U.S. residential storage: a glimpse at the market

Market trends and the case for residential energy storage in the U.S.

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The U.S. is experiencing major growth in the energy storage market, and it's only the beginning. According to Wood Mackenzie Power and Renewables' U.S. Energy Storage Monitor Q2 2020, the market (residential, non-residential and front-of-the-meter) is expected to grow more than 13-fold from 523 MW in 2019 to nearly 7 GW by 2025, in spite of an expected, but temporary slowdown in 2020 and 2021 due to COVID-19. This will result primarily from storage-friendly policies and opportunities to provide wholesale market services for energy storage owners.

Front of the meter (FTM) storage leads the energy storage market at present and will continue to make up the bulk of the market. FTM and BTM refer to the position of the storage system in relation to the meter. FTM systems (i.e. utility scale projects) provide power to off-site locations and BTM systems (i.e. residential systems, on-site commercial, microgrids) provide power that can be used on-site, avoiding the need to pass through a meter.

Residential storage had its strongest quarter ever in Q4 2019 with 40.4 MW/93.3 MWh deployed in the U.S. There are multiple incentives that drive homeowners to add storage to their homes in the U.S. including back-up, time-of-use arbitrage, self-consumption, and available grid & wholesale market services.

Back-up

Necessity of grid resilience during mass-grid outages emerged as a primary reason for storage in the U.S. residential sector. With increasing vulnerabilities to natural disasters, homeowners are beginning to look at adding residential storage for emergency back-up when the grid is down. California customers, who are increasingly finding themselves susceptible to wildfires, are beginning to see significant value in back-up power through energy storage. Meanwhile, Northeast customers are also looking to storage options for providing energy security during power outrages resulting from powerful tropical storms and hurricanes.

Time-of-use arbitrage

Net-metering, the financial mechanism by which homeowners with standard grid-tied solar systems earn from exporting excess solar power they produce to the grid, is increasingly facing hurdles from utilities that introduce mandatory time-of-use (TOU) tariff structures. These schemes shift utility rate structures so that electricity is more expensive during peak demand hours (late afternoon and evening) when standard grid-tied systems are not performing. To bypass having to pay for costly electricity from the grid during peak rates, homeowners can take more control of their electricity bill by installing a residential storage system to discharge power produced during the day during costly peak hours. This is known as TOU arbitrage.

Q CELLS Q.PEAK DUO BLK-G6+ modules and Q.HOME+ ESS

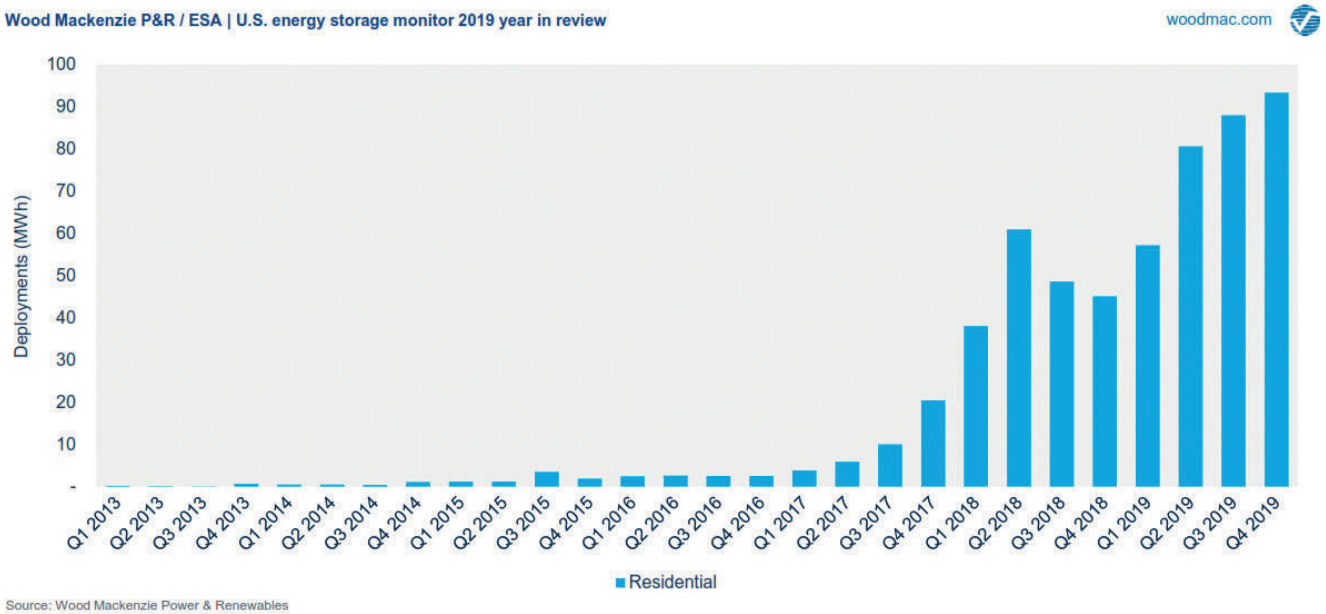
Self-consumption

In areas in the United States where net metering is curtailed or not allowed whatsoever, residential storage becomes a compelling move in order to supply home electricity needs in one contained system with reduced to no support from the grid. If PV generation exceeds the electricity needs of the home, the excess power is used to charge the batteries. If the batteries are fully charged and PV generation exceeds electricity requirements of the home, PV generation is curtailed or disabled to prevent back-feeding to the grid. With new net-metering rules reducing compensation for exporting power to the grid during the day, solar producers can benefit with a storage system in self-consumption mode. Examples of this case include Hawaii's HECO Customer Self Supply tariff, or in California's NEM 2.0 (Net-Metering 2.0).

Grid and wholesale market services

A final incentive for residential storage involves grid & wholesale market services. With California leading the charge, utilities in Arizona, Vermont, and New Hampshire are also experimenting with mechanisms where homeowners can help to stabilize the grid during periods of high demand by exporting their stored power in exchange for financial credit.

Various incentive programs are active in different states to support storage adoption for applications like TOU, resiliency, and grid service. California retains its leadership in residential storage growth, especially since the newest version of SGIP (Self Generation Incentive Program) reserves a special allocation for residential storage. The California Public Utilities Commission revised the SGIP to include additional funding for low-income communities and customers with resilience needs to benefit from energy storage.



Source: Wood Mackenzie Power & Renewables

Figure. 1. U.S. Residential ESS System Deployments (MWh)

Operation Mode	Features	Typical User
Self-Use	Intelligent use of battery to offset grid purchase throughout the day. Charges battery with surplus solar when available, discharges battery to mitigate load spikes.	Exporting (FIT/NEM) Non-exporting customer with flat-rate plans.
Home Backup	Battery charge maintained at 100% except during a power outage. Secure power source for backup load.	Customers living in an area with grid instability or frequent power outages due to adverse weather/fire conditions.
Time-of-Use Arbitrage	Charge battery with excess solar. Use battery at peak rate times with two programmable charge/discharge windows.	Exporting (FIT/NEM) Non-exporting customer with TOU plans.
Remote Control	Send commands to the inverter through APP, which can remotely control the status of the inverter (on/off, operation modes and charge/discharge rate).	Wholesale Market and Grid Service
Grid-Tied Priority	The inverter is set to deliver power to the grid first at any time, then to charge the battery.	Exporting (FIT/NEM) Non-exporting customer with TOU plans and demand charge.

Table. 1. Q CELLS Q.HOME⁺ Operation Modes

An introduction to the Q.HOME⁺ ESS

Q CELLS unveiled its Energy Storage System (ESS) for the U.S. market with an all-in-one brand solution. Q CELLS' ESS inverter system, the Q.HOME⁺ ESS HYB-G1 and Q.HOME⁺ ESS AC-G1, can connect ESS systems both in DC and AC-coupled configurations respectively for new and retrofit projects.

Q.HOME⁺ is an integrated residential solar + storage solution with a 6.0 – 8.6 kW hybrid inverter which provides energy storage capacity from 4.5 to 18.9 kWh. The storage capacity per battery can be either 4.5 or 6.3 kWh, for a maximum of 18.9 kWh with the application of three batteries.

The discharge power per battery is 2.5 kW, and with three batteries, the backup power can ramp up to 7.5 kW. As a future-proof solution, Q.HOME⁺ will provide critical support to legacy grid systems, in addition to benefitting the end user. Energy storage coupled with smart energy management algorithms enable PV power to be utilized for TOU, demand management, home backup and remote operation for grid service and wholesale market. A Non-Export/Self Consumption mode is also available for users consuming electricity being stored in the storage system.

The Q.HOME⁺ solution is capable of supporting partial to full household electricity needs based on the battery and inverter capacity. As an example, the Q.HOME⁺ ESS HYB-G1 7.6 kW inverter can be paired with three 6.3 kWh battery modules for an energy capacity of 18.9 kWh and 7.5 kW discharge power.

For a typical residential home in the U.S., the average load is around 7.5 kW which means Q.HOME⁺ can support the full load up to 2.5 hours without any grid power or solar PV. However, with optimized load selection, the three-battery system can support a 20 cubic feet freezer, microwave, fan, 1/3 HP well pump, TV, multiple bulbs, laptop, and humidifiers for 6 to 7 hours.

Table 1 highlights the operational modes available in Q.HOME⁺, which can support all the applications for the U.S. residential market including TOU arbitrage, home back-up for resiliency, and remote operation for grid service and wholesale market.

Q.HOME⁺ ESS for U.S. residential market

Q.HOME⁺ comes with two different product models, Q.HOME⁺ ESS HYB-G1 and Q.HOME⁺ ESS AC-G1, to support both DC-coupled and AC-coupled architecture respectively. A DC-coupled system has better round-trip efficiency compared to an AC-coupled solution and is the preferred method for new home installations. On the other hand, the AC-coupled solution is more suitable for the retrofit market, allowing the option to add storage to existing PV systems.

Q.HOME⁺ ESS HYB-G1 comes with a hybrid inverter to connect PV and batteries, a unique feature allowing multiple batteries to be connected to the inverter with a single Battery Management System (BMS). Modularity of the storage solution will provide enough flexibility to the end-users selecting their storage size based on necessity and economics. Higher back-up power at off-grid conditions is another interesting aspect of this solution, as the system can match up grid-tied output when three batteries are connected in the system.

One of the biggest challenges in troubleshooting product failure is identifying the failure's source. However, for this product, Q CELLS will be the single point of contact for all post-sales processes – Product Support, Warranty, and RMA. The Q.HOME⁺ ESS is expected to address field troubleshooting of solar modules, inverter, and ESS failure by identifying sources of product malfunction and offering service from a single entity.

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Q CELLS Q.HOME⁺ ESS