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CITY OF GLENDALE

Energy Storage System Procurement Targets

Compliance Report



Prepared by:

Glendale Water and Power

12/30/2016

141 N Glendale Avenue, Level 4

Glendale, CA 91206

1. Executive Summary

The City of Glendale, which owns and operates Glendale Water and Power (GWP), a local publicly owned electric utility, provides electric service to nearly 88,000 retail customers. GWP has a summer load peak of approximately 300 MW and an annual load obligation of 1.1 million MWh. GWP has made significant progress in meeting the requirements of the California Renewable Portfolio Standard (RPS) and Greenhouse Gas (GHG) reduction programs. Currently, at least 25% of its annual energy requirement is derived from renewable energy sources. GWP is continuously evaluating investment opportunities to ensure compliance to the increasing RPS targets, effectively integrate renewable resources, and maintain an efficient and reliable electric system.

In 2014, the City Council has adopted an energy storage target equal to the 1.5MW of an existing energy storage project and directed GWP to return to Council with an update regarding energy storage procurement under the Integrated Resource Planning process.

Pursuant to the requirements of California Assembly Bill 2514, GWP files this report with the California Energy Commission to demonstrate that it has complied with the energy storage system procurement targets and policies adopted by the City Council.

This report provides an update on the established storage target as well as the energy storage screening options identified in the 2015 Integrated Resource Planning initiative. Furthermore, an update on the Battery Energy Storage System, a pilot project, is also included in this report.

2. Adopted Energy Storage Procurement Targets

Assembly Bill 2514 (Skinner, Chapter 469, Statutes 2010) requires the governing board of the local publicly owned electric utility (POU) to open a proceeding by March 1, 2012 to determine appropriate targets, if any, for procuring technically viable and cost-effective energy storage system.

No later than October 1, 2014, the governing board is required to adopt an initial energy storage system procurement target, if determined to be appropriate, to be achieved by December 31, 2016, and a second target to be achieved by December 31, 2021. Subsequently, the POU must submit a report to the Energy Commission by January 1, 2017 for the first compliance period, and January 1, 2022 for the second compliance period.

As defined in the statute, “energy storage systems” means commercially available technology that is capable of absorbing energy, storing it for a period, and thereafter dispatching the energy.

The energy storage system has to be installed and first becomes operational after January 1, 2010 to be eligible. The system may either be centralized or distributed and shall accomplish one of the following purposes:

- reduce emissions of greenhouse gases;
- reduce demand for peak electrical generation;
- defer or substitute for an investment in generation, transmission, or distribution assets; or
- improve the reliable operation of the electrical transmission or distribution grid.

The system shall also meet at least one of the following characteristics:

- Use mechanical, chemical, or thermal processes to store energy that was generated at one time for use at a later time.
- Store thermal energy for direct use for heating or cooling at a later time in a manner that avoids the need to use electricity at that later time.
- Use mechanical, chemical, or thermal processes to store energy generated from renewable resources for use at a later time.
- Use mechanical, chemical, or thermal processes to store energy generated from mechanical processes that would otherwise be wasted for delivery at a later time.

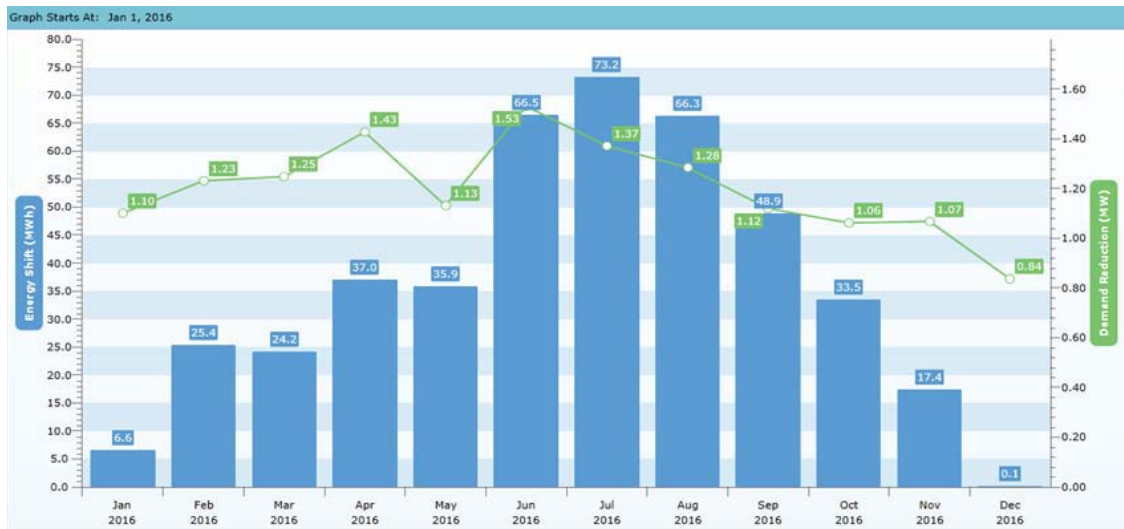
Based on the above criteria, GWP staff has identified and recommended to use the existing Ice Bear installations as the procurement target for the first compliance period. On September 9, 2014, the City Council adopted the existing procurement of 1.5 megawatts (MW) of energy storage as the City of Glendale's energy storage target, along with the authorization to allocate \$550,000 to provide continued maintenance of the Ice Bear units through the end of the term of the current maintenance and service agreement with Ice Energy (Appendices 1 and 2).

Ice Bear, a thermal energy storage system developed by Ice Energy and works in conjunction with commercial air conditioning systems, is a distributed behind-the-meter storage system that aims to reduce peak electricity demand by utilizing electric energy to produce ice at night during off-peak hours then use the ice for cooling during the day. This process has a result of eliminating the large electrical load of primary compressor of commercial air conditioners that would otherwise operate during peak periods of system electric demand, which typically coincide with the peak thermal load in the afternoon.

Glendale's Ice Bear project was procured in collaboration with the Southern California Public Power Authority (SCPPA), a joint powers authority of which Glendale is a member, and as approved by the City Council on January 26, 2010. The purchase and installation of the 166 Ice Bear units on City and customer premises were part of the US Department of Energy (DOE) modernization grant project. Ice Energy completed the installation of all units in June 2011, which represents approximately 1.6MW of installed capacity.

Currently, there are 161 Ice Bear units in operation. 5 units were decommissioned early this year. Even with the reduction in the number of units, the system has recorded a peak capacity or demand reduction of 1.53MW in 2016, as shown in *Figure 1 – 2016 Utility Systems Impact Dashboard*.

Figure 1 – 2016 Utility Systems Impact Dashboard



Source: ICE Energy

Based on Ice Energy’s monitoring system, the average peak capacity reduction over the 5 year operation period of the Ice Bear project is approximately 1.6 MW, with an annual average of energy shift from peak to off-peak of 512 MWh/year. The period for peak capacity reduction of HVAC load is from 12:00 noon to 6:00 pm every day of the week, including Saturdays and Sundays.

Figure 2 – GWP Ice Bear Annual Performance Report shows the performance history of GWP’s Ice Bear system from January 2011 through November 2016.

Figure 2 – GWP Ice Bear Annual Performance Report

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	0.38	0.47	0.61	0.68	0.82	1.05	1.3	1.51	1.53	1.44	1.31	1.25	1.53
Energy Shift, peak to off peak (MWh)	6	4	11	22	33	56	95	114	95	56	18	10	520.0
2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	1.32	1.2	1.33	1.42	1.35	1.33	1.45	1.56	1.56	1.57	1.39	1.14	1.57
Energy Shift, peak to off peak (MWh)	16	13	18	33	52	65	86	118	97	60	21	8	587.0
2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	1.26	1.17	1.28	1.27	1.33	1.42	1.37	1.32	1.34	1.32	1.41	1.29	1.42
Energy Shift, peak to off peak (MWh)	9.3	10.1	22.6	32	52.5	70.1	91.9	90.6	79.8	41.5	19.8	11.2	531.4
2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	1.29	1.25	1.32	1.35	1.27	1.14	1.25	1.23	1.22	1.15	1.27	1.1	1.35
Energy Shift, peak to off peak (MWh)	17.4	14.7	28	39.6	58.9	61.7	78.8	76.4	68.7	44.2	14.4	7.1	509.9
2015	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	1.16	1.11	1.21	1.19	0.94	1.23	1.92	1.49	1.29	1.28	1.15	1.12	1.92
Energy Shift, peak to off peak (MWh)	11.1	15.8	29.2	23.5	22.3	55.1	80.4	88.3	78.9	58.1	16.1	8.9	487.7
2016	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peak Capacity Reduction (MW)	1.1	1.23	1.25	1.43	1.13	1.53	1.37	1.28	1.12	1.06	1.07		1.53
Energy Shift, peak to off peak (MWh)	6.6	25.4	24.2	37	35.9	66.5	73.2	66.3	48.9	33.5	17.4		434.9
Average Peak Reduction (MW)													1.6
Average Shift, peak to off-peak (MWh)													511.8

Source: ICE Energy

3. Integrated Resource Plan – Energy Storage Screening

In collaboration with Pace Global, GWP developed the Integrated Resource Plan and presented the results to the City Council on June 2, 2015. This plan provides a roadmap for resources decisions over the next several years. To facilitate resource assessment and decision-making, GWP has established several key objectives to support the “best” portfolio selection process. These include:

- Minimize generation portfolio cost
- Improve Rate Stability/Manage Risks to Ratepayers
- Improve Reliability
- Enhance Environmental Stewardship
- Manage Debt Levels

Among other major issues, the IRP has identified the impacts and benefits of utilizing various types of energy storage technologies at the grid level, distribution level, and behind the meter as one of the fundamental IRP issues. The IRP screening process has identified three different potential applications for storage resource additions. The results of the assessment analysis are summarized below.

Grid Scale Storage designed to firm remote renewable resources

After screening a variety of battery options, it was determined that Lithium-Ion battery storage with four-hour storage duration is the most feasible technology for potential deployment

The test portfolio includes a 50MW of grid-scale battery to firm the intermittency of remote resources, added either in 2019 or in 2025, using reduced price forecast. The model optimizes the battery resource dispatch to charge when net load inclusive of renewable generation is low and discharge when load is high. Based on the output of the model, the analysis indicates a \$12/MWh increase in the overall levelized costs of the test portfolio with battery addition in 2019, which represents a 12% higher overall system cost every year. Even with delayed deployment in 2025, in anticipation for cost decline, the overall cost is still higher by \$6/MWh.

Given the results, the grid-scale battery addition is not a viable and cost effective option at this time. However, this determination should be revisited if storage prices fall sufficiently.

Behind the meter scale storage designed to shift load

The screening review process focused on the potential deployment of a 10 MW and 20 MW Ice Bear resource additions. This system uses and stores energy at night and then delivers it during the day when air conditioning loads are highest.

Considering all Ice Bear costs are assumed by GWP, the results of the analysis indicates that the addition of Ice Bear units to the portfolio increases the baseline cost by between \$0.6 - \$1.2/MWh.

Unless customers help pay for thermal energy storage, behind the meter storage is not cost-effective.

Substation scale storage designed to provide ancillary services such as frequency regulation through automatic generation control (AGC) or spinning reserves.

With the intra-hour balancing of loads and resources requirements and the penalty payments associated with deviations, GWP considered a battery energy storage solution as a viable option that could potentially reduce the magnitude and frequency of deviations and serve to mitigate the risk of paying penalties for inadvertent exchange. In addition, the same BESS can also provide spinning reserve services.

In the analysis, a single 30-minute BESS is assumed to provide both regulation and spinning reserve service. The cost assumptions include amortized capital costs, ongoing fixed O&M, and Augmentation Fixed O&M, a cost adder for the replacement of degraded battery cells over the life of the BESS at about 5% each year. Dispatch simulations were executed on a test portfolio with 10MW, 20MW, 30MW, and 40MW battery systems, including local generation Grayson Unit 9 on AGC in the mix, using 2014 historical deviation data.

Test results show battery sizes 20MW and above contribute to modest penalty avoidance savings for GWP, but are still unable to eliminate large and persistent deviations, driving continued penalties. The annual costs for the BESS are estimated to be greater than the combined savings from both regulation and spinning reserve operations.

Conclusion

Based upon the results of the IRP storage screening process, staff finds the economics of storage resource deployment do not meet the “least cost-best fit” criteria for GWP resource selection. No additional storage target is recommended at the moment.

As required by AB 2514, GWP will revisit this determination no less than once every three years. Results of the reevaluation will be submitted to the commission no later than October 1, 2017.

4. Other Storage Initiatives

GWP recognizes the significant role of energy storage in relation to the needs of the electric grid as a whole. GWP is committed to continuously monitor and assess the storage market for cost-effectiveness.

Independent of the adopted procurement target under AB 2514, GWP entered into an Energy Supply Agreement in 2016 for the procurement, design and installation of a 2MW Battery Energy Storage System as a pilot project.

This BESS is a small scale system that GWP will use to develop knowledge and gain experience in the use of battery storage and eventually use that experience to develop and incorporate a larger scale battery component into its energy system once the economics improve.

The installation of the BESS will better characterize the role and value of the storage system in actual operations, facilitating the re-evaluation process for appropriate energy storage system procurement targets and policies, as required by the statute.

Construction of the pilot BESS project is scheduled to be completed by the second quarter of 2017.

5. Appendices

Appendix 1 - Motion Adopting a Procurement Target

Appendix 2 - Motion Allocating \$550,000 for the Ice Bear Maintenance

MOTION

Moved by Council Member Friedman, seconded by Council Member Devine, that, in accordance with the requirements of California Assembly Bill 2514 (2010), Public Utilities Code Section 2835, *et seq.*, the City Council hereby adopts the existing procurement of 1.5 megawatts (MW) of energy storage within Glendale Water & Power's service territory as the City of Glendale's energy storage target. The City Council directs Glendale Water & Power staff to report on energy storage options and provide an energy storage procurement recommendation to the City Council as part of the Integrated Resource Plan (IRP) process approved by the City Council on August 19, 2014.

Vote as follows:

Ayes: Devine, Friedman, Sinanyan

Noes: None

Absent: Najarian, Weaver

Abstain: None

THE MOTION WAS ADOPTED AT THE
REGULAR CITY COUNCIL MEETING OF:
Tuesday, September 9, 2014.

APPROVED AS TO FORM
[Signature]
Senior Assistant City Attorney
Date: September 3, 2014

MOTION

Moved by Council Member Friedman, seconded by Council Member Devine, that the City Council hereby authorizes the expenditure of an amount not to exceed \$550,000 to provide for continued maintenance of Ice Bear energy storage units under an existing Maintenance and Verification Services Agreement between the City of Glendale, Ice Energy California (Operations), LLC, and the Southern California Public Power Authority (SCPPA), as described in the General Manager of Glendale Water & Power's Report to the City Council dated September 9, 2014.

Vote as follows:

Ayes: Devine, Friedman, Sinanyan

Noes: None

Absent: Najarian, Weaver

Abstain: None

THE MOTION WAS ADOPTED AT THE REGULAR CITY COUNCIL MEETING OF: Tuesday, September 9, 2014.

APPROVED AS TO FORM
[Signature]
Senior Assistant City Attorney
Date: September 3, 2014