energy storage resources, including the value of frequency regulation. Typically, energy storage resources will provide maximum capacity during peak times, while also providing ancillary services and/or operating reserves during a large number of additional hours. The resulting resource capacity factor can exceed 90%.

The effectiveness of advanced energy storage for frequency regulation has been well demonstrated around the country. In PJM territory, 117 MW of fast responding energy storage resources are already providing fast regulation services. These new resources were so effective that they allowed PJM to reduce its regulation requirements from 1% of peak load in 2012 to 0.7% of peak load in 2013, without reducing system reliability.

"Since October 1, 2012, PJM has lowered the Regulation Requirement on several occasions. In October 2012, the requirement was reduced from 1.0 to 0.78 percent of the peak/valley load forecast. It was further reduced in November 2012 from 0.78 to 0.74 percent. Finally, in December 2012, the Regulation Requirement was lowered to its current value of 0.70 percent of the peak/valley load. Even with these significant reductions to the Regulation Requirement, CPS1 and BAAL metrics have held steady throughout 2013 and show an increase starting in the summer of 2013…"[8]

Duke Energy recently installed a 36 MW battery energy storage system specifically for regulation and wind shifting services in Notrees, Texas. The AES Johnson City project has been delivering up to 20 MW of frequency regulation services to NY ISO since 2011[9]. Midwest ISO has already proposed an enhancement to its Area Generation Control (AGC) that would enable fast responding advanced energy storage resources to provide greater value to its system.[10] While PacifiCorp self-provides balancing services, energy storage could enable smoother, more efficient operations of its existing generation fleet.

As has been demonstrated elsewhere in the country, advanced energy storage systems provide an excellent means to reduce capacity and ancillary services costs. We believe PacifiCorp should be modeling these resources to understand the benefits they could provide to customers.

---

[8] PJM Performance Based Regulation: Year One Analysis

[9] New York Times Green Blog, Hold That Megawatt! (January 2011) http://green.blogs.nytimes.com/2011/01/07/hold-that-megawatt/

[10] Midwest ISO *Automatic Generation Control (AGC) Enhancement for Fast Ramping Resources* (October 2014) https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/MSC/2014/20141028/20141028%20MSC%20Item%2005b%20AGC%20Enhancement%20for%20Fast%20Ramping%20Resources.pdf

Energy Storage for Distribution Cost Reduction

Utilities typically require large scale distribution upgrades due to load growth or high renewable penetration. Utilities install these upgrades to service customers only during periods of highest demand or highest distributed generation. By their nature, these periods occur only during a limited number of hours per year. As such, local energy storage, installed either at utility locations or at customer sites, can be highly effective at deferring or avoiding costly infrastructure upgrades.

Pacific Gas and Electric ("PG&E") has already installed two systems for distribution deferral. The first is a 2 MW system at its Vaca Dixon substation, which, in addition to distribution services, is selling ancillary services into CAISO wholesale markets. PG&E's second system is a 4 MW resource at the end of a distribution line in Silicon Valley; it provides voltage stabilization for customers, as well as up to six hours of backup energy in the case of a grid outage.[11]

In December of last year, PG&E identified five additional sites for distribution upgrade deferral, and is in the midst of an RFO to fulfill those needs. Energy storage resources ranging from 1 MW to 4 MW at each of the five locations can provide PG&E's ratepayers with a lower cost alternative to traditional distribution upgrades.[12]

San Diego Gas and Electric ("SDG&E") is seeking a distribution level 4MW/12MWh utility owned energy storage system in lieu of traditional circuit upgrades. SDG&E expects to provide capacity support to one or more sites and one or more 12kV circuits, in 1MW/3MWh incremental sub-units.

These upgrade alternatives are helping to integrate high levels of renewable energy generation as well as traditional load growth. Given the high benefit to cost ratio for upgrade deferral as modeled by both EPRI[13] and DNV GL[14], we expect to see additional procurement authorizations for utilities across the country.

---

[11] PG&E Currents, *Largest Battery Energy Storage System in California to Improve Electric Reliability for Customers* (May 2013) http://www.pgecurrents.com/2013/05/23/largest-battery-energy-storage-system-in-california-to-improve-electric-reliability-for-customers/

[12] PG&E, *Energy Storage Request for Offers Solicitation* Protocol (December 2014) http://www.pge.com/includes/docs/pdfs/b2b/wholesaleelectricsuppliersolicitation/Energy_Storage/00_EnergyStorage_Protocol_Updated_012715_Clean.pdf

[13] EPRI, *Cost-Effectiveness of Energy Storage in California* (June 2013) http://www.cpuc.ca.gov/NR/rdonlyres/1110403D-85B2-4FDB-B927-5F2EE9507FCA/0/Storage_CostEffectivenessReport_EPRI.pdf

[14] DNV KEMA *Energy Storage Cost-effectiveness Methodology and Preliminary Results* (June 2013) http://www.cpuc.ca.gov/NR/rdonlyres/A7FF0A4E-44FA-4281-8F8F-CFB773AC2181/0/DNVKEMA_EnergyStorageCostEffectiveness_Report.pdf

Energy Storage to Reduce Transmission Costs

Utilities and transmission operators outside PacifiCorp territory are also proposing energy storage to reduce transmission costs. In November of last year, Texas transmission utility Oncor announced that it will seek regulatory approval to build up to 5000 MW of energy storage resources to firm up its grid and improve reliability. Based on a study it commissioned from the Brattle Group, Oncor says the procurement would reduce average residential electric bills by 34 cents per month.[15,16]

Oncor is already testing energy storage systems that could provide reliability benefits in addition to transmission cost reduction. According to the Dallas Business Journal:

"Oncor already is testing … two 25 kilowatt batteries in South Dallas that kick on automatically when there's a power outage or other problem on the grid.

"We've already seen the benefits of this in a test pilot in South Dallas," Molina said. "It's working for them. They saw it during our last power outage. They were able to keep their power."[17]

In the context of PacifiCorp, there may be an opportunity to reduce the cost of retirements, some of which is due to transmission upgrades. Advanced energy storage may provide an opportunity to reduce the retirement cost of the Carbon Power Plant, while additionally providing capacity, volt/VAR support, and ancillary services to the grid. Energy storage may also provide opportunities in the retirements of Huntington and other plants.

Energy Storage Enables Increased Local Generation

As has been shown by recent procurement by utilities, energy storage can be effective as either a centralized or distributed asset. In certain cases, large scale units can provide the greatest benefit to cost ratio. In other cases, distributed aggregated energy storage can allow ratepayers to participate directly in the benefits of energy storage systems, while increasing local reliability and reducing grid infrastructure costs. As the grid moves to a more decentralized generation

[15] The Brattle Group, *The Value of Distributed Electricity Storage in Texas (November 2014)* http://www.brattle.com/system/news/pdfs/000/000/749/original/The_Value_of_Distributed_Electricity_Storage_in_Texas.pdf?1415631708

[16] Brattle Group, *Deploying Up to 5,000 MW of Grid-Integrated Electricity Storage in Texas Could Provide Substantial Net Benefits According to Brattle Economists* (November 2014) - http://www.brattle.com/news-and-knowledge/news/749

[17] Dallas Business Journal, *Oncor proposes massive battery storage project on the grid with Tesla* (November 2014) http://www.bizjournals.com/dallas/news/2014/11/13/oncor-proposes-massive-battery-storage-project-on.html?page=all

model, we believe that PacifiCorp should evaluate opportunities for ratepayer cost reduction in all areas.

Energy Storage Provides Great Potential for PacifiCorp's Future Grid Needs

The FERC-approved salt cavern energy storage project in western Utah demonstrates what is possible. A joint project by Pathfinder Renewable Wind Energy, Magnum Energy, Dresser-Rand, and Duke-American Transmission, this project would provide more than double the amount of energy generated by the Hoover Dam.[18] Southern California Public Power Authority is proposing to use this project to provide balanced, cost effective wind energy for a large portion of Southern California.

We believe that PacifiCorp, utilizing other utilities' best practices, will find that energy storage can provide a lower cost, higher reliability option for its ratepayers. We look forward to collaborating with PacifiCorp and the Utility Commission to provide a reasonable and realistic evaluation of energy storage in the utility's territory.

Dated: April 17, 2015

Respectfully submitted,

Gloria D. Smith
Managing Attorney
Sierra Club Environmental Law Program
85 Second Street
San Francisco, CA 94105
(415) 977-5532
gloria.smith@sierraclub.org

[18] Deseret News, *Massive green-energy project taps salt caverns near Delta* (September 2014) http://www.deseretnews.com/article/865611571/Massive-green-energy-project-taps-salt-caverns-near-Delta.html?pg=all