

Battery Storage

A guide to choosing the right Solar Battery Storage System



What type of Solar Battery System is best?

Battery Types

There are many different types of batteries used in home battery storage systems. The two main types of batteries are the traditional Deep Cycle Lead acid and Lithium-Ion batteries. Lithium Ion (Li Ion) is now the more popular battery being used due to the deeper storage discharge capacity and its smaller size. Li ion can come in a few different chemical compositions and some of these are responsible for the battery fires occasionally heard about.

Note: Lithium Iron Phosphate (LiFePO₄) is the most stable and safest type of battery chemistry. From here on all references to battery storage will be for the LiFePO₄ batteries.

Choosing a Battery Depends on Three Main Considerations

1. Your power supply - is it single or three phases?
2. Are you going to add to an existing solar system or are you adding a new system?
3. How much battery storage capacity do you need?

Your Power Supply.

A single-phase power supply is the easiest to fit a battery to and the least expensive.

A three-phase supply means the power in your house is divided into different sections; one phase will power your lights and general power outlets; another phase may supply your air conditioner, and another may supply your bore pump or workshop.

If you have a three phase power supply, do you need the battery to cover all three power phases when using the stored battery power or just one selected power phase?

If you want the battery to cover all three phases then you need a battery system with a “true three phase battery inverter” that will supply stored battery power to all three phases in the house.

There are some battery systems that will connect to a three-phase power supply but will only power one phase in your house from the stored battery power.



Adding Batteries to an Existing Solar System.

Adding a battery to an existing solar system is technically possible, but it is not so straight forward.

Some solar systems have been set up with forethought to adding a battery later and already have a Battery Ready “Hybrid “inverter. In this case the battery being added needs to match the existing hybrid inverter, so that the battery voltage and inverter charging parameters are met.

If the current inverter is not a Battery Ready Hybrid inverter, then a AC/DC coupled battery system (which has its own Hybrid inverter built in) can be added. This makes the existing inverter a slave to the new AC/DC coupled battery system which will increase the inverter size of the existing solar system by adding together the existing inverter and the new AC/DC coupled inverter.

If the power supply is a **single phase**, then this presents a problem as the maximum inverter size for a single-phase supply in WA is 5kW and if the existing inverter is 5kW and the new AC/DC coupled inverter is 5kW then that is oversized for a single-phase supply. The way around this is the take off the old inverter.

In actuality, taking off the old inverter is preferable, as now the new AC/DC battery system can now be connected as a DC Hybrid inverter system. The advantage of connecting a DC Hybrid inverter means the solar system can have extra solar panels added to provide extra power for charging the battery.

If the system is AC coupled - keeping the old inverter, no additional panels can be added.

The next issue we come across when adding to a solar system is; all parts of the solar system which includes the existing panels wiring and electrical components, must be on the Clean Energy Council Australia (CEC) list of approved products. If the existing solar panels are over three - four years old, they may no longer be on the CEC list and the system can't be added to, it must be replaced.

A three-phase supply can have up to 15kW of total inverter capacity. If the new AC coupled inverter battery system being added to doesn't increase the 15kW limit, it can be connected, effectively increasing the inverter and solar panel generating capacity. The existing system is still required to have all system components on the CEC list. If the existing system is not CEC compliant, electrically there is a work around using an extra smart meter, additional CT clamps etc, but it is very messy (as far as electrical reporting) and not recommended.

It is better to take off the old system and put on the correctly sized DC Hybrid inverter Battery system with the additional panels to charge the battery.

Battery Storage Capacity?

This is the main deciding factor on which type of battery system to choose, apart from the one other important factor which is the cost variance between the different battery systems.

The reason the storage capacity will determine the type of battery system is that different battery systems have limits on their battery expansion.

How much storage capacity do you need?

A home battery system should typically be sized to cover the night-time usage so that apart from the supply charge, the electricity bill is mostly taken care of.

As an example, if the electricity bill is \$400 (less \$60 for the supply charge) - \$340. This is about 20 units of electricity a day being used. If we estimated 50% is used at night, then we would need a 10kWh battery system to cover the night-time usage. If the night-time usage will be more, then a bigger battery capacity may be required, or if looking towards the future, there may be a requirement to expand the battery size later. Therefore, it is important to make sure the battery system is the right size to accommodate your needs, both now and in the future.

Setting up a battery storage system with a 5kWh battery; while cheaper than a setting up a 10kWh battery, really won't provide a huge amount of benefit. In most cases it won't be large enough to offset the night-time usage. If we consider the main cost has already been paid to set up the battery, which includes the battery monitoring system, the smart meter, and the installation; increasing the battery size to 10kWh or larger, is worth the additional cost to offset night-time usage.

How Much Does a Battery System Cost?

The price of a battery storage system varies based on the Brand of the system, the size of the Battery Storage Capacity, whether you need a Single phase or Three phase system, whether it has Off Grid Back Up and the installation cost.

The price of the solar system is not included here, as the system price can vary depending on the size and brand of the system and the type of installation.

As an example, to give a ballpark estimate price, a 10kWh battery storage system including the installation, without off grid back up (or the solar panels) on a single-phase power supply, can range from \$7,500 for \$10,500.

For a three-phase power supply with the battery storage discharging back through all three phases, an additional \$1000 - \$2,000 could be added to the price.

Adding Additional Batteries to the System Down the Track.

When adding additional batteries to an existing battery system, they must be the same type of battery (chemical composition and voltage). Depending on the type of battery, each battery will have its own battery management system for charging and discharging, or there will be one battery management system for the entire battery stack. Where there is only one battery management system, as with Sungrow batteries, each battery added to the system must be matched according to the State of Charge (SOC) - the health or capacity of the battery. Batteries degrade over time, meaning that initially a full battery cycle from full to empty might range from 1 -10 in the first year, but on the fifth year the range might only be 1-9 (10% loss of battery capacity). Using the previous example, we see that if the existing batteries SOC is 90%, then the new (same type of battery) will need to have its SOC changed to 90% to match the existing batteries so that the charging rate will apply equally to all the batteries.

Off Grid Battery Systems

An Off-Grid battery system is not connected to the power grid and differs slightly from a home battery system. While some home battery system can work as an off-grid system provided there is a battery connected, a dedicated off grid battery storage system is a bit more involved and will have a generator connected with an automatic generator start up as well as a substantially larger battery storage system with a larger inverter to handle the higher current.

An off-grid system without the power grid to back it up needs to have the battery storage sized for at least three days and nights of complete power usage to cater for days of severe weather where there is not enough sun to charge the batteries from the solar system. In such a case a 60kWh plus sized battery system would not be unexpected. The cost for such a system could easily get to \$50,000 or more.



The photo here is of a Victron Energy (Australian made) Off Grid Battery Storage system with about 80kWh of batteries and full system remote monitoring.



Three Common Misconceptions about Battery Storage Systems

1. The whole house can be powered by battery storage

Unless the battery storage is sized up correctly as in the case of an off-grid system, even a 10kWh battery wouldn't last long if the air conditioner, heater, or other high load item was used for a period. Also, if it is a three-phase house, the battery system would need to have a true three phase hybrid inverter so that the battery power was distributed over each phase for use as required.

2. When the power goes down, the house can run on stored battery power

Unless the battery system has a back-up switch installed and the house has been wired for a back-up situation (explained in more detail below - back up switch) the solar system will not work and access to the batteries is unavailable. Even if a back-up switch is installed and wired up, there still needs to be enough battery storage available to run the house.

3. I don't need to use the grid now I have batteries

If your house is connected to the power grid, then whether you use the power or not you will still be charged a supply fee. As explained above, having enough storage power is the main requirement for how long a battery system can power the house without the power grid.

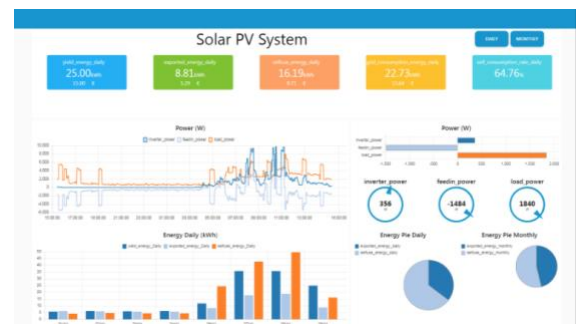
A Few Technical Things to Know

Smart Meter

A smart meter is required for all battery storage systems. A legal requirement for a battery system is that the system must be export limited so that excess power generated can't go back to the grid.

A smart meter will not only limit the export but will also give information on how much power is being generated as well as how much power is being consumed. This can give the added benefit of knowing how and when to use the battery energy wisely.

A smart meter will either be built into the inverter or be included as an additional component.



Back up Switch

A Hybrid battery inverter can work when the power grid is down, but the inverter is designed to stop working when the power grid goes down. This is because if the power grid is turned off due to linesmen working on it, any power generated from solar power going back to the grid would cause a danger to the workmen.

A back up switch ensures that the power generated by the solar won't return down the line and instead will be limited to the house circuit. Installing a back up switch and wiring up the back-up circuits can easily cost up to a \$1,000. Some Hybrid inverters come with a back up switch built into them, while others need to be purchased separately.

Manual Override Switch.

Depending on the inverter, it is either connected before or after the house power supply. If it is connected before the house power supply and there is a failure with the solar system or battery, the power to the house will be interrupted. In this case, a manual override switch is installed so the power can continue to the house.

Recommended Battery Systems

There are many different Hybrid Battery systems available to suit Single and Three Phase power supplies. The following battery systems are recommended.

Fronius Hybrid. Primo Gen24 5.0 Plus / Symo Gen24 5.0 Plus / Symo Gen24 10.0 Plus

Three phase inverter (Symo) delivers stored battery power to all three phases in the house
Smart Meter and Back up Switch not built into inverter

Battery Specs - BYD Battery. HVS 2.56kWh modules (102V) HVM 2.71 kWh modules (51V)
HVS Min 2 modules -5.1kWh | Max 5 modules -19kW = 1 stack. Scalable to 3 stacks 38.4kWh
HVM modules. Min 3 modules - 8.3 kWh | Max 8 modules - 21.7kWh = 1 Stack. Scalable to 3 stacks -65kWh



Sungrow Hybrid. SH5.0RS / SH5.0RT / SH10RT

Three phase inverter delivers stored battery power to all three phases in the house
Smart meter and Back up Switch built in

Battery Specs: Sungrow Battery. 3.2kWh modules (64V).
Single phase. Min 3 modules -9.6kWh | Max 6 modules -19.2kWh = 1 stack. Scalable to 4 stacks -78.4kWh
Three phase. Min 3 modules -9.6kWh | Max 8 modules - 25.6kWh = 1 Stack. Scalable to 4 stacks - 102.4kWh



Solaredge Home Hub. SE5000H-AU / SE5K-AU / SE10K-AU

No three phase battery solution currently available

Battery Specs: Solaredge Battery. 10kWh module (350-450V)
Min 10kW Battery | Max x 3 Batteries per inverter - 30kW



SAJ Hybrid. H2-5K-S3 / H2-5K-T2 / H2-10K-T2

Three phase delivers battery stored power to three phases in the house
Smart Meter and Back up switch built in

Battery Specs. SAJ Battery 5kWh modules (102.4V)
Single phase. Min 1 module - 5kWh | Max 4 modules -20kWh = 1 stack. Scalable to 3 stacks - 60kWh
Three phase. Min 2 modules -10kWh | Max 5 modules - 25kWh = 1 Stack. Scalable to 3 stacks - 75kWh



DEYE Hybrid. SUN-5K-SG04LP1 / SUN-5/10K-SG04LP3

Three phase delivers battery stored power to three phases in the house
Smart Meter and Back up switch built in

Battery Specs. (48V) Volta 14.3kWh Battery. Will suit 48V batteries.
Battery size can be scaled to suit solar array.
Suited to off-grid application (requires battery connected) Inverter includes a generator port



ALL IN ONE UNIT (Inverter included) - AC or DC coupled to existing solar system or stand-alone

Senec V3 Home

Single or Three phase connection as suited
Three phase delivers stored battery power to one phase in the house only
Built in smart meter. Back up switch not built in.

Battery Specs. 5kWh battery modules (44.8V - 58.1V)
Min 1 module - 5kWh | Max 2 modules - 10kWh



Alpha ESS Smile5 / Smile -T10-HV

Three phase delivers battery stored power to three phases in the house
Back up switch built in. Smart Meter supplied with unit

Battery Specs. 5kW module (LV-48V) 8.2kW module (HV-256V)
Single phase. Min 1 module - 5kWh | Max 5 modules - 25kWh = 1 stack. Scalable to 2 stacks -50kWh
Three-phase. Min 1 module -8.2kWh | Max 6 modules - 49.2kWh = 1 stack. Scalable to 2 stacks -50.4kWh



Conclusions

A Battery Storage system is generally added for one of two reasons.

1. To store the unused solar power generated so that it can be used at night to reduce the electricity bill or,
2. To ensure there is power available for emergency in case the power grid fails.

In all cases, the sizing of the battery system is the most important consideration.

Not all battery systems will expand to the same battery capacity. The correct battery storage system should be chosen to make sure the battery storage is expandable for what is required, taking into consideration future expansion.

Investing in a battery Storage system is a significant expense and should be done correctly from the start

Return on Investment - ROI

ROI is a term applied to all forms of investment as a way of gauging if the investment is going to be worthwhile or not. A long-term bank investment may get up to 5%, or a riskier investment such as in the stock market may get up to 10% -30%. The higher the ROI the higher the risk on the investment.

The most successful type of investment is not measured only by its ROI, but more by its ability to act as a Passive Income Producing Asset. This is the key benefit of Solar Power and a Solar Battery Storage system.

Solar and Battery storage are a totally different type of investment, and the ROI needs to be seen in the correct perspective. **It is a Passive income producing Asset.**

The investment is always paid back in full, with no risk because it is covered by a long-term warranty and receives immediate tax-free returns by way of savings on the electricity bill. The longer the system has been operating, the greater the ROI.

Setting up a Battery storage system has a larger up-front investment, but the overall long-term returns are also larger.

Calculating the electricity savings and hedging against the rising costs of electricity; a correctly sized battery system could be expected to pay back the investment in about eight years.

This seems a long time, but most house mortgages are easily three times longer, and the battery storage system should be viewed as an addition to the house.

Once the system has paid for itself (with the assumption it has taken 8 years), there is still another two years of warranty left where the system is now returning a 100% compounding ROI and even after these two years left of warranty, the batteries are only down to around 80% of the original capacity and are still creating a passive income, offsetting the ever-increasing electricity bills.

