Storage 101 for Installers

8 ESSENTIAL QUESTIONS

Integrating batteries in grid-tied solar PV system

ENPHASE.

WHY STORAGE?

Solar adoption by mainstream America is still in its infancy. So why all the hype around energy storage? Early adopters of 'cool tech' aside, it's about economics—or at least potential economics—and a bit of psychology as well.

Adding storage to solar can make PV much more valuable to the homeowner. Solar + storage gives a homeowner more control over how they consume and manage energy, plus it can give a sense of energy independence. Storage also allows the homeowner to store the "clean" electricity their PV array produces during the day and use it at night. Additionally, adding batteries to solar arrays can create valuable revenue streams for installers who understand the solar + storage use cases, educate the homeowner, know how to size storage to PV, and ultimately install a system that adds the most value to the PV.

Changes to utility rate structures and net metering rules are causing solar companies to think of innovative ways to maintain viability and competitiveness in today's evolving solar markets. As state Public Utility Commissions modify the rules for PV systems; solar companies are implementing battery storage, load management, and power ramping to enable the sale of PV systems in some markets. As consumers warm to the idea of adding batteries to their solar systems, there are new opportunities to add storage to meet zero-export requirements, to manage demand, and to lower utility distribution charges.

USING THIS GUIDE

Storage is new, and many solar installers are being asked about it. This guide aims to answer eight essential questions:

1. What is storage?
2. Why would my customers want it?
3. Where is it needed?
4. What's the difference between a battery and a storage system?
5. Which chemistry should I use?
6. What's the difference between AC- and DC-coupled systems?
7. How much storage does my customer need?
8. How do I get my customers storage-ready?

Home Energy Batteries

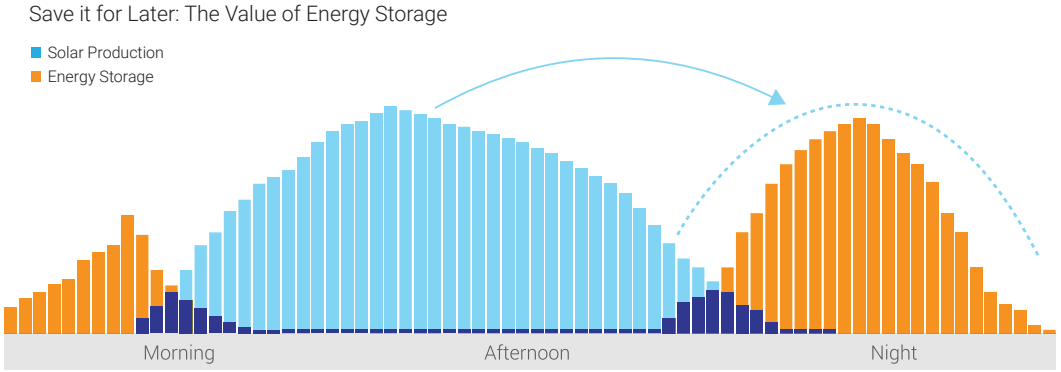
WHAT IS STORAGE?

1

Storage solves solar's most basic dilemma. Solar produces energy when most of us aren't home to consume it, and most of us need energy when the sun's gone down.

Storage solves the problem by holding energy that the PV system produces for when it is needed. It charges batteries during the day when the sun is shining, and then discharges the in the evening to offset a home's energy consumption. The best systems cycle more than once a day, so they can charge again overnight if the rates are low and discharge in the morning before the sun starts shining.

Solar plus storage allows system owners to not only offset the utility production charges, but also the distribution and demand charges.



THE ENPHASE WAY

Our high-performance energy storage solution brings homeowners more intelligence and better value than any other storage solution in the industry, with the lowest cost of entry and best lifetime value. It pairs seamlessly with Enphase microinverters and other solar technologies to help homeowners make the most of their energy.

WHY WOULD MY CUSTOMERS WANT IT?

2

Customers are asking about storage, but many don't yet understand its value. The reasons to add storage can be broken into two categories: economic and independence.

Economic reasons for adding storage include:

SELF CONSUMPTION

A homeowner's system stores the energy it generates to use later when it is needed. Changes in net metering rates can make this worthwhile. A special case of this is zero export: where a utility doesn't allow a homeowner to feed power back into the grid, so the homeowner must use it, store it, or lose it.

TIME OF USE BILL MANAGEMENT

This refers to storing the energy you generate during the day or energy from the grid when rates are low to use when electricity rates are higher. A homeowner can also shift their energy demand away from utility provided electricity when it costs the most. In certain markets, it can also mean selling electricity to the utility when it is paying the most for its energy.

DEMAND RESPONSE AND PEAK SHAVING

A homeowner can reduce the use of electricity from the grid during times of peak demand by using energy stored in the battery. Some utilities either charge higher rates during extreme demand spikes, or offer incentives to homeowners who can decrease their reliance on grid power at those times. Storage can help them do this for example without turning off the air conditioner during a heatwave.

The desire for independence is another driver of demand:

BACKUP

Storage is used by a grid-tied system to provide energy during a power outage. In general, batteries optimized for backup are different than those used for economic reasons, as they require fewer cycles and should be fully charged at all times. In most cases, generators are a better choice if customers are concerned about prolonged outages.

OFF-GRID

Storage is used by homeowners in areas without access to the grid to manage their power needs. In many cases this is accomplished by using large banks of lead-acid batteries, and this use case is best served by a legacy DC-coupled system.

THE BACKUP BIND

For a battery to serve well as a backup device for an outage of a day or more, it must be either large enough to have at least a day's worth of power—a massive 30kWh for a typical home*—or (more likely) it will require rewiring the home with a subpanel for critical loads.

Another problem with asking a storage system to perform backup functions too is that an outage probably won't happen when the battery is fully charged. And if the outage is due to a weather condition, you wouldn't be able to count on solar the next day to recharge the battery if the grid is still down.

* Source: U.S. Energy Information Administration

WHERE IS IT NEEDED?

3

By 2020, the U.S. energy storage market will be $2 billion, a 15x increase from 2014, and a 5x increase from 2015, GTM Research estimates. (Source: Q4 2015 Energy Storage Monitor). As more U.S. states begin to examine their net metering and energy policies, the demand for storage will grow.

There are two fundamental drivers of demand:

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PRICING OF POWER

Storage may make sense if energy prices vary greatly either by time of day or by whether your customer is importing from or exporting to the grid. Already Hawaii has done away with net metering, an attractive economic driver for solar. As more states adopt similar policies, the economic case for adding storage to solar becomes more compelling.

GRID STABILITY

The contiguous 48 states in the U.S. have a distributed grid, and only .6% of our energy comes from solar today. But what happens as we increase solar penetration, and what if we didn't have access to that network of energy sources? Hawaii gives us a good example of how this scenario can play out. One in nine homeowners has installed solar on the islands. And because they are islands, there is no sharing energy across a network of power generators. Each island is...well, an island.

As more of Hawaii's energy comes from solar, maintaining a stable grid has become increasingly challenging, so utilities have implemented 'Power Export Limiting' or PEL requirements. What this means is that the utility will limit how much power it can take back from rooftop solar in order to protect the stability of the grid. If your customer is not using that energy during the day, it is wasted. Actually, that "extra" energy is never even harvested. Zero export, means nothing is generated if it has nowhere to go.

THE ENPHASE WAY

Our storage system uses a microinverter that is designed for the smart grid. And with bi-directional communications, the software-defined inverters can be updated to respond to evolving grid conditions.

WHAT'S THE DIFFERENCE BETWEEN A BATTERY AND A STORAGE SYSTEM?

4

In these early days of the industry, many are using the terms battery and storage interchangeably. But there are significant differences, and whether you are comparing systems or comparing prices, it's important to understand the terminology.

BATTERY

A battery essentially acts as a bucket in which to store energy. Because it doesn't come with a built-in inverter, smart home software or other key components, it can't operate by itself. Some may be pretty boxes with slick logos, but all batteries are useless until they have additional systems added to them.

STORAGE SYSTEM

An integrated system, whether DC- or AC-coupled, incorporates an inverter, battery management system, sophisticated software, and power electronics. Some have the ability to "talk" to home automation platforms as well as the local utility. These are not commodity products, but rather differentiated pieces of advanced technology. The best systems have them integrated into one single product.

HOME ENERGY SOLUTION

Taking it a step further, a true intelligent home energy solution would be integrated with a rooftop solar PV system—solar + storage + energy management. It simplifies integration with one brain, one software platform.

Reports on battery costs often ignore the true cost of a storage system. To make an apples--to-apples comparison, ensure it includes an inverter, battery management system, and other system components, whether they are integrated or not. On top of that, consider the cost of design and installation, permitting, and the like. In most cases, the battery may make up only half of the ultimate price of a fully installed system.

THE ENPHASE WAY

The Enphase Home Energy Solution brings solar, storage, and energy management seamlessly together in a modular, plug and play solution from one brand that delivers the greatest value to the customer.

WHICH CHEMISTRY SHOULD I USE?

5

A battery is an energy storage device that contains a chemical reaction that gives off energy in the form of electrons that can be used to power your home. The battery chemistry refers to the types of chemicals and metals inside the battery that are used to store and release energy.

Most of the new energy storage systems coming on to the market today use Lithium-ion batteries. There are several different chemistries that are all considered a Lithium-ion battery, and two most commonly used in energy storage are:

LiCO

LITHIUM-ION WITH COBALT
Most Lithium-ion batteries contain cobalt, which can make the batteries unstable and at risk of thermal runaway, which means it can catch fire if punctured or crushed and be quite dangerous. While not likely in most small devices, this is not something you would want to have happen with a larger scale battery. For instance, this type of battery is used in certain high end electric vehicles. Videos of car fires where this sort of battery is involved show dramatic consequences.

$LiFePO_4$

LITHIUM FERROUS PHOSPHATE
Also called LFP, these batteries use iron instead of cobalt. The chemistry is much more stable on its own, and depending on the shape of the cell it's used in, can actually be the safest chemistry available.

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What about good old-fashioned lead acid? They are not particularly efficient and can be quite bulky, although they are readily available and inexpensive. They are still common in off grid systems which value price over size.

Battery packaging is also important, with prismatic cells preferred over pouch or cylindrical cells.

THE ENPHASE WAY

Enphase holds the safety of your customers and their belongings in the highest regard. With that in mind, we have chosen a prismatic Lithium Ferrous Phosphate battery, which brings chemistry and packaging together for top notch stability and performance.

Li Fe

WHAT'S THE DIFFERENCE BETWEEN AC- AND DC-COUPLED SYSTEMS?

6

Storage systems come in two varieties: AC-coupled or DC-coupled. AC-coupled storage systems interface with a solar array in the AC load panel, while DC-coupled systems connect directly to the DC power source.

AC-coupled systems offer simplicity, flexibility, reliability, and safety—and the best ones offer equivalent efficiency to DC-coupled systems. The most obvious advantage of DC-coupled systems is that they allow both the solar array and battery to be served by a single inverter; however, that has its downside too. First, there's now a single point of failure that can take down not only the solar, but also the storage system. For retrofits, choosing DC-coupled means either replacing the existing inverter or adding a second inverter; and for systems that may want solar in the future, it means either oversizing the inverter today or integrating a second inverter in the future.

AC-COUPLED SYSTEM ADVANTAGES

- Solution can be retrofitted to existing solar installations
- More incrementally scalable
- Minimizes high-voltage DC indoors
- Systems can be made solar-ready for future storage without oversizing inverter

DC-COUPLED SYSTEM ADVANTAGES

- One inverter handles all conversion for PV and batteries
- Equivalent efficiency to AC-coupled systems

THE ENPHASE WAY

The Enphase AC Battery is an AC-coupled modular, easy-to-install unit that delivers 1.2kWh of energy, 96% round-trip efficiency, 95% depth of discharge, and 2 cycles per day, offering **homeowners twice the value for a faster payback period.**

The all-AC distributed architecture offered by the Enphase battery makes it easy to add to new and existing PV systems, with no need for an expensive, oversized 'storage ready' inverter.

HOW MUCH STORAGE DOES MY CUSTOMER NEED?

7

With storage systems that are both new and fairly expensive, it's important to sell your customers enough to meet their needs, but not so much that they're stuck with an expensive asset that never pays dividends. Many storage system companies have taken a stab at a size—7kWh, 4.4kWh, 10kWh.

Each family's needs will vary based on:

- Size of solar PV system
- Pattern of energy use throughout the day
- Total energy consumption
- Reason storage is needed (e.g. zero export)

Because there are so many variables, installing consumption monitoring lets you size a system accurately. Choosing a system available in smaller increments lets you install the right amount. A modular AC-coupled system offers further advantages as it lets you offer customers enough storage to meet today's needs. Plus you can easily add on if electric prices, grid rules, or family needs change in the future.

THE ENPHASE WAY

One bonus of Enphase's 1.2kWh AC battery is that it's simple to install and flexible to lay out. Its plug and play design and easy install (55lbs/25 kg) means you can scale storage capacity to meet your customer's needs, and it works with any PV system for easy retrofits.

HOW DO I GET MY CUSTOMERS STORAGE-READY?

8

Outside of markets where electricity prices are very high and net metering has been eliminated, adding storage to solar PV may not make economic sense today, but you can prepare all homeowners for storage in the future.

At some point their electricity rates will go up, and they may face the reality of restrictions on their ability to export or sell power back to the utility. Until that day comes, they should at least have more insight into their electricity consumption, so that their PV system can be properly sized with an appropriate storage solution.

Today you can:

- Install consumption monitoring
- Keep one 20 amp breaker free for future storage
- Choose a system designed for seamless integration with future storage

If reliable and meaningful backup power is a concern, discuss installing a generator for whole house or critical load backup.

THE ENPHASE WAY

To get a home storage-ready, install an Envoy-S metered and CTs for consumption monitoring. Only one 20 amp breaker will be needed for up to 13 AC batteries.