DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Product: Residential Battery Demand Response

Description:

Residential customers with select ~~solar and~~ battery storage systems, receive a rebate for participating in a demand response program. Xcel Energy calls on a customer's battery to off-set the customer's load and potentially export capacity during frequent DR events called in the afternoon.

Equations:

~~Eq.kW_Savings (Customer kW)~~	~~See Table 2~~
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Average Annual Battery Electric Demand Savings (PC Customer kW)	= Customer_kW * Coincidence_Factor
Non_Export_Customer_kW	= MIN (((Battery_Quantity * %_Battery_DR) / Event_Duration) , Gross_Customer_Demand)
Non_Export_Customer_kWh	= Non_Export_Customer_kW * (1 - Round_Trip_Efficiency) * Event_Duration * Cycles_Year
Export_Customer_kW	= MIN (((Battery_Quantity * %_Battery_DR) / Event_Duration), Available_Inverter_Capacity)
Export_Customer_kWh	= Export_Customer_kW * (1 - Round_Trip_Efficiency) * Event_Duration * Cycles_Year

Variable ID	Value	Description
~~Baseline_kW~~	~~See Table 2~~	
~~Proposed_kW~~	~~0~~	
~~Battery_Capacity~~	~~6.75~~	~~Amount of energy (kWh) in the battery reserved for demand response. We assume the full~~
~~Inverter_Size~~	~~6~~	~~The continuous power (kW) rating of the battery.~~
%_Battery_DR	80%	Percentage of customer battery that will be used during DR events
Event_Duration	4	The duration, in hours, that each event will last
Cycles_Year	100	Estmated number of demand response events the pilot will call in a year
Coincidence_Factor	100%	Percentage of Customer_kW savings that will coincide with peak summer kW savings
NTG	100%	Net to Gross adjustment
Measure Life	10	(Reference 4)
Incremental Capital Cost	$0	
Battery_Quantity	Customer Input	# of kWh available from the customer's battery or batteries, must exceed 5 kWh
Gross_Customer_Demand	Customer Input	Average gross on-site load during the hours of a demand response event that can be off-set by discharging a non-exporting battery
Available_Inverter_Capacity	Customer Input	Average inverter capacity remaining for battery to utilize, accounting for solar production, during the hours of a demand response event
Round_Trip_Efficiency	Customer Input	Customer input describing the round trip efficiency expected from their battery

Inputs:	Verified during M&V:
~~Battery charges with rooftop solar~~	~~Yes~~
Battery_Quantity	Yes
Gross_Customer_Demand	Yes
Available_Inverter_Capacity	Yes

Assumptions:

~~Regardless of whether the system is permitted to export or not, we assume that all systems will charge exclusively with rooftop solar. We make this assumption because we imagine most customers will seek to take advantage of the federal Investment Tax Credit (ITC), which requires that at least 75% of the charging comes from on-site solar. To take advantage of the full ITC, all battery charging must come from on-site solar.~~
~~The program is for customers that install rooftop solar and storage, it currently excludes customers with stand-alone storage.~~
~~Load reduction calculations found in Table 2 assume randomized demand response in summer and non-summer months. The total number of calls is 100 per year.~~
~~Table 2 averages assume that the typical demand response event in the summer will fluctuate between 2-6 pm and 3-7 pm. In the winter the typcial DR event will occur from 5-9 pm. These hours/days are used to calculate the average demand response potential for a battery.~~
Non-export means a customer that interconnects a solar plus storage system under an interconnection standard that does not allow the battery system to export because it can charge from the grid and the on-site solar. The relevant interconnection standards are "2a" and "2c" and more can be found about these standards in reference 2. A non-export customer's demand response potential would be affected by the availability of energy stored in the battery and the customer's load during an event.

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Export means a customer that interconnects a solar plus storage system under an interconnection standard that does allow the battery system to export because it charges exclusively with solar. The relevant interconnection standards are "2b" and "3a" and "3b". More can be learned about these systems in reference 2 and 3. An export customers demand response potential would be affected by the availability of energy stored in the battery. Since this customer is able to export the battery capacity, the demand response potential is not affected by the customer's actual load.
The customer participants are battery early adopters and are already bearing the full cost of the battery for purposes that aren't related to program participation.

Table 1	Measure Life (Reference 1)	Incremental Capital Cost (Assumptions)	NTG	Estimated Round_Trip_Efficiency (1)	Coincidence Factors
Non-export participant	10	$ -	100%	90%	100%
Export participant	10	$ -	100%	90%	100%

Table 2: Average monthly peak load reduction from residential batteries

Month	Non-export kW Savings	Export kW Savings	Non-export kWh Savings*	Export kWh Savings*
January	1.310	1.470	-3.48	-3.93
February	1.240	1.520	0.68	0.68
March	1.120	1.520	-8.60	-10.80
April	1.050	1.520	-2.79	-4.05
May	1.190	1.520	3.70	4.73
June	1.520	1.520	-9.57	-11.03
July	1.460	1.460	-14.98	-14.98
August	1.460	1.520	-7.78	-8.10
September	1.490	1.520	0.75	1.31
October	1.060	1.520	-8.88	-10.76
November	1.120	1.480	-4.48	-5.93
December	1.170	1.520	-3.12	-4.05
Average	**1.320**	**1.510**	**-58.55**	**-66.92**

Table 2 calculations use one calendar year of hourly solar production and load data from five representative PSCo residential solar customers. The calculations use this data to simulate hourly solar, battery, and load conditions and derive kilowatt and kilowatt hour values for 100 demand response events. The kilowatt and kilowatt hour estimates are based on the differences between a baseline customer that only uses their battery during a grid outage and a participating customer that discharges their battery during a demand response event. We assume a baseline customer only uses their battery during grid outages because there is no economic rationale for a customer (unless they have enrolled on a time-of-use or demand charge rate) to use the battery other than during a grid outage.

***Some months have positive kWh balances because the analysis dispatches the battery on the last day of the month. The re-charge of the battery occurs the following day, during the next month. The positive kWh associated with a discharge for a DR event is therefore not off-set by the re-charge. This occurence leads to a positive kWh balance for the month, but this is driven by accounting convention rather than what is actually happening to kWh savings.**

References:

1. Tesla Powerwall 2.0 Product Specifications; https://www.tesla.com/powerwall

2. Xcel Energy, Storage Guidance 2: https://www.xcelenergy.com/staticfiles/xe-responsive/Programs%20and%20Rebates/Residential/CO-solar-residents-Storage-Guidance-2.pdf

3. Xcel Energy, Storage Guidance 3: https://www.xcelenergy.com/staticfiles/xe-responsive/Programs%20and%20Rebates/Residential/CO-solar-residence-Storage-Guidance-3.pdf

4. Battery_Quantity and Round_Trip_Efficiency assumptions are based on data for the two battery vendors the Company is currently conducting contract negotiations with. Battery_Quantity also utilizes data the Company collects during the interconnection process regarding battery size.

5. Gross_Customer_Demand is based on data from the Company's 2016 residential solar load and production monitoring program and Available_Inverter_Capacity is based on this monitoring data and also the average inverter size from the two battery vendors the Company is currently conducting contract negotiations with.

Changes from Recent Filing: