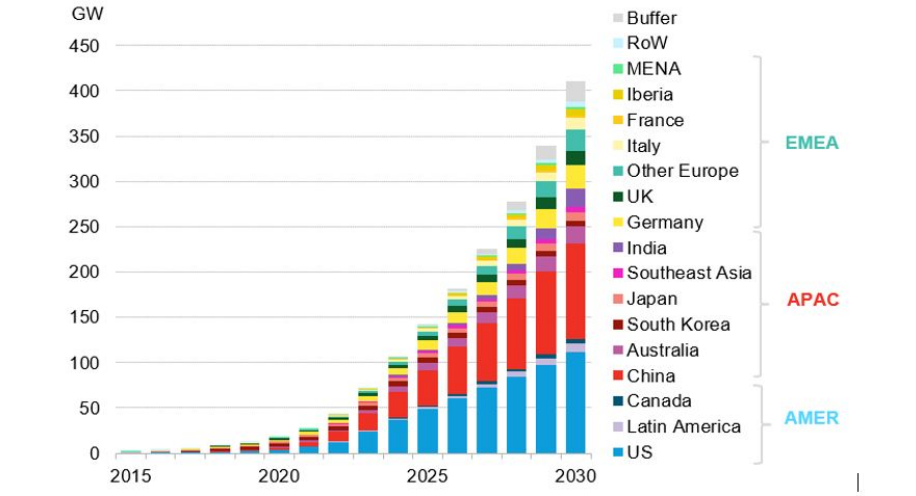
Capturing the Full C&I Battery Storage Value Stack

Introduction

The past decade has been shaped by intense transitions within the traditional energy market. Breakthroughs in renewable and battery technologies - coupled with falling costs to deploy these technologies - are fueling widespread adoption and dramatically shifting how the world generates, uses, regulates and distributes energy.

This inflection point is cemented even further by the recent passage of the Inflation Reduction Act (IRA), which significantly invests in both renewables and the domestic battery storage supply chain. BloombergNEF predicts that global energy installations will reach a cumulative 411 gigawatts (GW) or 1,194 gigawatt-hours (GWh) by the end of 2030.

Figure 1: Global cumulative energy storage installations, 2015-2030



Source: BloombergNEF. Note: "MENA" refers to the Middle East and North Africa; "RoW" refers to the rest of the world. "Buffer" represents markets and use cases that BNEF is unable to forecast due to lack of visibility.

In recent years, energy storage adoption has gained particular traction in the Commercial and Industrial (C&I) sector, which cannot ignore the increasingly salient economic, energy efficiency and resiliency value of battery storage applications. However, battery storage economics are complex and still relatively new to the market - as a result, a robust contextual framework is needed to support adoption and effectively synthesize capital incentives and revenue streams. Intelligent battery optimization technologies will ease this transition and unveil the endless array of new renewable opportunities.

For both C&I battery system developers and owners, getting the economics right will be critically important to future adoption, scalability and deployment. In this paper, we explore the C&I storage landscape, highlight the regulatory and market forces shaping the storage value proposition and unpack how system developers and owners can navigate the stack of available revenue streams to create a strong business case for battery storage.

Understanding the C&I Storage Landscape

Objectives of C&I Storage Customers

Return on Investment

A wide array of C&I customers are now deploying battery storage solutions, including industrial facilities, apartment building complexes, commercial office buildings and more. Return on investment (ROI) continues to be the primary driver for C&I storage adoption. With energy prices rising across the country, C&I operators are looking for solutions to better control their energy usage and reduce their bills. Storage offers multiple revenue streams and cost-saving solutions; moreover, incentives from the IRA will further push down the cost of investing in storage systems, increasing their upfront value for commercial enterprises.

Resilience

Increasingly, resilience is also a key motivator for C&I facilities to consider storage. As extreme weather events that strain the grid - such as heat waves and cold snaps - become more frequent and intense, businesses are contending with greater risk of power outages. In order to avoid disruptions to operations and ensure long-term resilience for their facilities, C&I customers are turning to storage to provide backup power and enhance energy security.

ESG

Capturing the sustainability benefits of battery storage is becoming more important for C&I customers as well. Through load shifting, storage systems can help reduce the need to rely on fossil fuel power plants to keep the grid balanced during periods of strain.

For large commercial entities, advancing operational decarbonization can be a key objective. Publicly-traded companies in particular are looking for new solutions to meet their ESG goals, and both solar+storage and standalone storage systems offer tangible opportunities for positive climate impact.

Challenges for C&I Customers

Market Structures

Despite steadily declining system costs, making the business case for storage continues to be the largest hurdle for C&I adoption. The value proposition for adding storage varies greatly by region. Market and regulatory factors, such as rate structures, utility bill saving incentives and demand charge pricing, can significantly impact the economics of a storage system in a given location.

Today's energy markets do not recognize the full potential value of energy storage systems; many do not compensate storage systems for energy exports or do not allow storage to fully participate in wholesale markets.

> Making the business case for storage continues to be the largest hurdle for C&I adoption.

Economic Complexity

Navigating the stack of available value sources for battery storage systems can be complex and onerous for developers and customers.

Moreover, the load profiles of individual sites greatly impacts this value stack. Different types of C&I customers see very different electricity consumption patterns - for example, an office building's peak usage periods tend to be very different from those of an apartment building. It can be difficult for battery developers to optimize charging and dispatching schedules across different C&I use cases.

Supply Chain

Procurement issues for battery storage system technology present additional obstacles for C&I applications. Disruptions across the global storage supply chain have plagued the industry over the last few years, stemming from rising costs for materials, operational disruptions from COVID-19 and inflationary price spikes. Delays and rising system costs for product procurement exacerbate logistical and economic concerns for C&I customers.

Embracing the Changing Regulatory Landscape

Impacts of the Inflation Reduction Act

The IRA is the most aggressive legislative action that the U.S. has taken to confront the climate crisis, with goals to reduce carbon emissions by roughly 40% by 2030. This historic legislation addresses a large number of complex political, social and economic issues, and in doing so, has a clear focus on clean energy and storage decarbonization solutions. BloombergNEF forecasts that the IRA will drive the buildout of an additional 30 GW/111 GWh of storage between 2022 to 2030.

The IRA will have significant impacts across the battery storage value chain. In addition to bolstering support for domestic battery storage manufacturing, the IRA crucially extends the investment tax credit (ITC) to standalone storage systems. Previously, only storage systems paired with solar could access the ITC, limiting incentives for standalone battery storage applications.

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Under the new law, standalone systems with a capacity of at least 5 kilowatt-hours (kWh) can qualify for the credit, significantly lowering the cost of storage adoption for many potential C&I customers.

Energy Market Reform

Changes in energy market policy also have major implications for the storage system value proposition. Although storage systems continue to face constraints on their capabilities to transact in energy markets, there has been significant progress towards regulatory reform.

The landmark FERC Order No. 2222 passed in 2020 has been key to removing barriers preventing storage from accessing grid services revenue streams. FERC 2222 requires regional grid operators across the U.S. to allow energy storage and other distributed energy resources (DERs) to compete in wholesale energy markets alongside traditional resources. This unlocks the potential of battery storage systems to serve as paid grid resources, enabling storage customers to participate in capacity, energy, ancillary and other grid revenue opportunities.

Navigating the C&I Battery Storage Value Chain

Technology advancements, regulatory reforms and business innovations have expanded the array of revenue opportunities available for C&I storage systems. Battery storage owners and operators can leverage a wide range of strategies to capture the full value of their systems.

Bill savings opportunities for batteries

Batteries can follow three key strategies to produce bill savings: increased solar self-consumption (aka solar shifting), Time-of-Use Arbitrage and Demand Charge Management (DCM). These strategies all take place behind-the-meter, which means they can be achieved regardless of whether or not the front-of-the-meter energy markets are deregulated. This makes bill savings one of the most consistent economic opportunities for batteries across the country. Let's dive into how each of these strategies works.

Time-of-Use Arbitrage

Utilities charge customers different rates for their energy use depending on the time of day, known as Time-of-Use (TOU) rates. In the case of California (seen below), rates are most expensive during peak times (3-8pm weekdays) and less expensive during off-peak times (all other times). Batteries can be programmed to charge during off-peak times and discharge during peak times, reducing the energy consumption during expensive peak times and resulting in bill savings.

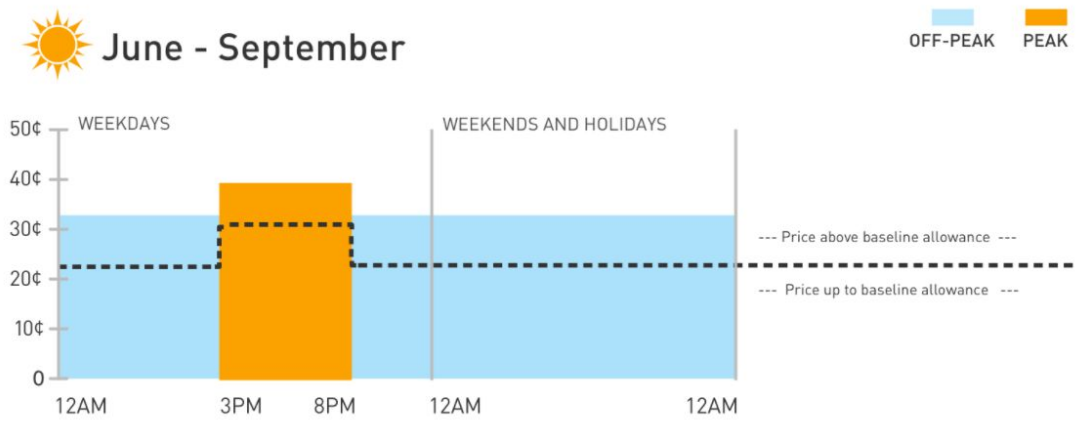


Figure 1: A diagram of a PG&E time of use rate (E-TOU option A) during the summertime. Source: www.pge.com.

Solar Shifting

Once installed, photovoltaic (PV) systems produce significant amounts of energy at almost no marginal cost. However, PV production peaks in the middle of the day when customer loads tend to be the lowest and TOU prices are cheapest. In many cases, PV production can exceed the available load to serve, which means that the energy will either be wasted (and must be curtailed) or discharged back to the grid at low prices if the utility allows net metering.

Using a similar strategy as TOU arbitrage, batteries are able to charge in the middle of the day when energy is plentiful and discharge in the evening when demand and prices are higher. This greatly increases the economic impact of the solar system and results in additional bill savings. The graphic below demonstrates a combined TOU Arbitrage and solar shifting strategy:

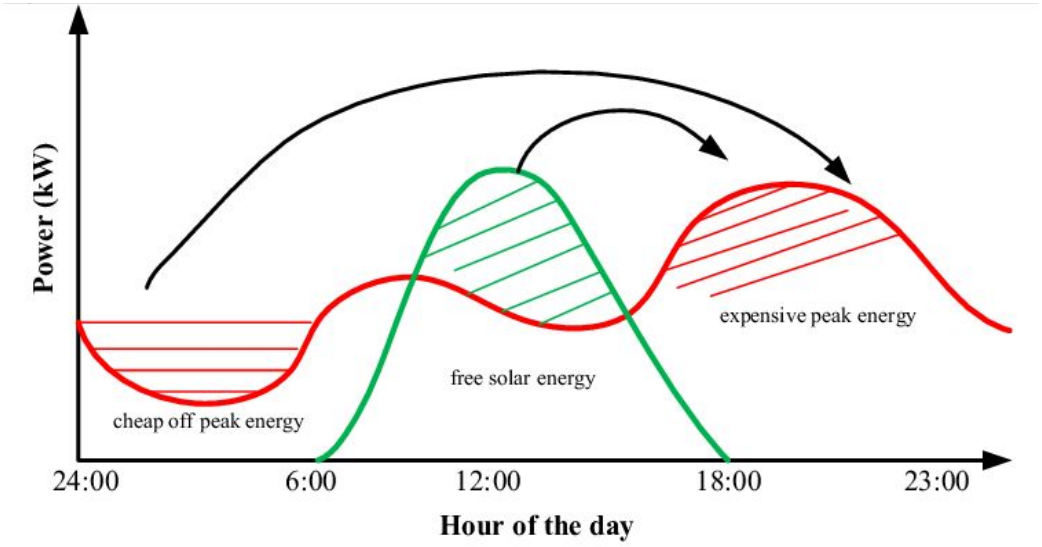


Figure 2: Using solar shifting to achieve TOU Arbitrage. Source: "Optimal battery storage operation for PV systems with tariff incentives" (DOI:10.1016/j.apenergy.2017.06.043)

Demand Charge Reduction

A utility charges a ratepayer for two primary expenses: energy use and demand charges. Energy use is the sum of all energy used during a month with the rate determined by the Time of Use. Demand charges are different - this charge is based on the customer's peak demand in a given month. To reduce demand charges, peak demand must be minimized. Again, batteries are uniquely well suited for this task.

By utilizing the energy stored earlier in the day, batteries can discharge during peak periods and reduce the demand measured at the meter. This approach of discharging during peak demand periods is often called “peak shaving.”

However, peak shaving is uniquely difficult for two reasons:

1. Unlike TOU “peak” and “off-peak” periods, which are fixed, demand is variable and can not be predicted with 100% accuracy. The time and intensity of peaks can change significantly day by day, which means that a simple pre-programmed discharge schedule can often miss peak demand.

2. Demand charges are based on the highest 15-minute power consumption window of the entire month, so “missing” a single 15-minute window of high power consumption can ruin a month’s worth of peak shaving.

This makes the quality of forecasting a critical component of successful peak shaving - particularly when the battery owner is trying to engage in other revenue generating activities.

Grid revenue opportunities for batteries

By integrating into energy markets, battery storage assets can monetize across a range of grid services products, from contracted multi-year resource adequacy to merchant real-time energy and ancillary services. Depending on the risk appetite and market structure, storage developers and owners have a range of options to stack the best value from wholesale energy markets and utility programs.

Battery storage assets can monetize across a range of grid services products.

Capacity

Resource Adequacy (RA) or Capacity is a contracted revenue stream, where the owner of a flexible resource earns revenue for being available to supply energy or curtail load based on market or utility dispatch signals. This is a monthly, seasonal, or annual payment that is stackable with bill savings and other battery use cases. Depending on the market, battery owners contract directly with load serving entities (LSEs), bid in annual auctions or participate in utility programs.

Energy Arbitrage

Energy Arbitrage enables battery storage owners to earn revenue by storing electricity in batteries at low prices and selling it back to the grid at a higher price. Owners will take merchant risk in predicting the best time to charge and discharge their batteries. Operators can sell power in the real-time or day-ahead energy markets based on opportunities identified in internal or third-party price forecasts. Energy Arbitrage revenues can be de-risked via hedge, insurance and other mitigating transactions.

Ancillary Services

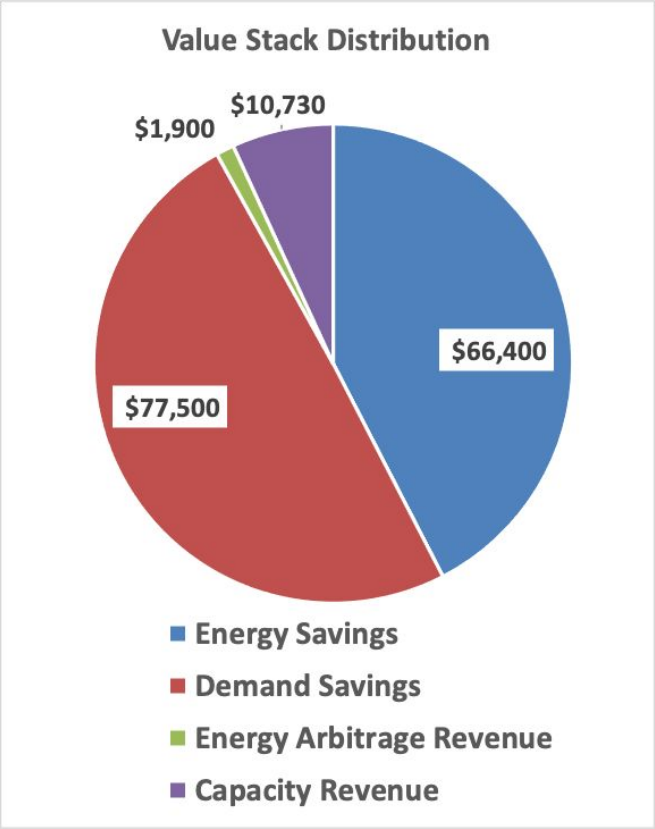
Ancillary Services facilities and supports the continuous flow of energy by providing frequency control, synchronized regulation and other functions required for a stable and reliable power grid. These services are highly lucrative but require more active battery dispatches. Thus, they are commonly stacked with Energy Arbitrage to optimize the revenue mix of the battery asset.

Case Study: Optimizing Capital and Revenue in CAISO

The following analysis is of a commercial office building in Southern California that aims to maximize the value of its newly installed solar-plus-storage system.

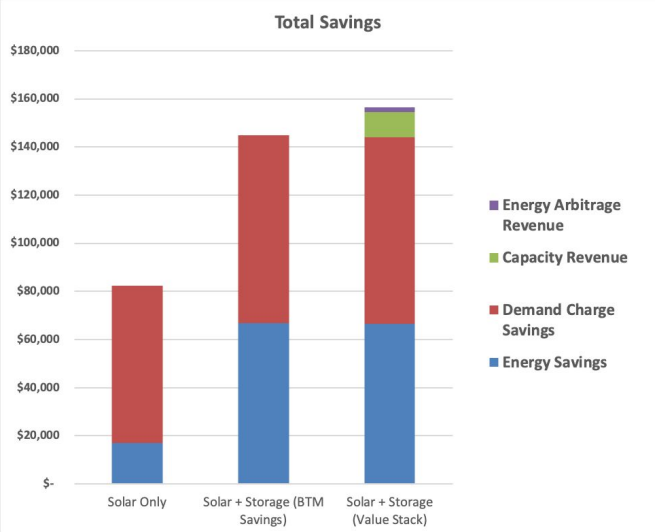
It utilizes both behind-the-meter bill savings strategies such as Demand Charge Reduction and TOU Arbitrage as well as grid revenue activities such as Energy Arbitrage and Resource Adequacy.

 Customer Type	 Location	 Battery Type	 Battery Capacity	 PV Capacity	 Original Energy Bill (Annual)
Commercial Office Building	Orange County, California	Lithium-Ion	250 kW/ 1328 kWh	400 kW	$215,500



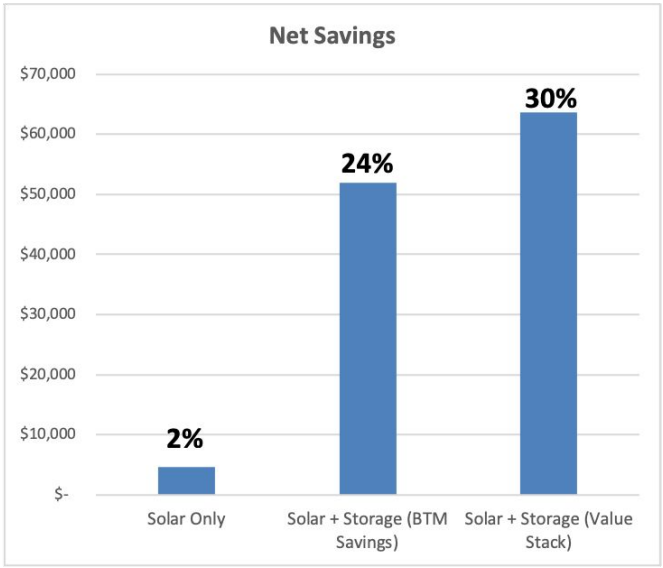
A 250kW/1.3MWh storage asset in CAISO could stack multiple value streams:

- Peak shaving to reduce demand charges
- Systematically engage in Time-of-Use Arbitrage (energy savings)
- Contracted revenue through CAISO Resource Adequacy (Capacity)
- Opportunistically engage in the real-time energy market (Energy Arbitrage)



Note: The PPA payment required to add solar to this is $92,800, so a Total Savings of $156,400 results in Net Savings of $63,600 or 30% of the original bill.

Stacking all these value streams results in a 30% bill savings for the customer. This greatly accelerates the payback period for the solar-plus-storage system and makes the upfront capital investment much more attractive.



Facilitating Optimal Storage Value

The C&I storage landscape is well-positioned for tremendous growth over the next several years, thanks to breakthroughs in storage and renewable technologies, market and regulatory reforms and the increasing customer demand for resiliency and ESG solutions.

C&I battery developers and owners have access to a growing array of bill savings and grid revenue opportunities that strengthen the ROI of storage system applications. This complex value stack demands an intelligent EMS to understand site constraints, contractual commitments and market opportunities. With the right digital scheduling coordinator, battery owners can structure the right value stack and dynamically bid their assets in a range of products that will unlock maximum value. An integrated hardware and software stack enables bilateral communication between the battery and the market for optimal performance and financial outcomes.

WATTMORE and Leap deliver complimentary services to capture the full value stack that is now available to C&I customers. Leap's platform connects battery systems to wholesale energy markets and enables easy participation in grid services programs, and WATTMORE's AI-driven software intelligently stacks bill savings and grid revenue value streams to deliver maximized savings and flexibility for any C&I storage use case.

Visit www.leap.energy and www.wattmore.com to learn more.