



# Battery Storage Guide for Homeowners

Navigate The World Of Battery Storage With Confidence



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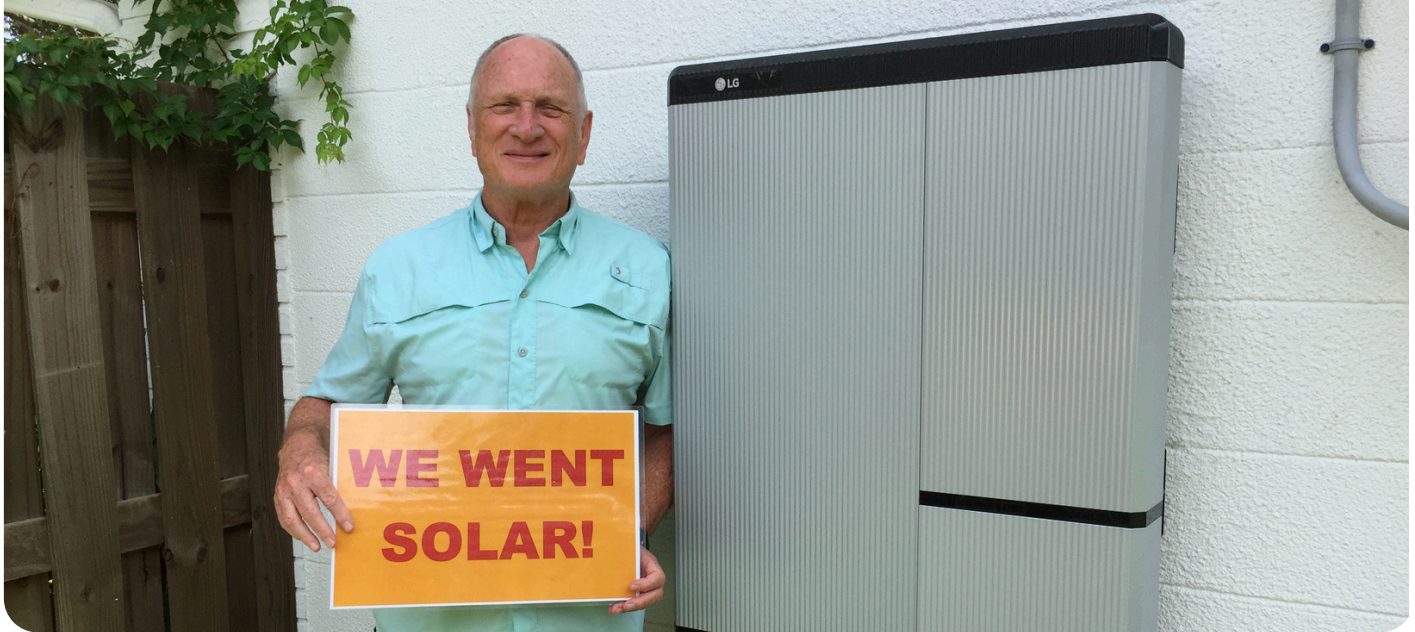
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# Introduction



Florida homeowner Steven Murphy with his LG RESU battery bank.

## Welcome! We're glad you're here.

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A battery storage system installed in your home enables you to use electric appliances when your power goes out. It's something that more and more homeowners are looking into. That's why we created this vendor-neutral guide.

We want to help homeowners like you navigate the world of battery storage systems. If installing battery backup in your home makes sense for you and your family, we want you to be able to do it with the utmost confidence and least amount of stress.

## So, what's in the guide?

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In this guide, you'll learn what battery storage is, how it works, why you might consider it for your home, and what your options are when shopping for batteries.

We'll also tell you about the costs, incentives, and financing. Plus, we'll guide you through finding an installer, provide tips for making sure you get what you need, and tell you what happens once your batteries are installed.

### Who is "we"?

**Solar United Neighbors (SUN) is a national nonprofit that helps people go solar, join together, and fight for their energy rights.**

# Introduction

## Battery storage: A growing industry

### Interested in battery storage for your home? You're not alone.

In fact, the number of homes making use of battery storage systems has been climbing steadily for years. Battery storage use saw a big jump in 2020 as COVID-19 hit. Weather events like Hurricane Sally, Winter Storm Uri, and the California wildfires magnified further the need for disaster preparedness.

The growth of residential battery storage continued even into 2021. It happened despite the global supply chain issues and manufacturing setbacks faced by almost every industry due to the pandemic.

There are many reasons for this enduring growth. More people are coming to understand that backup power is a viable option. The events discussed above have shown that electric service is less reliable than people thought.

At the same time, new battery storage technologies and partnerships between battery vendors and solar installers are making it easier to install solar and storage in tandem ([source](#)).



Florida homeowner Mary Blackwell and child with her Tesla Powerwalls installed.

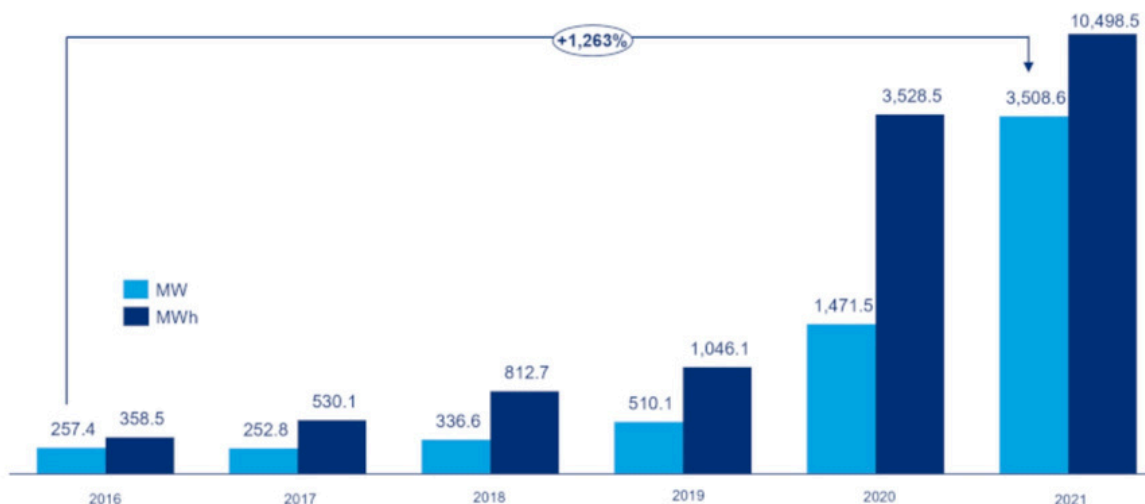


SUN staff members and Puerto Rico homeowner Daniel Munoz with Tesla Powerwalls.

# Introduction

## Battery storage: A growing industry (continued)

### Growth of battery storage in the US from 2016-2021



Source: [solarpowerworldonline.com](http://solarpowerworldonline.com)

**Annual residential storage installations are expected to grow to 2 gigawatts (GW), or 5.4 gigawatt-hours (GWh) by the year 2026.**

Leading markets will be California, Puerto Rico, Texas, and Florida. ([source](#))

It's no coincidence the places with the most demand for battery storage are those that have experienced extreme weather events in recent years.

In Puerto Rico, for example, extreme weather paired with an aging and mismanaged electrical grid has many homeowners installing solar and storage as a way to take control of their energy use.

**How big is 2 GW?** About 2.6 million horsepower!

**What about 5.4 GWh?** That's the equivalent to one gigawatt (1 billion watts, or 1.3 million horses) running for one hour.



# Battery Storage Basics

## What's battery storage?

A battery is a device that stores electricity for later use. A battery storage system installed in your home enables you to use electric appliances even when your neighborhood experiences a power outage. A typical home battery system will have a couple of batteries and take up a space no more than three feet wide and four feet high, often on one wall of a garage.

With electricity stored in your battery bank, you can endure a power outage more comfortably and safely. With battery storage you can use your lights, heat water for a shower, and avoid disruptions to lifesaving tools like well pumps or medical equipment.

Think of a backup battery like a traditional generator. They're often used for the same purpose, though there are distinct and important differences between the two:

### Battery storage banks:

- Use electricity from the grid or from solar, if you have it
- Operate automatically once installed

### Generators:

- Run on fossil fuels such as diesel, gasoline, propane, or natural gas
- Require you to buy and store fuel or rely on fuel delivery during an outage

Note: If you do not pair your batteries with solar, the battery will charge and recharge only from utility-supplied grid electricity. This limits its usefulness for backup power purposes during a utility outage. This is because it will only be able to discharge once before it needs the utility grid to be restored for it to recharge.

**“Many of our neighbors have power backups,” said John Hedlund, whose Virginia home has solar and battery storage.**

**“I chose a battery backup option because, in an extended outage, it would not run out of fuel (the sun).”**

# Battery Storage Basics

## How does battery storage work?



Florida homeowners Steven Murphy and Betty Jo Henson in front of their solar home.

**Florida homeowners Steven Murphy and Betty Jo Henson lost power for two weeks during Hurricane Charley in 2004. “It was miserable,” Betty Jo said. “We didn’t want to go through that again.”**

Most homeowners who use battery storage do so for the backup power it provides during grid outages. When your utility grid goes down and you lose electric service, you can use a battery system to power some or all of your household electricity needs (called “loads”).

Before installing battery backup, Florida homeowners Steven Murphy and Betty Jo Henson lost power for two weeks during Hurricane Charley in 2004. “It was miserable,” Betty Jo said. “We didn’t want to go through that again.” Now, the couple has solar, plus a 10 kW battery that powers six circuits in their home. This is enough to cover the majority of their home except for guest rooms, stove, dryer, and their central air conditioning unit. They have a portable AC unit that can run off their battery instead.

Battery backup systems work by isolating some or all of your loads from the main utility system with something called an “automatic transfer switch”. Batteries then power those loads with electricity stored in the battery bank. The backed-up loads in your home then automatically reconnect to the grid when the utility grid power returns. The result is that these “critical” loads receive power even when the grid is down, switching seamlessly between utility electricity and stored electricity from your battery.

A “load” refers to anything in your home that requires electricity to run. Loads can range from small (light bulbs, toasters, a laptop computer) to large (a refrigerator or a well pump).

Your battery storage system will be installed with a device called an inverter. The inverter is needed to convert your battery power, which is DC, into power usable by your loads (AC). See page 16 for more.

# Battery Storage Basics



Battery storage system in action.

## How does battery storage work? (continued)

Many battery storage systems include a separate electric panel, called a subpanel. Your most important loads are wired to the subpanel. When a power outage occurs, an automatic switch transfers power supply to your backup batteries in a split second. Your batteries, which have been sitting fully charged and ready to be used, begin to power those select loads.

As advances occur and costs decrease, more homeowners are integrating smart technology into their homes.

Instead of a separate subpanel, they have just one electric panel — a smart panel. From an app, a homeowner can rank their home's loads in order of importance, allowing their smart panel to choose which ones can and should be powered by the battery during an outage. With a smart panel, the homeowner can also see real-time energy consumption data on their app, like how much power is flowing to each appliance, and control the power supply as needed, including turning loads on and off.

## Why can't I just power my entire home with battery storage?

Put simply: it's expensive. Many homeowners install a smaller battery bank or single battery to power their most important appliances (referred to as "critical loads").

However, if you feel strongly about powering your entire home during an outage, a whole-house fossil fuel-powered generator may be more cost effective.



# Battery Storage Basics

## How does battery storage relate to solar?

With solar panels, you generate your own electricity to power your home. Adding battery storage means you also get to keep any extra electricity and store it for later use, like during a power outage.

A common myth about solar is that it'll provide your home with electricity during a power outage. This isn't the case, unless you have battery storage. Solar systems are tied to the grid and required to automatically shut off. This requirement is a safety measure if the grid goes down.

This ensures systems don't "backfeed" power onto the lines and injure workers that may be repairing the electric line.

When you have battery storage paired with solar, you can both generate and store your own electricity. The electricity produced by your panels will power your home's appliances and charge your batteries so they're ready when you need them. We'll talk more about solar and storage in a later section.

## Should I consider storage?

### Benefits of battery storage

- Protect your home and family from power outages and grid failures, which are unfortunately increasing in many areas due to hurricanes, wildfires, and other weather events.
- Meet your critical energy needs in an emergency if you rely on medical equipment or a well pump.
- Enjoy increased independence from the electric company.
- Show off your cool tech and join the clean energy club!
- Save money if your utility employs advanced rates like Time of Use (see page 20).
- If you also have solar, protect its value from net metering changes (see page 20).

### Potential drawbacks to consider

- The initial cost to install batteries is still relatively high, though it has been declining steadily year over year.
- With a complex system, there is a learning curve. Increasingly, battery storage systems are being pre-packaged for easier installation by professionals, and we hope this guide is helpful too!
- Added maintenance for your home (see page 23).
- It's still economically impractical for most people to back up their entire home's energy needs.

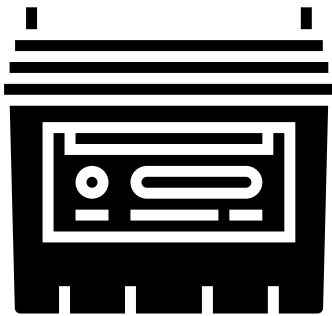
# Shopping for batteries

## In this section we cover:

- The types of batteries available
- How to determine your storage needs
- Ways to install solar and storage together or separately
- What different batteries cost

## What kinds of batteries are on the market?

1

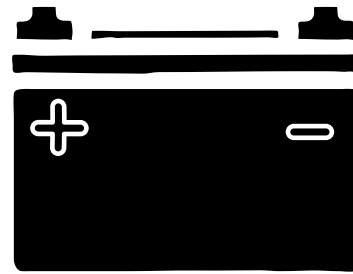


### Lead-acid batteries

Lead-acid batteries have been around a long time. They've powered cars, tractors, and submarines for decades. When it comes to backup power in homes, the most common variety of lead-acid batteries are called "sealed lead-acid". These batteries don't require regular maintenance to stay operational. (Their "flooded lead-acid" cousins, on the other hand, typically require the owner to monitor fluid levels in the batteries and periodically add distilled water to keep the batteries healthy.)

Lead-acid batteries have a lower upfront cost than newer lithium-ion batteries. But, they also take up more space than newer options. Depending on how often they are used (or "cycled"), they can last from 5 to 10 years. Their product warranties are typically shorter than lithium-ion models.

2



### Lithium-ion batteries

Lithium-ion batteries are a newer technology and can be found powering your phone or computer. These batteries offer a higher density of energy (more energy per unit of space) than lead-acid batteries. They can be used (or "cycled") more often during their lifespan.

Lithium-ion batteries cost more upfront, but the market for them is growing fast. Prices are dropping. This is due in part to the rapid expansion of electric vehicle (EV) manufacturing. EVs also use lithium-ion batteries. Because of their longer lifespan (~10 years) and their ability to be charged and discharged more frequently, lithium-ion batteries have a lower lifetime cost than lead-acid counterparts.

# Shopping for batteries

Comparison	Sealed-lead-acid	Lithium ion
Average number of battery cycles	Less	More
Regular maintenance	No	No
Typical lifespan	5 years	10 years
Upfront cost	Less	More
Weight	Around 15 pounds	Averages 55% lighter, around 8 pounds

## Two main types of lithium-ion batteries dominate the market.

### 1 Lithium Nickel Manganese Cobalt Oxide (“Li-ion-NMC”)

Lithium Nickel Manganese Cobalt Oxide or “Li-ion-NMC” is the more commonly available lithium-ion battery type. It’s also the least expensive lithium-ion battery on the market.

While it’s rare, Li-ion-NMC batteries can overheat and catch fire due to overcharging or improper use. Known as “thermal runaway,” you may have heard of this happening with cell phones, e-cigarettes, and other small consumer devices. Thankfully, there have been very few instances of home battery storage systems catching fire. Their sophisticated management software is designed to prevent overcharging and thermal runaway. Unlike phones and e-cigarettes, home storage batteries are stationary. This means they are better protected from things that would trigger thermal runaway.

### 2 Lithium Iron Phosphate (“LiFePo”)

Lithium Iron Phosphate or “LiFePO” is the second type of lithium-ion battery. LiFePO batteries are more expensive but do not experience thermal runaway.

Sonnen, SimpliPhi, and Enphase are several of the manufacturers who use this chemistry in their battery backup solutions.

# Shopping for batteries

## Determining your battery storage needs

When figuring out your storage needs, you'll want to ask an important question with two parts:

1. What do I need to power
2. and for how long?



Various battery brands: LG, Sonnen, Tesla.

### 1 What do I need to power?

Maybe it's your home's lighting, refrigerator, TV, and a few electrical outlets to charge your mobile devices. You'll want to determine how much power these items use. Your battery installation contractor can help you with this.

Keep in mind that certain electrical loads will likely use more energy than you can realistically provide from a battery system that fits your budget. Appliances with resistive heating elements (like electric stoves, electric water heaters, and space heaters) use a large amount of energy. They can also draw lots of power all at once. Whole house air conditioners also use a lot of energy and may not be realistic to power from batteries. As an alternative, you may choose to power a smaller window-based AC unit for a particular room.

#### **A typical home with battery storage will use the system to power loads like:**

- Some or all house lighting
- Ceiling fans
- Personal consumer electronics
- Cable modems/routers
- Food refrigeration
- Limited air-conditioning (window units)
- Well pumps
- Medical equipment

# Shopping for batteries

2

**Now, let's cover the second part of our question: "For how long?"**

For most battery backup systems the standard length of run time is one day. This is especially true if you have solar on site to recharge your batteries. Your contractor will guide you through how long you want to be able to run your appliances. You'll need to consider both the size of the battery and its capacity.

## Battery Size

Batteries are typically rated in amp- hours (Ah) or kilowatt-hours (kWh). For example, you may purchase a 2 kWh or 5 kWh battery system for your home. A battery system that operates your appliances and lights for one day would be smaller than a system that can operate the same equipment for two days without being recharged.

### Meet John Hedlund, Virginia Homeowner

John Hedlund has a 25 kW solar array consisting of 84 panels. He also has a battery rated at 9.3 kWh. He sized his system so that during an outage he could power his water pump, refrigerator, the air handler for his propane furnace, electrical support for his propane stove, and several general circuits for lighting and device charging.



# Shopping for batteries

## Determining your battery storage needs

**Battery capacity:** In addition to knowing the kWh size, it's also important to know the battery's "relative capacity". This refers to the amount of energy ("depth of discharge, or DOD") that can safely be drained from a battery before it needs to be recharged. For lithium-ion batteries, the DOD is often 90% to 100%. For lead-acid batteries, on the other hand, it is around 50%. This means you can only discharge half of a battery's energy before you must recharge it.

A 100% DOD for a 2-kWh lithium-ion battery can deliver up to 2 kWh before needing to be recharged. A 2-kWh lead-acid battery might only deliver around 1 kWh (50% capacity) before needing to be recharged. Lead-acid batteries can be discharged further than their recommended depth of discharge. But, doing so regularly will shorten their lifespan.

**Another way to look at our question ("What do I need to power and for how long?") is in terms of how much energy and power your needs require.**

### What is power?

Power is instantaneous and measured in watts (W). 1000 Watts equals one kilowatt (kW). Power measures the ability to do (electrical) work in a given moment. Think about the "Test Your Strength" game at a carnival. You hit the lever with a hammer. This moves a weight up a tower. How high the weight goes is a measure of your power in that instant.

### What is energy?

Energy is measured in watt-hours (Wh). It is what the electrical loads in your home consume over time in order to operate. A thousand watt-hours equals one kilowatt-hour (kWh). It's the total amount of (electrical) work that can be done. It's what we pay for every month on our electric bills.

### Wait, energy is different from power?

Yup! While these terms are often used interchangeably, they are two different parts of our electricity system.

It takes an equal amount of energy (measured in kWh) to heat a cup of tea in:

- a 1000 Watt microwave for two minutes
- a 2000 Watt microwave for one minute
- Either way, your tea will come out just as hot.

1000W Microwave  
2 minutes



2000W Microwave  
1 minute



The same temperature in the end!

# Shopping for batteries

## Where will you install your battery bank?

The type of battery you buy will determine where you should keep it in your home. Different types of batteries have different temperature requirements, space constraints, and siting conditions. You may need to place the battery bank indoors, or outdoors in a shady, temperate area. Your contractor may also need to adjust the size of your battery system to accommodate your available space.



Solar and storage installation in action at the home of Florida's David Rivera.

Comparison	Lead-acid batteries	Lithium-ion batteries
Temperature	Preferred range for optimal efficiency and longevity is 50° - 80°F.	Preferred range is 32° - 100°F.
Space taken up	A single battery is about the size of a shoebox.  Usually, multiple batteries are strung together to power multiple loads. This increases the space needed for installation.	Smaller batteries, contained in a singular unit.
Positioning	Keep away from water to prevent damage.  The less-common flooded lead-acid batteries require monthly maintenance. Good ventilation and easy access will allow you to clean the battery terminals and add distilled water to the batteries.	No maintenance required. Ongoing operations (cycling the battery on and off) are controlled in the inverter component of the device.
Other equipment	Must be connected to a separate inverter, which will be wall-mounted.	Depending on the manufacturer, Li-ion batteries may or may not contain an integrated inverter.
General recommendations	Install indoors, off the ground. For flooded batteries, choose a well ventilated and easily accessible space.	Install indoors or outdoors, unless your area experiences extreme temperature swings. If outdoors, away from extended direct sunlight is best.

# Shopping for batteries



**Virginia homeowner John Hedlund had his 9.3 kWh battery bank installed in a room attached to his garage.**

The rest of the components for his solar and storage systems are on the outside wall of his home. These include two inverters. One provides AC power during normal operation. The other provides AC power during grid outages. John also has surge protection for his system.

## What's your solar status?

If you're reading this guide, you're probably curious not just about storage but about solar too. Or, perhaps you already have a solar system at your home. Where you're at in your "solar journey" can have an impact on how you purchase and install battery storage.

Battery storage systems receive and put out direct current (DC). This is also what solar systems produce. The devices in our homes, on the other hand, require alternating current (AC). A device called an inverter is needed to convert DC to usable AC power. Whether you're interested in installing battery storage, solar, or both, **you'll need an inverter.**

## What does AC vs. DC power mean?

Electrical current is the flow of charged electrons. With direct current (DC), the flow of electrons moves in one direction. With alternating current (AC), the flow of electrons oscillates, creating a wave-like pattern.

It's much easier to change the voltage level of AC. Plus, it transmits better over long distances. That's why most household appliances and buildings are powered by AC. Still, many devices, such as batteries, use DC.



# Shopping for batteries

**If you don't have solar and you want to install it along with your battery system, read on.**



Puerto Rico solar homeowner Victor Santana on his roof next to his new system.

**Installing solar and storage at the same time will let you plan a fully integrated system. Adding both at the same time makes setup and usage more efficient and cost-effective.**

You'll probably want a single inverter that can be used by the battery system and solar system. Electricity from your solar panels (in DC form) will flow through the inverter, convert to AC, and flow out to your home.

The extra electricity will be fed directly from your solar panels into your batteries in DC form. When there is an outage it will flow back through the inverter to convert to AC.

This setup is called **DC coupling**. It is currently the most common setup for homes where solar and storage are installed simultaneously.

**Learn more about going solar and check out our Go Solar Guide.**

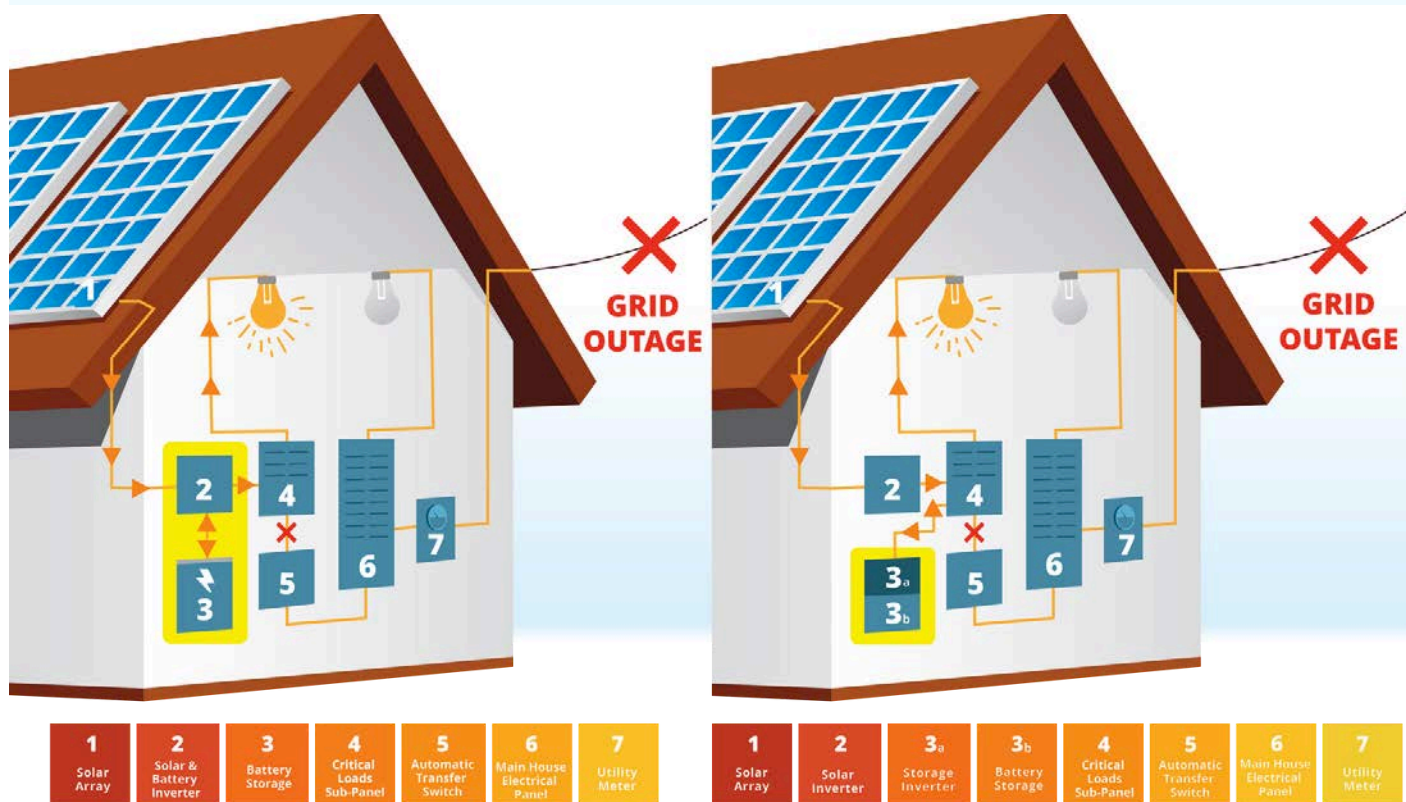
[Click here to download it.](#)

# Shopping for batteries

**If you already have solar and want to add battery storage, we've got you covered too.**

While your two systems will work together, their setup will be independent of each other. This means you'll have two inverters, the one you already have for your solar and the one you'll add for your storage system. Your existing inverter converts your solar electricity from DC to AC so it can power your home. The inverter you'll add for your battery will convert the solar electricity (now AC) back to DC so that it can be used to charge the battery. Typically, the energy produced from your solar system enters your house and then your excess electricity (not used by your home) is stored in your battery.

This setup is called **AC coupling**. AC coupled systems allow you to keep your existing solar inverter and wiring (saving you time and money). They also require your solar inverter to communicate with your battery's inverter during an outage. If you go with an AC coupled system, be sure to have your installer explain exactly how your existing solar inverter and your new battery inverter will talk to each other.



DC coupled system.

AC coupled system.

# Shopping for batteries

**Whether or not you have solar, keep in mind that sizing is an important factor for using solar to charge batteries.**

During a power outage, you'll need enough solar to be able to fully recharge your batteries during the day so you can power your critical loads day and night.

If your solar system is properly sized and configured, it will do just that.

Inform your installer of your current and future plans so they can help you choose a system that is sized to accommodate them.



A diagram showing how a battery and solar system operates when there is a grid outage both during the day and at night.

# Shopping for batteries

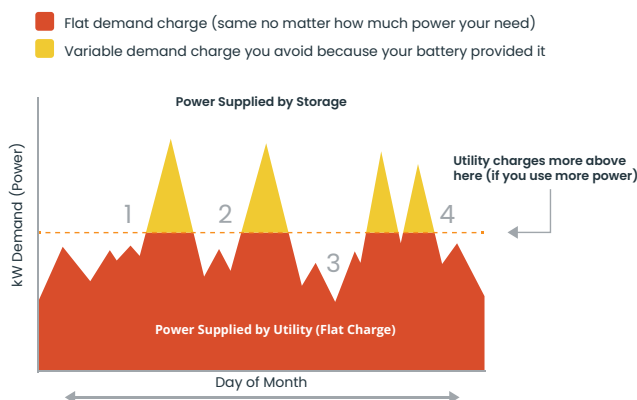
## How much control do you want over programming your system?

All battery storage systems require an inverter to convert DC power to AC. These inverters can all be programmed to operate based on your needs and preferences. Standard inverters can only be programmed to work in a predictable, static manner, smart inverters can do much more. Smart inverters are becoming increasingly common.

### Here are three options to consider:

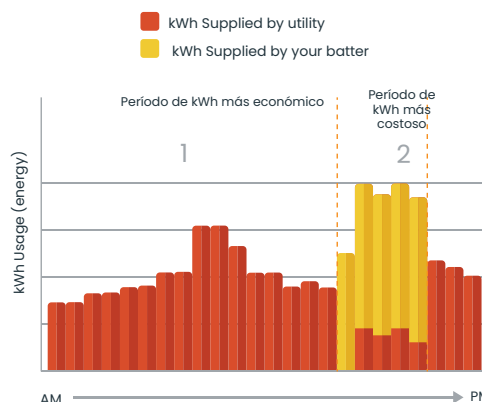
- 1 A smart inverter** can be programmed (via mobile apps and web portals) to run when it makes the most sense, given physical, financial, or owner-preference signals. Smart inverters give battery owners more programming control over when and how their battery is used.
- 2 Maybe you have solar but your area doesn't offer net metering.** Net metering is a billing system that provides you full credit for the electricity you generate but don't use yourself. In such a case, you may want to consume as much solar-produced energy as possible in your own home. Doing so will cut down on how much excess you produce. You can program a smart inverter to do that. This is typically called "self-consumption."
- 3 Perhaps your utility offers a rate structure that allows storage to provide you economic value, such as Time of Use (TOU).** This is an increasingly common rate structure. The utility charges customers more for using grid electricity during peak times. Electricity usage usually peaks in the evening when everyone is at home cooking, heating or cooling their homes, and using entertainment devices. You can program a smart inverter so that your batteries power your appliances during peak hours and grid electricity powers them at all other times.

DEMAND CHARGE AND STORAGE



- 1 & 2 Really cold days and you had your space heaters on.
- 3 You were out of town
- 4 You ran the dryer, microwave, oven, and blow dryer all at once.

TIME OF USE AND STORAGE



- 1 You are getting ready for work in the morning
- 2 You are home from work, making dinner, kids are watching TV, and you just turned on your AC.

# Shopping for batteries

## How much does battery storage cost?

As we've mentioned, most homeowners use battery storage to power their most important loads during power outages. It would be prohibitively expensive for most people to install and maintain a battery system capable of regularly powering their entire home.

In fact, when deciding what battery system is right for you, cost is the limiting factor for most homeowners. Of course, incentives and financing make it easier for many people to afford battery systems. (See page 24 to learn more).

But, unlike solar which generally pays for itself after 7 to 12 years depending on where you live, the value of battery systems really lies in the protection and peace of mind they provide. In the event of a power outage, a homeowner with battery storage knows they can continue to power lifesaving medical equipment and critical appliances. And, if you live in an area where using battery storage has some economic value like we talked about above, you can think of that economic value as paying down the cost of the resiliency and peace of mind the batteries provide.

### The cost of NOT having a battery backup system

Often left out of the equation, the cost of losing power to your home is important to consider. Going without electricity can lead to a host of situations that have economic and quality of life impacts during an outage.

Florida homeowners Steven Murphy and Betty Jo Henson estimate that their 10 kW battery costs them **\$1.40 per day**.

"Think of it like an insurance policy," Steven said. "For the price of a cup of coffee, you'll have power during the next outage."

Item	Cost
Food loss	\$50 - \$500
New refrigerator	\$500 - \$1000
Staying at home vs. a hotel	\$500+
Keeping a sump pump running vs. your basement flooding	\$5,000+
Home medical equipment working vs a hospital visit	\$10,000+
Fish tank pump working and pet fish happy	Priceless

# Shopping for batteries

## Three categories of cost to factor in when installing battery storage:

### 1 Hardware costs

Battery costs vary significantly between manufacturer and battery type. They range from \$3,000 to more than \$15,000. Much like solar, batteries are priced based on the amount of electricity they provide. Batteries are sized according to their power (dollars per kW) and energy (dollars per kWh).

While lead-acid batteries have historically been cheaper per unit than lithium-ion batteries, the cost of lithium-ion batteries has fallen rapidly. It's now close to reaching parity with lead-acid.

AC coupled battery systems added to existing solar arrays will oftentimes require a second inverter. This can cost an additional \$3,000 - \$5,000. Some manufacturers, like Tesla and Sonnen, integrate the additional inverter functionality into the battery itself. This eliminates the need to purchase and install a second inverter.

### 2 Installation, permitting, and design costs (also called “soft costs”)

The second biggest cost to add battery storage is for design, installation, permitting, and project administration (referred to as a whole as “soft costs”). These costs vary significantly between geographies and between battery types.

While it is hard to estimate a standard installation cost, we suggest budgeting \$3,000 - \$5,000 for a standalone battery installation. If you need a second inverter too, budget an additional \$1,000 - \$2,000 for those installation costs.



Two grid-tied inverters on a solar home in Florida.



Washington, DC solar homeowners Adondra Woods and Samuel Awosika at their installation.

# Shopping for batteries

## 3 Maintenance costs

The more commonly used chemistries for battery backup (sealed lead-acid batteries and lithium-ion) require little to no routine maintenance.

Still, we recommend budgeting \$1,000 over the lifetime of your system for maintenance-related activities like system check-ups by the contractor. Your contractor should be able to tell you the manufacturer's recommendations for your particular system.

Your lithium-ion batteries and lead-acid batteries will likely be under warranty for 10 years and 2 to 5 years, respectively. Battery warranties depend on the "cycles," the extent to which a battery is charged and discharged.

It's important to note that battery warranties have a shorter timeline than that of solar panels (usually 25 years). This means that if you pair battery storage with solar panels, you will likely have to replace the batteries at some point during the life of the solar array.

At that time, you'll incur the cost of both hardware and labor to install the new battery. We'll talk more about warranties in the post- installation section.



A happy storage owner in front of his battery.



Virginia solar homeowner Scott Sklar with his Concorde Sun Xtender AGM bank.

Popular battery types				
Tesla's Powerwall 2.0	LG Chem RESU 10H	Pika Energy Harbor	Sonnen Eco	Panasonic EverVolt
13.5 kWh	9.8 kWh	10.1 kWh	10 kWh	11.4 kWh
\$6,700	\$5,250	\$13,500	\$16,750	\$15,880
Plus \$1,100 for supporting hardware				

Source: [Build with Rise](#)

# Shopping for batteries

## Homeowners producing and storing their own electricity benefits everyone.

This is why governments at the federal and local level are providing incentives to add solar and storage. The most well-known is the federal Investment Tax Credit, or ITC.

## Three tools and resources to help with costs

### 1 Federal ITC

You can write off 30% of your total installation cost. The federal ITC provides a non-refundable credit you can count towards your federal tax burden. The credit is worth 30% of the total installation cost of your battery system.

You file for the tax credit when you file your taxes for the year the battery was installed. Thanks to the Inflation Reduction Act of 2022, the ITC will remain at 30% through 2032. After that, it is scheduled to decline to 26% in 2033, 22% in 2034, and 0% beyond that. As with any tax matter, we recommend you consult with your tax advisor.

### Here's an example of how the ITC works:

- Frida installs a \$15,000 lithium-ion battery system and solar panels at her home.
- Thirty percent of that is \$4,500. When she sits down to do her federal taxes, she submits the necessary paperwork for the tax credit, worth \$4,500.
- She's then able to credit that \$4,500 to her tax burden, essentially saving \$4,500 off the cost of her new system.
- Should the 30% credit value exceed Frida's federal tax burden for the year, she can roll over the remainder to subsequent tax years.



# Shopping for batteries

## 1 Local Incentives

State and utility incentives come in many different forms from various types of tax credits (income and property), tax exemptions, and rebates.

Check for incentives in your area:

- DSIRE incentive database
- SUN's Solar incentives website

## 2 Financing

Once you've determined if you're eligible for incentives, you'll have a clearer idea of what your battery storage system will cost. Most buyers rely on financing to help pay for their systems.

**Several good options exist:**

- Home improvement loans
- Home equity lines of credit (HELOC)
- Storage financing from select solar loan providers
- PACE (Property Assessed Clean Energy) financing, which may be available for storage

Ask your installer about financing options they can offer from the manufacturer or from third-party financiers. Compare them to what you can acquire on your own.

### Examples of local incentives as of 2022:

- **California's Self-Generation Incentive Program** - provides an upfront rebate for installing a battery storage system.
- **Maryland's Storage Tax Credit** - provides a credit for 30% of your system cost up to \$5,000, in addition to the federal ITC.
- **Jacksonville Electric Authority's Solar Battery Incentive program (in Florida)** - offers a \$4,000 rebate for solar owners who install a battery system.
- **The City of Fort Collins' Residential Battery Storage Program (in Colorado)** - offers an incentive of up to \$1,500 for new system installations, plus advice on how to use the system to decrease electric bills.



Installation of 8.1kW system in Centro Buen Pastor, in Barrio Rio, in Guaynabo—February of 2024.

# Finding an installer



Virginia homeowner Scott Sklar with his GridPoint Connect battery.

## What criteria should an installer meet?

When shopping around for a contractor to install your battery system, it's important to consider their background, experience, and qualifications.

### Here are a few things you should look for:

- Experience in your area (number of battery installations completed)
- Experience with the specific technology/ equipment you are interested in
- Availability of equipment
- Access to your preferred equipment (lead-acid vs. lithium-ion, specific brands, etc)
- Installer workmanship warranties
- NABCEP certification, a common certification for solar installers that includes skills related to battery system design and installation as well
- Open and honest communication: Your installer should be talking to you about what you want to back up in an outage and helping you to choose equipment that meets your energy (kWh) and power (kW) needs

# Finding an installer

## How to find a trusted installer in your area



**Virginia homeowner John Hedlund was one of five members of his solar co-op to add battery storage to their solar systems. “Producing [and storing] our own power makes me more aware of where it’s all being used, and where our home could be more efficient,” John said.**

A happy solar homeowner on his roof in Washington, D.C.

**If you’ve never thought about battery storage installers, where do you even start looking for a contractor? Great question.**

### 1 Ask your neighbors

- Community Facebook Groups and NextDoor are great resources to connect with neighbors who may already have battery systems.
- SUN hosts a number of state-based Facebook Groups for solar owners and advocates. You can find those at [facebook.com/solarunitedneighbors/groups](https://facebook.com/solarunitedneighbors/groups).
- We also run state-based Google Groups where you can find the same support: [solarunitedneighbors.org/listservs](https://solarunitedneighbors.org/listservs).

### 2 Join a Solar + Storage Co-op

SUN is a nonprofit organization that helps people go solar. One of the most important ways we do this is by facilitating neighborhood groups to go solar together. We call them solar co-ops, and we’ve run them all over the U.S.

In many of our solar co-ops (which are free to join), members have the option to install battery storage systems in addition to solar.

**See if there’s a SUN solar co-op near you.**

[Click here to check SUN's website.](#)

## Reviewing your proposal

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**Once you find an installer, or a few you're choosing between, your next step will be to request a proposal. We recommend looking at proposals from 2-3 contractors before deciding on an installer.**

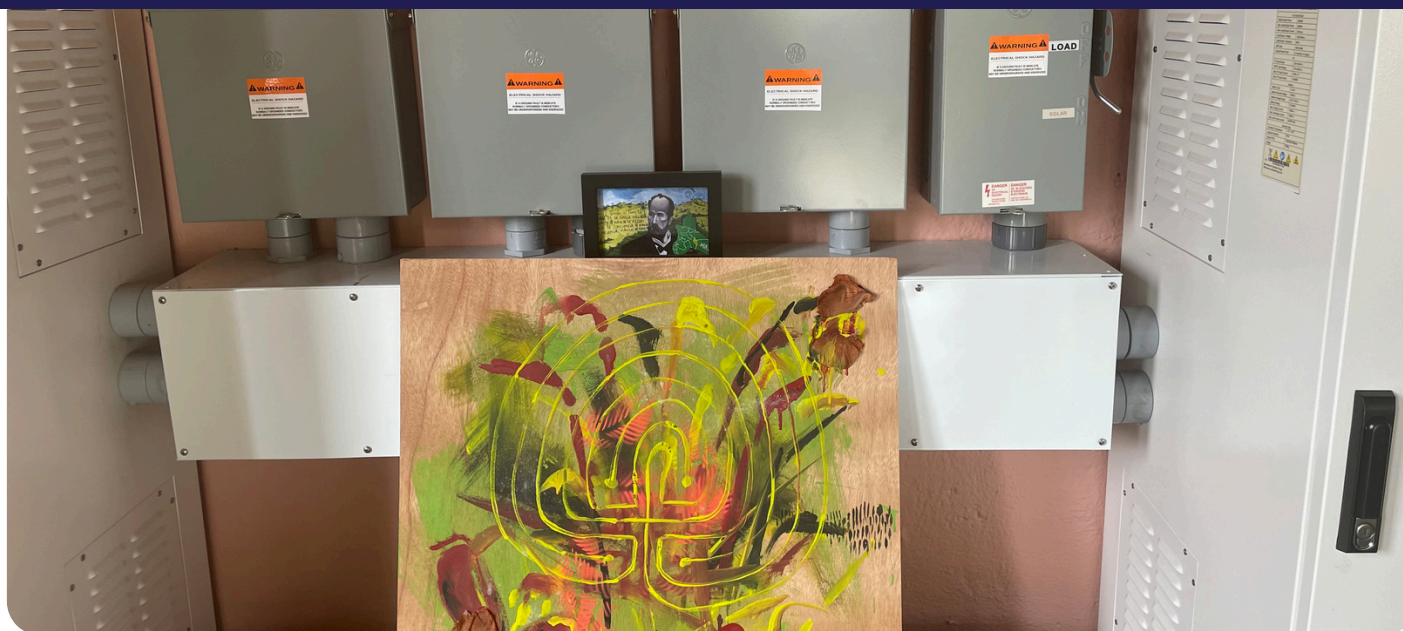
### **What should be included:**

1. Full cost of the storage system, installation, and additional equipment
2. Payment milestones, what do you owe and when
3. Equipment details
4. Battery size (kW and kWh), model and manufacturer
5. Inverter model and manufacturer (if separate from battery)
6. Battery management system (if used)
7. List of all warranties (battery, inverter, installer workmanship)
8. Details of additional work needed (electrical work, inverter swap, etc.)
9. Pricing guarantee for all equipment
10. Installer information (office location, point of contact, contact information)

**Want help? Connect with our Help Desk today!**

If you'd like vendor-neutral guidance from our experts, we can help you to review and compare your proposals.

# Finding an installer



Casa Pueblo Solar Inverters in Puerto Rico.

## 1 Sign your contract

Once you're happy with everything in your proposal, you'll sign a contract with your installer and set a date for the installation.

## 2 Obtain the required approvals

Then, your installer will connect with your local permitting office and secure the required permits to install your storage system. Because battery systems are still relatively new, some local permitting jurisdictions may not have updated their code requirements yet to incorporate residential battery storage. Your installer should help you navigate this process. Because you're connecting an electrical resource to the electric grid (called "interconnection"), some utility companies require their own review and approval of your battery installation. Work with your installer to identify your utility's requirements.

## 3 Getting your system installed

Most battery storage system installations take one day or less to install. The process may vary depending on whether you're installing solar with storage or adding storage afterward. A critical part of this process is for you to be clear on where your storage bank will be installed.

While your local electric codes will determine some aspects about the location of the storage, you may also have preferences that your installer can accommodate. Be sure to speak with them about this beforehand.

## What to do after installation

Once your system is installed, be sure to check these few boxes to wrap up your project and ensure your new system lasts as long as possible.

### 1 Inform your insurance company

Just as we recommend with solar, it's a good idea to let your insurer know that you've installed a battery system in your home. This way, your system can be added as an additional appliance that is covered by your homeowners insurance. Installing battery storage should not change your insurance payments.

### 2 Keep your batteries healthy

While the commonly used batteries (sealed lead-acid and lithium-ion) don't require much, if any, maintenance, be sure to ask your installer about manufacturer's recommendations for keeping your batteries as healthy as possible for as long as possible.

### 3 Understand your warranty

For most systems, the most important maintenance aspect to consider is how long they're under warranty in case anything goes wrong. Warranties for batteries can be measured in two ways:

1. Number of guaranteed operational years, or
2. Number of guaranteed cycles.

#### What is a cycle?

A "cycle" refers to the battery being discharged and then recharged. The number of cycles used in a given year will depend on how you operate your storage system. For instance, if your system is only used to provide backup power during grid outages, you may only cycle your batteries a few times a year. However, if you configure your storage system to maximize self-consumption of any solar electricity you produce, your storage system may cycle once a day.

#### Manufacturers' warranties

On average, lithium-ion batteries are under warranty for 10 years or for 7,500 to 10,000 cycles.

Lead-acid batteries are under warranty for much less time, typically 2 to 5 years.

#### Workmanship warranties

In addition to manufacturers' warranties, your installer should also provide a warranty for their workmanship. This warranty covers things like wiring and electrical work.

Its length will depend on the installer and the local market.

# Installation and maintenance

Equipment	Battery Type	Warranty
Tesla Powerwall 2	Lithium ion	10 years (unlimited cycles)
LG Chem RESU10H	Lithium ion	10 years (unlimited cycles)
Sonnen Eco 4	Lithium ion	10 years or 10,000 full cycles
SimpliPhi	Lithium ion	10 years or 10,000 cycles
Enphase storage (x 3)	Lithium ion	10 years or 7,300 full cycles
Rolls AGM Lead Acid	Lead acid	2 to 5 years (prorated after year 2)

Examples of battery storage warranties offered by various manufacturers.

## Adding more batteries to your system

What if after you've installed your battery system, you decide to add additional storage capacity (more batteries)? Maybe your budget limited the amount of storage you could install originally. Maybe your household situation has changed: you've added more appliances, bought an electric vehicle, or added more people to your home.

- Only add batteries that are identical to your existing ones in the same battery bank. Never mix and match.
- New batteries will inherit the capacity of your existing (used) batteries. This is because they all charge and discharge in unison. So, when you add new batteries to used ones, know that the new ones won't operate at 100%, as they would if operating alone.
- Luckily, if you have the longer-lasting lithium-ion batteries, it's more effective to add new to old than it is with lead-acid batteries.
- Some brands of lithium-ion batteries also allow you to easily "stack" an additional battery onto your existing one to add capacity.

## Replacing your batteries

Batteries wear out over time. Luckily, they can last as long as 10 years or more. When they wear out you'll have to replace them. An installer can remove your existing battery or batteries and replace them in your system with the same kind. You'll have to pay for the cost of labor and hardware.

## Recycling your batteries

Lead-acid batteries can be easily recycled. This is because they have been available for decades in the automotive and energy industries. Several home improvement stores take old lead-acid batteries for recycling. Some municipalities do as well. Recycling options for lithium-ion batteries are more difficult to find. It's best to contact your installer or the battery manufacturer to find out about recycling options.



At Solar United Neighbors, we believe we should all have the right to produce - and store - our own power!

Join us:

**[SOLARUNITEDNEIGHBORS.ORG](http://SOLARUNITEDNEIGHBORS.ORG)**

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Solar United Neighbors is a 501(c)3 nonprofit. We're a community of people building a new energy system with rooftop solar at the cornerstone. We help people go solar, join together, and fight for their energy rights.

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