

Residential Battery Demand Response Pilot

A. Description

Background

Batteries are quickly emerging as an important component of the electricity system. A growing number of utilities have signaled their interest in batteries through pilots and resource solicitations. The Company, for example, recently proposed the acquisition of 275 MW of batteries through its latest resource solicitation.¹ Similarly, customers are beginning to make investments. California customers have led the way with nearly 100 MW of installations since the beginning of 2016.² The Colorado market is also showing signs of growth. In 2017 and 2018, residential Public Service customers installed nearly 100 batteries (approximately 500 kW of capacity) and there are 200 more applications in the interconnection process.

Batteries can perform multiple functions for the customer and the grid. A battery can provide back-up power to a customer's critical energy uses during a grid outage, while also helping to manage energy costs when paired with time-of-use or demand rates. From the grid perspective, a battery sited at a customer location could deliver system peak load reduction, support local voltage management, and/or provide renewable integration to name just a few.³

The Company proposes the Residential Battery Demand Response pilot to test how battery technology could contribute to the grid. In the pilot, the Company partners with early adopters that are already installing battery technology. These early adopters afford the Company a unique opportunity to leverage ongoing customer and third-party investment to test batteries more quickly, and at a lower cost, in order to build the expertise and experience necessary to develop scalable products in the coming years.

Pilot Description

The Residential Battery Demand Response pilot seeks to address three research areas: (1) integration of batteries into utility systems, (2) battery performance, and (3) customer preferences.

Integration of batteries into utility systems: The pilot seeks to integrate a set of batteries from two or more technology vendors⁴ into its Demand Response Management System

¹ See Proceeding No. 16A-0396E.

² GTM Research and Energy Storage Association. (2018). *U.S. Energy Storage Monitor: Q2 2018 Full Report*.

³ Several organizations have provided a comprehensive accounting of the potential functions a battery can provide, for examples see: National Renewable Energy Laboratory. (2016). *Batteries 101 Series: Use Cases and Value Streams for Energy Storage*. Retrieved from <https://www.nrel.gov/technical-assistance/blog/posts/batteries-101-series-use-cases-and-value-streams-for-energy-storage.html> and Rocky Mountain Institute. (2015). *The Economics of Battery Energy Storage*.

⁴ The Company uses "Technology Vendor" to refer to the entity that either pre-sets the battery equipment to participate in the pilot or operates and maintains software and communications that directly control the battery on behalf of the Company. Examples of Technology Vendors include Sonnen, SolarEdge, Sunrun, and Tesla.

(DRMS). The DRMS can streamline the integration and use of batteries by making it easier to gather data from individual batteries and send DR instructions back to the batteries.

Battery performance: The Company will assess the availability of batteries for demand response. In addition, the pilot will evaluate the quantity of demand response offered from a battery and the response speed during a series of year-round demand response events. The Company's assessment of availability and performance is critical in determining expected performance of the technology and ultimately assessing the level of compensation to be offered to future customers.

Customer preferences: Customers can choose to use their battery in ways that provide benefits solely to the battery customer (e.g., back-up power), to the grid, or both. The pilot will explore customer interest in allocating a portion of their battery to support the grid.

To achieve these objectives, the pilot will focus on a simple incentive structure. Customers who agree to participate in the pilot will receive ~~an a upfront rebate of \$1,250 at the time of enrollment along with an ongoing monthly bill credit during the pilot.~~ In exchange for ~~those incentive payments~~ this rebate, a customer will agree to allow the utility to use ~~50~~80% of the battery's available capacity for up to 100 events per year. To manage pilot costs, the Company will select a small number of technology vendors for participation.

The Company will use participant batteries to test how a battery performs as a (DR) resource. The Company will call events that will result in the discharge of the battery over the duration of the event. The amount of DR from each battery will be governed by the customer's interconnection agreement⁵—with some customers able to discharge all available capacity and other customers limited to discharging an amount not to exceed their onsite electricity demands.

This pilot expands on common residential DR practices. Existing products, such as AC Rewards and Saver's Switch®, only operate during the summer months when there is air conditioning load. As a result, the Company's period to call events is limited. Unlike air conditioning-based control strategies, batteries can provide demand response year round, and the regular use of a battery does not have the potential to affect the customer's comfort in any way. As a result of these differences, a battery can be used more frequently and for more purposes.

Approximately half of the proposed DR events will provide regular peak-load reduction during the summer months. The remainder of events will be spread across non-summer months to provide afternoon capacity during days when wind production is below average. In addition, in non-summer months, the Company may reserve one spring or fall month to perform a solar time-

⁵ The Company offers several interconnection options for customers seeking to connect a battery to the grid behind their meter. Some of these options allow a customer to export energy from the battery to the grid. Other options do not allow for export. To review these interconnection standards, see Storage Guidance 1, Storage Guidance 2, and Storage Guidance 3 on Xcel Energy's "How to Interconnect" webpage (https://www.xcelenergy.com/working_with_us/how_to_interconnect).

shifting function, where the battery charges with solar in the middle of the day and discharges in early evening. The solar time-shifting function is aimed at the distribution system, and could become useful in the future as rooftop solar adoption continues to grow.⁶

To execute these events, the Company's DRMS will send a secure signal to a participating vendor's network operating center. The vendor will then communicate instructions to each battery through the internet or the vendor's preferred communications path to the battery.

B. Targets, Participants & Budgets

Targets and Participants

The Company will target existing residential customers with batteries that have interconnected in a way that allows the battery to operate in parallel with the grid. This pool of customers is limited to systems interconnected after January 1, 2017, since any systems interconnected before that time were not permitted to operate in parallel with the grid. In addition to existing battery customers, the Company will also partner with installers⁷ to inform new customers that are considering battery purchases. Any customer that purchases or leases a system using an approved vendor technology, regardless of who installs their system, will be eligible to participate in the pilot.

The pilot will target participation from up to 500 residential customers. This number is based on forecasts of total residential market size in Colorado from Greentech Media.⁸ A pilot of this scale will have a better chance of attracting interest and participation from vendors and yielding more diverse information about customers and different battery types. The Company's achievement of this level of customer participation in the pilot will be partly determined by whether installers are able to continue to sell battery systems in the volumes achieved since the beginning of 2017.

Budgets

The largest share of the budget is for rebates and incentives. Administrative expenditures are associated with vendor selection, promotion and vendor partnerships to capture participants, monitoring and management of enrolled battery systems during demand response events. The Company also has inserted costs to integrate vendor technology into its DRMS and collect data from vendors and customers necessary to perform measurement and verification (M&V) of battery system performance.

⁶ The solar time shifting function is typically aimed at customer's that have both on-site solar and storage. However, it may also be deployed to stand-alone battery customers, by charging and discharging the battery at times that reflect the same dynamics that occur for customers with on-site solar (when solar on the system is peaking, charge the battery, and when residential demand peaks, discharge the battery).

⁷ "Installers" refer to the company that is installing the hardware at the customer's home. In some instances the installer is the same as the "Technology Vendor" that operates the battery (e.g., Tesla). In other instances, an installer is using hardware and software partly or wholly supplied by a Technology Vendor (e.g., Local solar installer chooses an LG Chem battery and a SolarEdge inverter that is operated by SolarEdge software).

⁸ GTM Research and Energy Storage Association. (2018). *U.S. Energy Storage Monitor: Q2 2018 Full Report*.

C. Application Process

A customer that would like to participate in the pilot will enroll through an online or paper-based enrollment process. The Company will ask for information necessary to validate that the customer and their technology is eligible to participate in the pilot. At this time, the customer would agree to terms and conditions associated with the pilot, including agreement to share data necessary for calling DR events and performing M&V. The Company will confirm a customer is eligible by verifying customer equipment has been installed and connected to a participating technology vendor's cloud service.

After eligibility is confirmed, the Company will mail a rebate check to the customer. In addition, the Company will set up its systems to provide the customer with a monthly credit for the duration of the pilot.

D. Marketing Objectives & Strategies

The Company will use a targeted marketing approach that attracts existing battery customers into the pilot, while also informing prospective customers that are engaging with installers. The Company will prepare and use promotional materials through direct mail, email, and/or phone campaigns to existing battery customers. It will also seek to engage the small community of existing battery customers in more non-traditional marketing forms, such as meet-ups to discuss batteries and the pilot. In addition, the Company will develop a program webpage to explain the pilot and promote it to interested customers. To target prospective customers, the Company plans to educate installation partners and provide them with promotional materials.

The Company also intends to further collaborate and coordinate with technology vendors and installation partners to consider how they may directly promote the pilot to customers.

The Company will adapt its marketing tactics over the course of the pilot depending on pilot participation results.

E. Product-Specific Policies

Batteries: Participation is open to customers that have onsite solar and battery storage or standalone battery storage. As of the end of the first quarter of 2018, combination solar and battery customers made up 84% of the customer-sited battery storage market in the Company's service territory. The emphasis on solar and battery storage customers allow the Company to focus its testing efforts on the largest part of the battery storage market in the state and test the interaction between solar and batteries.

Interconnection Agreement: Each customer participating in the pilot must have an interconnection agreement with Public Service that allows their system to operate in parallel with the grid. These interconnection agreements will dictate how the Company utilizes each

customer’s battery in the pilot. For example, some agreements only permit a customer to use their battery to offset onsite electricity demand. For these customers, the Company will work with participating technology vendors to ensure a customer’s participation in the pilot does not violate the interconnection standard they have chosen to operate within.

Eligible Technology: The Company will select one or several approved technology vendors for participation in the pilot. The vendor selection process will primarily focus on the vendor’s capability to execute a demand response signal, whether the vendor is ready to integrate with the Company’s DRMS, and the number of existing or forecasted systems that the technology vendor expects to see installed in Colorado.

System Size: There is a wide range of battery sizes in the residential market today that range from one kWh up to tens of kWh. For this initial pilot, the Company is limiting participation to those customers that have batteries equal to or greater than five kWh.

Early Termination: The Company will include an early termination fee to discourage customers from accepting an upfront rebate and ~~leaving unenrolling the pilot before the Company is able to achieve its learning objectives. The early termination fee will be prorated based on the amount of time the customer has participated in the pilot. If a customer leaves the pilot before they have participated for a full year, the customer will be required to pay back the \$500 upfront rebate.~~⁹ If a customer chooses to leave after one year of participation, there will be no early termination fee.

F. Stakeholder Involvement

During the pilot development process the Company engaged numerous stakeholders to gather feedback and refine the pilot including the following events:

Stakeholder Type/Group	Date	Description
Demand Side Management Roundtable	February 15, 2018	<ul style="list-style-type: none"> • Introduced pilot • Requested interested parties attend Existing/Future Programs and Grid Stakeholder Group for detailed pilot description
Existing/Future Programs and Grid Stakeholder Group	February 23, 2018	<ul style="list-style-type: none"> • Description of initial pilot concept • Feedback and discussion
Existing/Future Programs and Grid Stakeholder Group	June 15, 2018	<ul style="list-style-type: none"> • Further details on pilot concept, including initial plan for participation

⁹The Company will consider a year of participation as one year from the date the Company verifies the Customer has an eligible system and approves a customer’s enrollment in the pilot.

		<p>options and customer incentive levels</p> <ul style="list-style-type: none"> • Feedback and discussion • Shared contact information and offered further discussions with any interested stakeholders
Installers	Numerous	<ul style="list-style-type: none"> • Multiple conversations with installers throughout the pilot design process covering program objectives and attributes
Technology Vendors	Numerous	<ul style="list-style-type: none"> • Multiple conversations with installers throughout the pilot design process covering program objectives, attributes, technical battery and software capabilities, and integration approaches
Battery Customers	Numerous	<ul style="list-style-type: none"> • Prior to product launch, the Company plans to discuss motivation for battery investment and feedback and interest in the pilot concept
<u>Solar plus storage working group associated with 2020-2021 Renewable Energy Compliance Plan</u>	<u>Numerous</u>	<ul style="list-style-type: none"> • <u>Company engaged with Public Utilities Commission Staff, Colorado Energy Office, Colorado Solar and Storage Association/ Solar Energy Industries Association, Energy Outreach Colorado, Grid Alternatives, the City of Boulder, the City of Denver, and Western Resource Advocates</u> • <u>Stakeholders discussed goals related to storage and different ideas for program concepts</u>

		<ul style="list-style-type: none"> • <u>The Company proposed and sought feedback on changes described herein as a way to meet some of the group’s goals related to encouraging storage deployment</u>
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G. Rebates & Incentives

The Company will offer a ~~combination of rebates and credits~~ to participating customers. Upon signing up for the pilot, each customer will receive a rebate of ~~\$500~~1,250. ~~During each month the customer participates in the pilot, they will also receive a \$10 credit on their bill.~~

The ~~combination of an~~ upfront incentive ~~and an ongoing bill credit~~ is meant to draw customers into the pilot, ~~while providing ongoing value that keeps them invested in participating for the full pilot.~~ The Company selected a total compensation that it thought could attract a customer who had made a multi-thousand dollar investment in their battery. The Company also considered typical customer compensation in Company demand response products and the range of state and utility incentives for battery storage that exist nationally.¹⁰

The rebates and incentives are designed to attract participation for this particular pilot, and do not necessarily reflect the compensation level or structure for any future product.

H. Evaluation, Measurement, & Verification

There are four components to the Evaluation, Measurement, and Verification plan for this pilot.

At and immediately after the time of enrollment in the pilot, the Company will perform the following three activities to better understand the customer’s motivations for participating in the pilot and to validate their equipment:

- Desktop review: The Company reviews the installation to ensure that the installation matches the Company’s expectation for the performance of the system.
- Sampling of onsite reviews: The Company performs site visits to make sure the physical interconnection is capable of performing the desired function. The number of site visits will scale up based on the number of participating customers and is based on achieving 90% confidence in battery installations. For example, if there are 100 pilot participants, the Company will visit between 20 and 40 sites.
- Enrollment survey: At the time of enrollment, the customer will complete a short survey explaining the customer’s reasons for participating in the pilot.

¹⁰ The Company reviewed several battery incentive programs that included California’s Self Generation Incentive Program, Maryland’s Energy Storage Tax Credit Program, Jacksonville Electric Authority’s Battery Incentive Program, and Green Mountain Power’s Tesla program.

During and at completion of the two-year pilot, the Company will estimate the demand response availability and performance of each battery system and compare the performance to initial estimates. The analysis will utilize data supplied by participating installers and vendors and taken from a combination of the inverter, current transformers, and utility metering.