



Customer Bill Savings from Behind-the-Meter Storage: Some Illustrative Analyses

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A few relevant Berkeley Lab analyses





Demand charge savings from BTM storage depend on...



Variation in demand charge rates

- Demand charge rates vary significantly by utility and by customer class and size
- Most are in the \$2-15/kW range, with a national median of \$7/kW
- Previous analyses by NREL (2017) and McKinsey (2017) identified \$10-15/kW as the threshold for BTM storage costeffectiveness

Maximum C&I Demand Charge Rate by Utility



National Renewable Energy Laboratory.



Other important demand charge design details

Annual demand charge savings from BTM storage Example: Shopping Center, 2-hr storage



Demand charge rate is the most critical element, but others also matter, particularly:

- Use of coincident peak demand charges
- Definition of peak period

Averaging intervals



Examples showing the effects of storage duration and customer load shape

Demand Charge Reduction as a Percentage of Storage System kW Size



Longer duration storage is more effective at reducing demand charges—but gains are not proportional

 Storage is most effective at reducing demand charges for customers with narrower peak loads

Solar + Storage synergies in managing demand charges

Synergy #1: Solar creates narrow peaks in the shoulder hours that storage is able to easily clip

Synergy #2: Storage can buffer transient dips in solar production





Solar + storage synergies based on building type & climate



Albuquerque Atlanta Baltimore Boulder Chicago Duluth Helena Houston Las Vegas Los Angeles Miami Minneapolis Phoenix San Francisco Seattle

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Solar + storage synergies relatively high for:

- Buildings with relatively wide peak load periods that extend beyond daylight hours (e.g., hospitals and office buildings)
- Locations with intermittent clouds but an otherwise strong solar resource (e.g., Miami)

Recent rate reforms for NEM customers have prompted rapid growth of solar + storage in several jurisdictions





Energy arbitrage savings under different types of rate designs and pricing differentials

Annual energy charge savings from BTM storage 2-hr storage, illustrative range of rates



- Wide range in arbitrage savings across TOU rates
- CPP arbitrage driven mostly by underlying TOU rates, but also by CPP events
- RTP arbitrage value is relatively modest
- Arbitrage under net billing rates (for PV customers) largely driven by approach to setting grid-export rate



Storage utilization rates (aka duty cycle)

- I.e., How frequently does the storage unit get (fully) cycled?
- Another key determinant of the annual bill savings value
- Constrained by:
 - Minimum pricing differential needed to warrant cycling on any given day
 - Limits on grid exports from storage
- Under net billing, will be driven by load shape and PV system size (see figure)
- But an important consideration under other rate designs as well

Example: Utilization rates for a 13-kWh/5-kW battery storage system under a net billing rate





Comparing demand charge vs. energy arbitrage savings from BTM storage



Energy arbitrage savings can rival demand charge savings under some circumstances DU with high peak-

- to-off-peak pricing differentials
- Longer duration
 storage



Question 1: Do utility bill savings offer a compelling value proposition for customer investment?

- For reference, current BTM storage costs are ~\$1000-2000 per kW (for 2-hour duration)
- To achieve a 10-yr payback would require bill savings of at least \$100-200 per kW of storage
- As shown, it's possible to hit that range under some optimistic rate scenarios, but that's more of an exception than the rule
- Value stacking (bill savings plus other value streams) essential to customer value proposition in most contexts



Question 2: Do bill savings align with utility system value (avoided utility costs)?

An example where they do not...

BTM Storage Dispatch on the System Peak Day under 2 Rate Designs



Capacity credit ≈ 0%

- Relatively little PV exports on peak load days
- No price signal to discharge during system peak hours

Capacity credit = 20-100%

- Range reflects different calculation methods
- Constrained by energy-limited nature of battery storage





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For more information

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Amy Heart Director, Public Policy

NARUC 2019

SUNLUN

The national leader in solar, storage, & home energy management.

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Active in policy throughout country.

More than a quarter million customers nationwide On average, every **2.3 minutes** a new system is installed Sunrun customers have saved over \$300 million on electricity bills

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Sunrun alone has created more than **4,000** jobs & thousands more through our partners.

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Brightbox: Product and Markets

Brightbox meets needs of residential customer + grid at lowest cost.



Now Available In: HI, CA, AZ, NY, MA, FL, PR, TX, VT, & NJ

Brightbox for Time Shifted Solar

Illustrative Residential Solar+Storage & Load Curve

Brightbox manages residential load shift in CA - managed for TOU, to **minimize midday solar exports, and to flatten evening load** - with flexibility for DR or other targeted shift, while maintaining charge for backup.



Home Solar & Batteries: the future, today

Wholesale: e.g., ISO-NE

- 20 MW bid won in 2019 Forward Capacity Auction
- Spread through number of New England states & ~5,000 homes
- First in nation
- Still providing backup power!

Retail: e.g. BYOD

- Bring Your Own Device: reduce G, T&D costs
- Utility program reducing
 wholesale or utility costs
- MA, VT, NH, NY, soon CT
- Low risk, pay for performance
- Still providing backup power!

Utility: e.g. Aggregation

- Virtual Power Plant
 Procurement
- NWA locational
- Peaker replacement
- Low-income/multifamily
- Still providing backup power!

Behind the Meter Storage: What opportunities exist for customers to reduce their demand and energy charges?

NARUC - Staff Subcommittee on Rate Design November 17th, 2019



Exelon Corp Overview

\$23B

Being invested in utilities through 2022

10M

Six utilities serving 10M electric and gas customers, the most in the U.S.

In 2018, Exelon gave approx. \$51 million to charitable and community causes

Ver

over 240,000

Employee volunteer hours

\$35.9B

Operating revenue in 2018

Customer load served

1.8

Exelon's

million

Constellation

sector and

business customers

business serves

residential, public

(Approx.)

Zero-carbon

energy provider in America

FORTUNE

100

Exelon is a

company

FORTUNE 100

#1

212 TWH 32,500

Megawatts of total power generation capacity

11,180Transmission

line miles for utilities

33,400

Employees



Exelon Utilities - Strong Operational Performance

Operations	Metric	At CEG Merger (2012)			2015		YTD 2019				
		BGE	ComEd	PECO	PHI		BGE	ComEd	PECO	PHI	
Electric Operations	OSHA Recordable Rate										
	2.5 Beta SAIFI (Outage Frequency)										
	2.5 Beta CAIDI (Outage Duration)										
Customer Operations	Customer Satisfaction				N/A						
	Service Level % of Calls Answered in <30 sec										
	Abandon Rate										
Gas Operations	Percent of Calls Responded to in <1 Hour		No Gas Operations					No Gas Operations			
Overall Rank	Electric Utility Panel of 24 Utilities ⁽¹⁾	23 rd	2 nd	2 nd	18 th	,	Performance Q1 Q2 Quartiles Q3 Q4				



We believe the future will be oriented around Connected Communities





Storage can provide a wide variety of benefits





Source: The Economics of Battery Energy Storage, Rocky Mountain Institute

Maryland Energy Storage Pilot Project Act

- Building on work done in the Transforming Maryland's Electric Grid proceeding (PC44), Maryland passed the Energy Storage Pilot Project Act in March of 2019
- The Bill requires the MD PSC to mandate each MD IOU to solicit offers to develop energy storage projects under the following commercial and regulatory models:
 - Utility Only Model
 - Utility and Third-Party Model
 - Third-Party Ownership Model
 - Virtual Power Plant Model
- All PSC-approved storage projects to become operational by no later than February 28, 2022
- The cumulative size of the pilot projects beneath the program must be between 5 to 10 MW, with a minimum of 15 MWhs



Demand Charge relief for Electric Vehicles

Maryland - Pepco and BGE Maryland

- "Demand Charge Credit" program would be available to "demand-billed" non-residential customers who install EV chargers at their workplace or for fleet use.
- A bill credit would be provided for a portion of the maximum distribution demand that results from the addition of EV chargers to the customer's load.
- The credit is for a fixed amount at 50 percent of the maximum nameplate capacity of the L2 or DCFC equipment installed for up to 30 months or the end of the five-year program.

Pennsylvania - PECO

- Electric Vehicle DCFC Pilot Rider (EV-FC) PECO should calculate and apply a fixed demand (kW) credit, initially equal to 50% of the combined maximum nameplate capacity rating for all DCFCs connected to the service, to the customer's billed distribution demand.
- The pilot began on July 1, 2019 and will continue for five years, expiring on June 30, 2024

