# Buying Guide Backup Power Kits

## What is a backup power system?

Backup power systems are a way to keep things operating during power outag
You may already be familiar with a UPS (uninterruptable power supply), which
specific type of backup power system that keeps your computer running long
enough during a blackout to save your work before shutting down. A backup
power system can be attached to essential appliances like a refrigerator so you
food doesn't spoil. Or, they can be large enough to run a whole house or even
business.

## Why install a backup power system?

You've probably noticed in the news there are more and more reports about utility grid failures. This can be attributed to several factors, including aging equipment, higher customer demand and more severe weather. Not only are failures happening more frequently, but the outages are more widespread and last longer. Below we will discuss several different backup power systems, their components and capabilities.

## What are the types of backup power systems?

### Essential Loads Backup

An essential loads backup system is a power system similar to a computer UPS that can continue to provide AC electricity during grid-down events to "essential loads" like a refrigerator, freezer, cell phones and even life-sustaining medical equipment. Essential load backup systems include an inverter/charger, a battery system and a grid isolated loads panel or breaker panel that feeds the essential appliances with AC electricity. The inverter charger takes power from the utility grid to keep the batteries fully charged and also passes some of that utility power to the essential loads. During a blackout the inverter/charger senses the loss of utility power and in a few milliseconds switches itself to generate AC power for the essential loads. At most you might see a blip of a light fixture when this transfer to the backup power system occurs. AC electricity will be supplied to the essential loads until the battery system is completely drained. PV panels and a charge controller can be added to an essential loads system to use solar power to keep the battery system charged up during daylight hours, which extends how long the backup system can sustain the essential loads.

### Whole-House Backup

Larger backup systems are like the essential loads systems but can provide enough power to run an entire home. These systems can be just battery powered or battery with solar power production. One essential requirement is a whole-house transfer switch. This switch is the gatekeeper between the house and the utility grid system and automatically disconnects the entire house electrical system from the utility. This is a safety requirement known as "anti-islanding." This switch prevents the backup power system from inadvertently back feeding its electrical AC power to the rest of the grid where utility workers might be in danger of electrical shock from that back fed power.

Whole-house backup systems usually require larger, more powerful inverter/chargers and battery systems since they typically power many more appliances and loads than an essential loads system. Generator-powered whole-house systems have been available for many years and are common in places that experience many weather-related power outages (like hurricanes in Florida), but solar-powered system are becoming more popular as they do not require flammable fuel storage or mechanical maintenance of an engine.

### Grid-Tied Backup

Grid-tied solar systems that feed back energy to the utility grid are not usually capable of also generating power when the grid is down. This is actually a requirement of grid-tied systems—the anti-islanding requirement. These grid-tie systems can be designed or retro-fitted to provide backup power when the grid is down. This involves a battery to store solar energy and an inverter to produce AC power from the DC battery system during a blackout. An additional benefit for some of these grid-tied backup systems is the ability to shift loads or power fed to the grid at different times of the day when per kilowatt hour rates vary. That allows you to store power when rates are low and sell back to the grid when rates are higher.

Many grid-tied solar system customers that want to retrofit their existing systems can benefit from an AC-coupled system. This involves a grid-interactive battery inverter system that must conform to UL1742 SA requirements, which is a set of inverter functions that allows safe and seamless interconnection to the utility grid. These inverters are also called "grid forming" inverters because they appear to the grid-tied solar system components as if they were the utility grid. Essentially the grid forming inverter regulates the power and energy from the grid-tied system and is the system that feeds energy back to the utility. More and more grid-tie inverter manufacturers are offering battery backup units that integrate directly with their grid-tie-only systems as the demand for backup power from existing solar systems grows.

Another grid-tied system with backup capability is a DC-coupled system. DC-coupled systems can feed back power to the grid but are essentially off-grid solar systems with grid interactive battery inverter/chargers and solar panels. The key to these systems is the UL1741 SA capable inverter. A common name for such a system is a "hybrid" system.

## What considerations will affect which grid-tied kit is right for me?

The size of your electrical loads, amount of time you wish to run them, power characteristics of your electrical loads and desired functions of the inverter will be the factors that determine which of our kits is suited for your application.

**Inverter** – Wattage, surge capacity, type of power output and charging capability will all affect the type of inverter you'll need. For example, if you have a well pump or air conditioner that you want to power offline, you will have to select an inverter that can meet the surge wattage of those units. (Often you'll see this in specifications sheets, listed as locked-rotor current, surge wattage, startup current or startup wattage.) If you have to power a single-phase 50Hz load or a three-phase 120/208VAC load, your inverter will need to output this kind of power. If you want a system that has the ability to charge its battery from a generator or another AC power source, the inverter will need to have a built-in charger and it must be able to charge the battery connected with it in an effective manner. If an inverter charger cannot be configured to charge a lithium iron-phosphate battery, then its charging function should not be used with this kind of battery.

**Batteries** – The amount of time that the system must operate without the presence of the primary power source will determine the number and capacity of batteries (or total energy in kilowatt-hours, kWh) your system needs to have in order to meet this goal. For example, if you have a 100W piece of communications equipment, and you want it to run continuously for a full day without any external power supplied, you will need to have a sustainably usable energy capacity in your battery of 2400Wh or 2.4kWh to meet this goal. The percentage of sustainably usable energy capacity in a battery varies based on the kind of battery you select. (View our battery buying guide for more information regarding this.)

**Alternate Power Sources** – There are several different sources of power that backup systems can be tied into:

- Direct tie to a solar array, where the inverter has one or more built-in solar charge controllers
- Grid-forming inverter, where the inverter can AC couple with a grid-tied inverter for grid-down operation
- Generator connection, where the inverter can use power from a generator for battery charging and power load offset. Most of these inverters have an automatic generator start based on battery voltage or other factors.

**Net Metering** – Selling back power to the utility grid during peak hours and buying outside of those peak hours can save you a good amount of money over a period of years and give your energy storage system an additional function when the utility grid is online.