INFORMATION BRIEF

BATTERY COUNCIL INTERNATIONAL

ESSENTIAL ENERGY EVERYDAY

Behind the Meter Energy Storage:
Advancing Towards Net-Zero Carbon Energy Production

Behind the Meter energy storage is essential for utilities to manage fluctuating electricity demand. Advancing towards net-zero carbon energy production will require consumers to efficiently manage energy usage, thereby reducing strain on the grid.

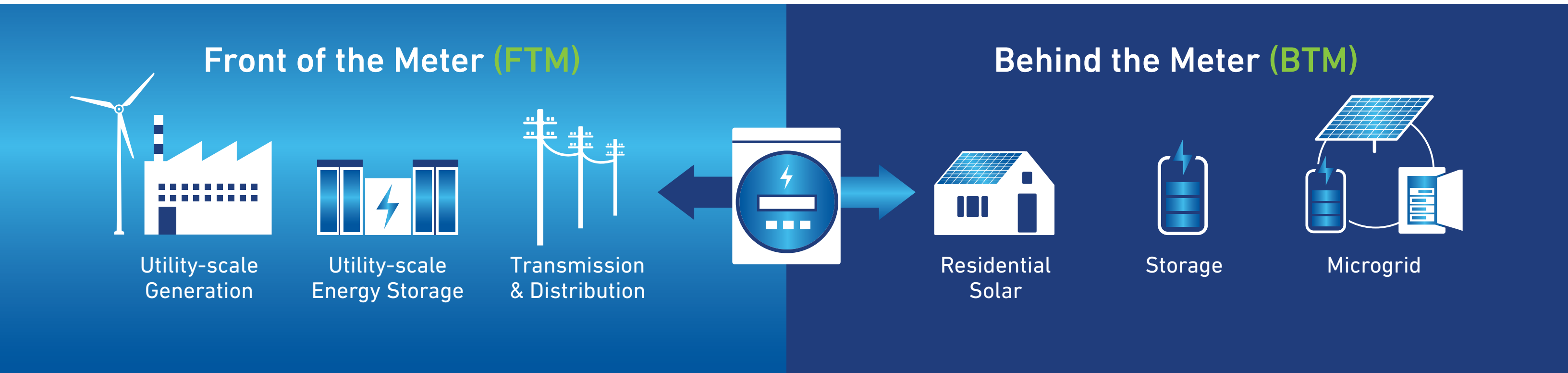
What Is “Behind the Meter”?

Two terms that are often used when discussing energy storage are “Front of the Meter (FTM)” and “Behind the Meter (BTM).” To better understand the meaning of these terms, we need to envision the meter on the side of a home or business as the middle ground. All components of the electrical grid between the meter and the utility scale generation site are considered “front of the meter.” This includes but is not limited to transformers, energy storage, transmission lines, substations, grid scale solar and wind generation, and so on. All components on the consumer side of the meter are considered to be "behind the meter". This includes breaker panels, electrical systems, solar (photovoltaic cells on roof or solar shingles), inverters, energy storage, and micro grids. It is important to note that behind the meter refers to ALL residential, commercial, and industrial customers.

Battery Energy Storage Systems (BESS) in both FTM and BTM are being adopted at an accelerated rate due to a number of challenges within the electric market and the utility grid.

The Purpose of this Information Brief

- Explain the key role BTM energy storage will play in the evolution of our energy network.



Why Do We Need Behind the Meter Energy Storage?

Inconsistent Consumer Demand

Utilities are faced with the challenge of providing consistent and stable electricity to a consumer base that does not use electricity in a consistent way. Demand for power ebbs and flows throughout the day as energy is used for heating, cooling, cooking, lighting, and running industrial manufacturing and processing facilities. High and low spikes in power usage can tax the grid infrastructure and production capabilities of generation plants. To incentivize customers to limit spikes in electricity usage, many utilities have implemented time-of-use rates, and some commercial and industrial customers receive peak demand charges.

Time-of-use rates charge the customer a significantly higher rate for energy used during specified hours of the day when the utility expects a high demand.

For example, PG&E in California charges residential customers peak pricing from 4 to 9 p.m. every day and a lower rate at other times. If customers are able to turn up their thermostat, wait to run laundry and dishwashers, and in general reduce power consumption during peak periods, then they can substantially lower their electric bill while also reducing strain on the grid.

Utilities that use a **peak demand charge** provide two separate charges on their customers' electric bills. The first part of the bill is based on a kWh usage of electricity at a standard rate similar to a residential bill. The second part of the bill is known as the demand charge, where the utility uses the 15-minute period of time when the customer had the highest power demand or load and charge them a $/kW (typically $4 to $10/kW) fee for this time interval.

This charge can account for between 30% and 70% of an electric bill. These billing structures encourage customers to use less power during certain times of the day when demand is at a high, while also encouraging industrial and commercial customers to ramp up power usage slowly to avoid high power spikes for even short periods of time.

Direct current (DC) fast charging for electric vehicles (EV) is an application that requires a significant amount of power for a relatively short duration and can often put high stress on the local grid and infrastructure, and at the same time induce high peak demand charges.

A DC fast charger requires up to 150 kW per EV charging. When this is multiplied by 4 to 12 charge stations that would typically be found at a charging platform, the owner of the fast charge location will likely incur a demand charge of several thousand dollars over the pay period. This demand charge offsets any profit the owner of the charging station would receive from EV's refueling.

Intermittent Renewable Energy Supply

Due to inclement weather and migration away from stable fossil fuel generation plants to intermittent renewable sources, the grid in the United States has become less reliable over the past few years with a record number of blackouts and brownouts. For example, high demand for power in California during the summer heat has made brownouts commonplace. Winter storms in the South, especially in Texas, have made blackout periods during cold months a major issue. Across the U.S., these blackouts can last from minutes to days depending on the cause, result in massive disruptions to businesses, and be problematic for homeowners. BTM energy storage is one financially feasible solution to these challenges and will be discussed.

How Demand Charges Can Impact Electric Bills

The data table below demonstrates how demand charges can significantly impact the electric bill of a consumer, in this case a commercial facility. Even though both customers in this example use the same amount of energy over the month period, decreasing the peak load during the month lowers Customer 2's overall power bill by around 20%.

	Customer 1				Customer 2			
	Usage	Units	Cost/unit	Charge	Usage	Units	Cost/unit	Charge
Electricity consumption (kWh)	25,000	kWh	$ 0.12	**$ 2,875**	25,000	kWh	$ 0.12	**$ 2,875**
On-peak energy charge	615	kW	$ 7.15	$ 4,397	410	kW	$ 7.15	$ 2,932
Off-peak energy charge	175	kW	$ 4.75	$ 831	115	kW	$ 4.75	$ 546
Total demand charges				**$ 5,229**				**$ 3,478**
			Total amount due:	**$ 8,104**			**Total amount due:**	**$ 6,353**

Applications for Behind the Meter Storage

As discussed earlier, behind the meter (BTM) refers to the electrical system on the consumer side of the power meter.

Energy storage solutions in BTM applications have been used for many years as a standby power source in the case of power loss. Historically, lead-based batteries were the battery of choice for these applications. In recent years, more lithium-based solutions have come to market.

Legacy stationary applications primarily provided simple back-up to critical services, and due to the relatively stable grid during this period, were seldom used. The incorporation and migration from consistent generation from fossil fuels to the intermittent generation of solar and wind has defined new duties for energy storage, necessitating much more consistent, cyclical use of the batteries. Past legacy systems often failed from calendar aging and did not utilize the available cyclical life of the battery.

For many years a major limiting factor in fully utilizing BTM storage was the lack of available SMART electronics to control the source of power for the grid. Consumers have no way of knowing that the utilities are struggling to produce sufficient power and do not want the responsibility of dispatching the power when needed.

In recent years technology has advanced, allowing a consumer with energy storage system (ESS) installations to opt into programs that allow the utility to connect to their SMART BTM energy storage and draw power from it on an as needed basis. This is carried out in different ways depending on the vendor of the energy storage device. It's known as demand response.

Missouri University of Science and Technology solar microgrids in on-campus homes

Demand Response

In certain areas of the U.S., utility companies are able to use weather data, expected renewable output, and historic consumption to form predictive models of expected energy usage from week to week. When extreme weather or other factors create a projection in which energy demand will be higher than the utilities ability to produce, they are able to lean on the distributed energy resources to help make up the energy deficit and avoid blackouts. In most situations, the owner of the ESS is rewarded financially for each kilowatt hour of energy that is put back into the grid, which can help to financially justify the upfront cost associated with the ESS.

Key benefits of demand response:

- The owner of the ESS is typically informed in advance that there will be a demand for their stored energy, which allows them to ensure it is fully charged during off-peak hours or by a renewable energy source.
- With BTM distributed energy sources available, the utility is able to pull power from ESS's at locations where the demand is at its highest while saving the energy in other locations for another time.

Peak Shaving

Increased utility rates due to high peaks of energy usage or energy usage at certain times of the day can represent a significant portion of a customer's electric bill. With the currently available SMART technology, ESS owners are now able to configure a system that charges the ESS during off peak times when their energy consumption is low or when renewable energy is being produced from solar or wind.

- **Peak shaving** reduces peak electricity demand by using stored energy to power internal loads, thereby decreasing the energy required from the utility and reducing peak loads and time-of-use charges.

This can be accomplished either on a timer basis such as between 4 and 9 p.m., or in the case of DC fast charge or other high power demand scenarios, the controller of the ESS can sense the overall electric load and dispatch energy from the ESS to keep the peak demand under a specified threshold. Using an ESS for peak shaving can provide significant financial savings to the owner on a monthly basis and allow them to not only help reduce strain on the local grid, but also provide them with a stable and reliable power source in times of need.

Backup Power for Outages

Telecommunications towers (cellular, 5G) and hospitals must have energy resiliency and ESS in BTM applications supports operation of these critical services during inclement weather or catastrophic events. Lead batteries serve as one of the primary technologies for this sector of ESS due to the high capability for the batteries to provide "black start" for site-specific generation (i.e., back-up diesel generator) and the strong safety profile of the technology in stationary markets.

Backup power over the last few years has become a dynamic application space with hybrid use, such as back-up/demand charge reduction, becoming a promising evolution and extension of the application. For example, ESS used for data center back-up could also provide demand charge or time-of-use management to a certain utilization rate while keeping the majority of charge in reserve for typical fast response critical backup power.

Conclusion

There is a growing need for distributed energy storage to ensure that electricity needs can be met by all customers due to the shift in how and where energy is produced around the world. BTM energy storage will play an increasingly important role in advancing towards a net-zero carbon energy production.