



## Battery Energy Storage Fundamentals

*Effective communication, customer expectations, and satisfaction are very important to us. We have gained valuable experience from hundreds of energy storage installations and would like to share some of the more important lessons we learned over the years with you. Below is a short list of items that we want to make sure are effectively communicated for the best customer experience and expectations.*

- 1) Right sizing for best savings
- 2) Comparing battery proposals
- 3) Battery backup operation

### 1) Right sizing for best saving

By default, we size solar PV and battery energy storage systems for day-to-day use at your home that result in the best economics. When your solar panels produce more electricity than you are using in your home, you can store the excess electricity in the battery system instead of sending it back into the utility grid. Later, when your panels aren't producing enough electricity to meet your home's needs, you can use the electricity stored in your battery instead of having to buy it from your utility company.

You can think of your battery like water being stored in a bucket running through a valve. Energy capacity is the amount of water that can be stored in the bucket and be available to run through the pipes, while power is the size of the valve feeding the pipes. Larger valves allow more water to flow through at once, but depletes the water faster. Similarly, a battery with a high power rating can deliver more electricity at one time, but will deplete through its available energy capacity at a faster rate.

A battery's power determines what appliances you can run at once, while usable capacity determines how long those appliances can be run. Batteries with a higher power rating are capable of powering more robust appliances or many appliances at once, while batteries with a higher usable capacity can store more total energy and thus can run your appliances for longer periods of time without needing to recharge. The goal is to strike a balance between system capacity, power rating, and economics. It is important to understand that a properly sized system may actually require the use of additional grid power in high usage months instead of purchasing a larger, more expensive, system that only shows full economic benefits a few months out of the year.

A residential home's power draw is typically within a battery systems power limit at most times of the day, although this limit may be exceeded for short periods when there is an overlap of power draw from multiple appliances at the same time. For example when an electric water heater and electric oven or air conditioner are on at the same time. If the homes power draw exceeds the solar panels and battery power output, you simply pull in the balance from the power grid.

## 2) Comparing battery proposals

We often hear about homeowners that shop for multiple proposals but get stuck when trying to compare them side-by-side. As you learned from the previous section, there are multiple components to an energy storage system. These include the 1) solar PV system size, 2) battery capacity (size of bucket), and 3) battery inverter power (size of valve).

When comparing proposals for an apples-to-apples comparison, all 3 of these areas should be similar. We have heard of proposals that may have a similar PV system size, but that include less energy storage capacity in an attempt to show a lower price.

## 3) Battery backup operation

Most battery energy storage systems come with backup power capabilities, but others may be designed purely for solar savings and limited to on-grid operation only. Systems with backup power capabilities require an external transfer switch to allow for off-grid operation. This component connects your home, the grid, your storage, and your solar energy system all together so that the battery system system can automatically power your home's appliances when the grid goes down.

### **Can you go off-grid with battery energy storage?**

Installing a solar-plus-storage system at your home is a great way to take control of your electricity bill, but it doesn't mean that you're completely disconnected from your utility. Going "off the grid" with solar batteries is actually a more expensive and complicated proposition than you might think. Home batteries that are sized for the best economics and bill savings may only have enough capacity and power to serve essential appliances during an emergency. That being said, larger battery systems could serve as temporary backup when the grid goes down and even charge from your solar panels to provide power during extended outages.

### **The myth and challenges of whole home backup.**

Battery energy storage systems with backup capabilities work best when they are designed to ration battery capacity and minimize the use of major appliances. Whole home backup systems are typically designed similar to off-grid living: the homes are typically smaller and well insulated; use combustion heating with propane backup; incorporate active and passive solar thermal systems; and do not have power-hungry air conditioning systems, Level 2 EV chargers or swimming pools. Of course, installing additional battery capacity and inverter power can address these energy and power limitations. But the cost of these systems is prohibitive for the typical homeowner.

As mentioned earlier, even though a home's power draw may be within a battery system's power limit at most times of the day, this limit may be exceeded for short periods when there is an overlap of power draw from multiple appliances at the same time. For example when an electric water heater and electric oven or air conditioner are on at the same time. During backup power operation, the grid is no longer available if the homes power draw momentarily exceeds the solar panels and battery power output causing the system to shut down to protect itself requiring homeowner intervention.

One possible solution is to manually shut off large appliances during a blackout. Unfortunately, many blackouts occur during the day when no one is home or at night when people are asleep. Customers who have tried to manually shed loads usually end up being disappointed and frustrated with their backup system.

Another consideration is the momentary startup power surge requirements of an air conditioner, pump, or motor is often two or three times the normal power draw — meaning that the system simply will not switch over to backup mode. Even if the battery is fully charged on a sunny day, the air conditioner and pool pump will not start, and none of the protected loads will get power. Upcoming smart home electric system technologies will address these practical limitations by automatically shedding loads during a blackout, but these devices are relatively new to the market and often cost prohibitive.

A more practical approach is to design a battery backup system to power protected loads only: no large appliances such as air conditioning, 240-volt EV chargers or electric stoves. Instead, just an appropriate amount of circuits in the house for refrigeration, lighting, entertainment, communications and convenience outlets. A protected loads panel allows a homeowner to segment off a smaller subset of the home's electrical needs that they want to keep powered during an emergency power outage.

By default, Kumukit battery energy storage solutions that have backup power capabilities include a protected loads panel as part of our standard installation. These protected panels provide limited backup power to dedicated electrical outlets located inside the panel. Many homeowners simply plug extension cords in these convenience outlets for emergency power during a grid outage, similar to a backup generator. **These protected load panels will not supply power to the entire home during a grid outage.** There is an option to hard wire limited emergency circuits from within the home to this protected load panel for an additional fee. Every homes electrical layout is different, so we will need to estimate this amount on a case-by-case basis.



If you are still interested in pursuing a whole home backup solution, we will be more than happy to discuss a possible solution.



solar electricity



energy storage



solar hot water



solar charging