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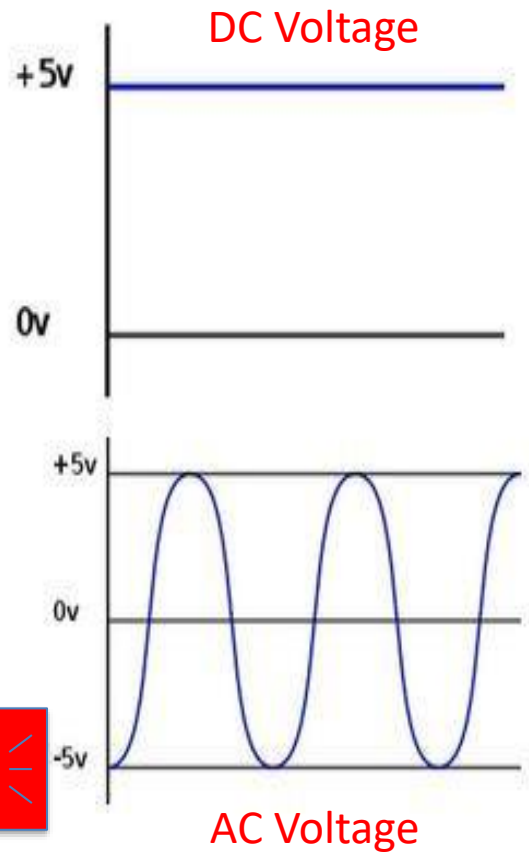
Computer speakers will be required

Electricity Basics

Electricity or "current" is the movement of electrons through a conductor, i.e. a wire. The difference between Alternating Current AC and Direct Current DC lies in the direction in which the electricity flows.



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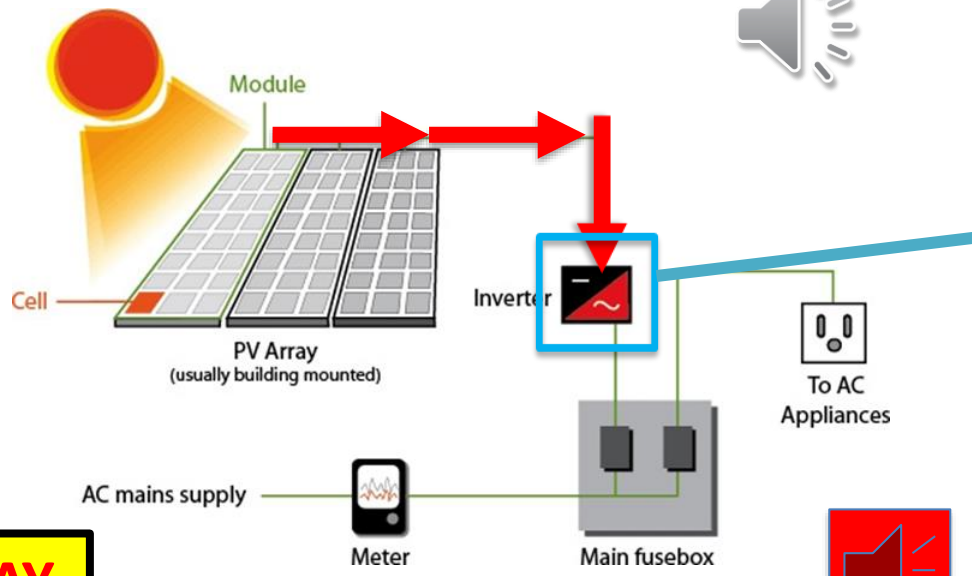
Solar panels output Direct Current (DC) when they are exposed to sunlight. As DC electricity cannot be used directly by common household appliances or fed into the mains grid; it needs to be converted to Alternating Current (AC) which is performed by an inverter.



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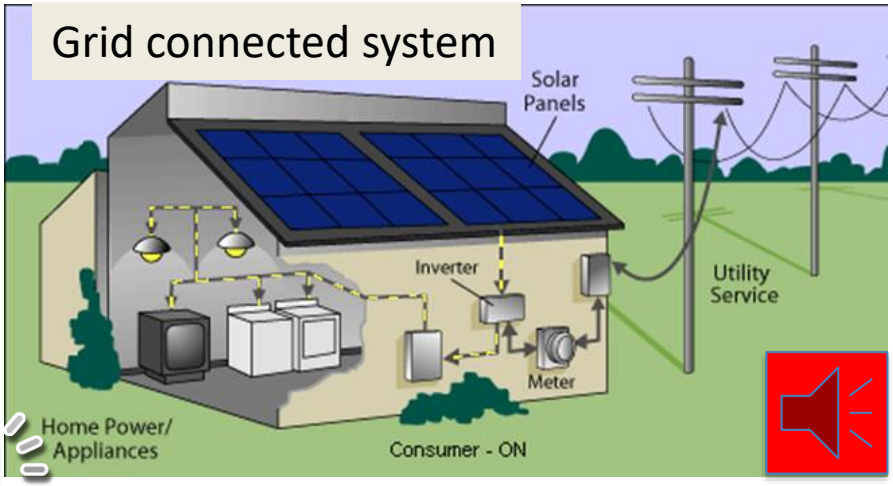
Solar systems can be classified into three broad types:

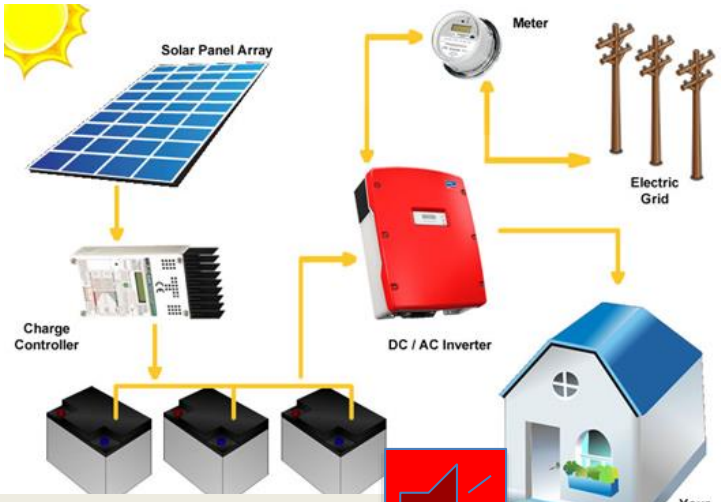
- Grid connected
- Stand-alone or Remote area power supply
- Battery backup

Grid connected system



Stand-alone system

Battery Backup system



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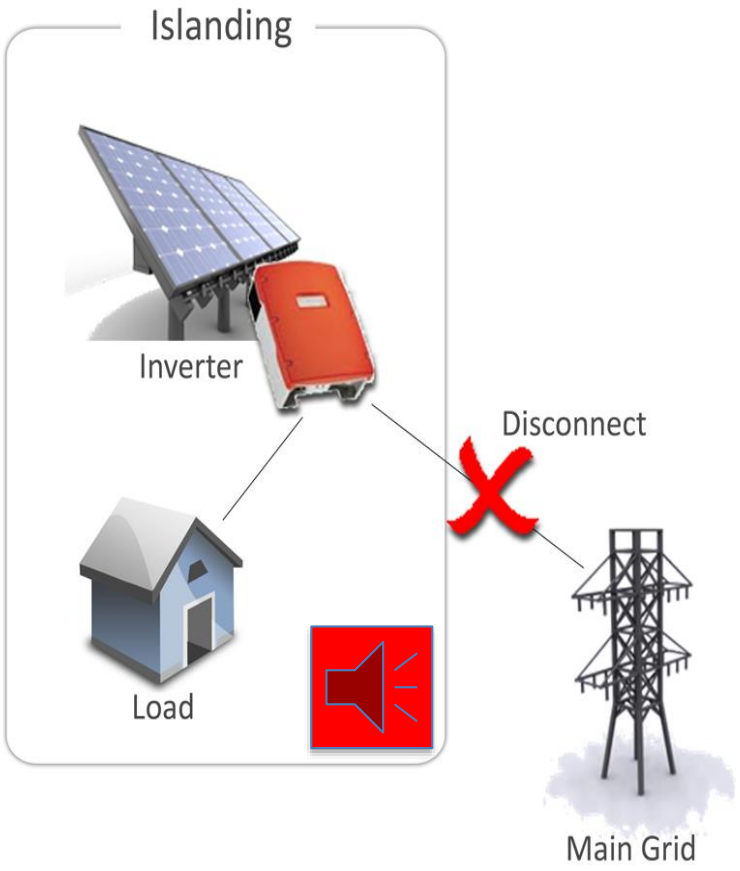

Grid-tied or Grid connected inverters by design, need a power supply for them to operate. When the power supply to these systems is shut down, the inverter automatically shuts down, this is called anti islanding. Therefore they do not provide backup power during utility outages or when isolated by emergency services.

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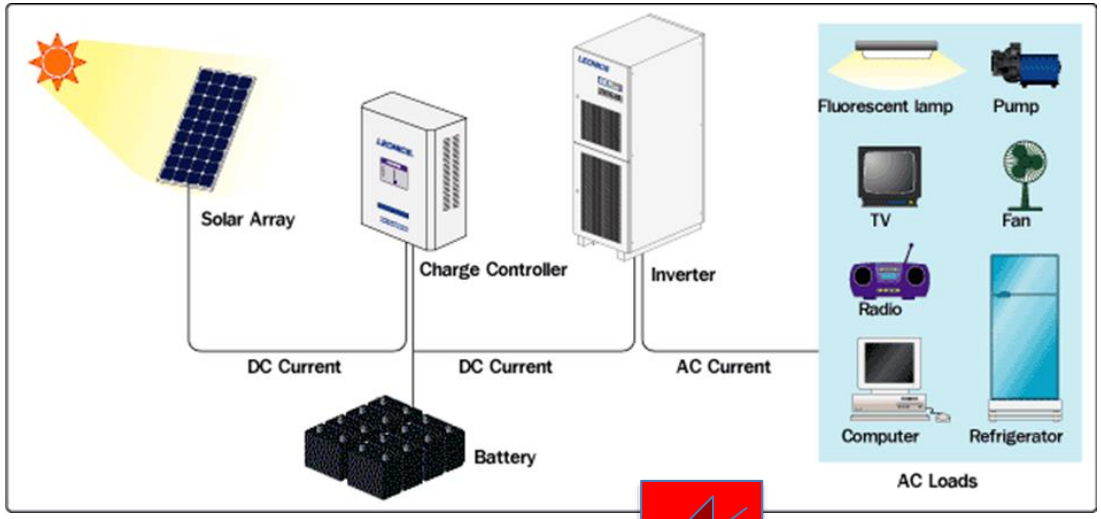
Stand-alone systems are generally used in isolated areas where there is no utility grid to supply power. Most stand-alone systems use charge controllers connected to solar panels to charge the batteries. As the name suggests these systems do not interface in any way with the utility grid.

Common stand alone system battery bank



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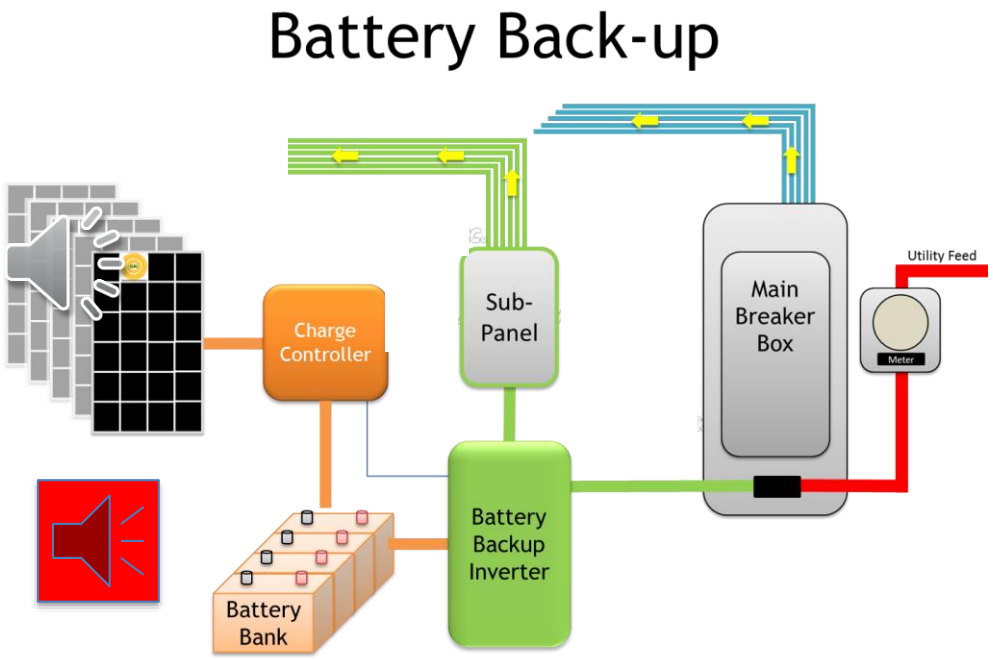
Battery Backup inverters are designed to convert the stored battery DC into household AC power and supply it only to selected loads during a utility outage, they maintain the battery power via a battery charger, and export excess energy to the utility grid. These inverters are required to have anti-islanding protection.



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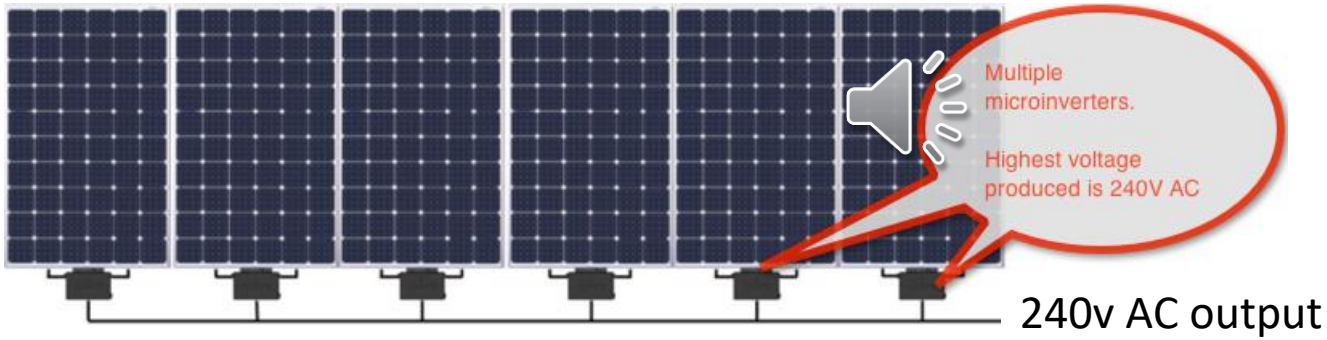
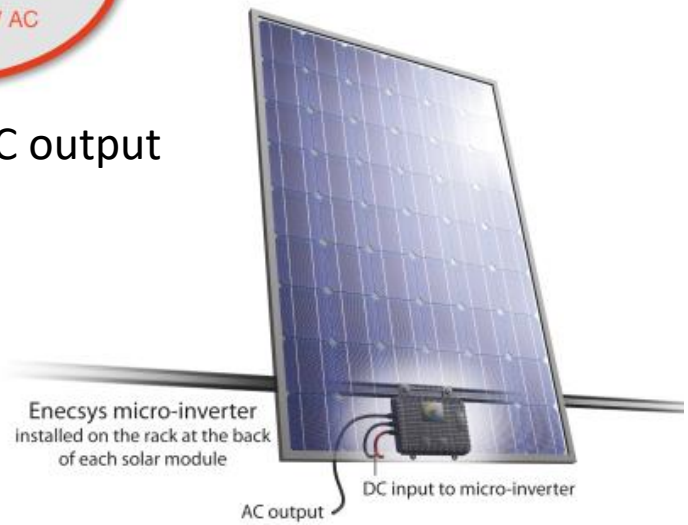
New technology on the market, means now there are 2 main types of grid connected inverters –The old style central inverter and the new Micro inverter . Central inverters are still the most common type, but many new installations are micro inverter systems.





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A Micro inverter is a compact DC to AC inverter unit, generally installed at the back of the solar panel/s. They convert DC power (generated by the solar panel) to AC power at the panel and distribute it to the switchboard of the property. This AC power can be used by the appliances in the property or fed back into the electricity grid. Micro inverters also have anti-Islanding protection so they will not provide backup power during utility outages or when isolated by emergency services.

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Micro-inverters eliminate the high voltage DC wiring, (of up to 600V) which generally runs through the property from the panels down to the Central inverter. These systems reduce the risks to solar installers, property owners and emergency workers because power conversion from DC to AC is done at the solar panels. Previous DC Isolation processes and equipment are not required for such systems.

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One of the first things OIC's and/or rescuers do upon arrival at the scene is to take a "recce" lap, a quick walk around the building to see all sides, to locate the utility isolation points and get a general size up of the job. It is usually at this point that a solar system is identified.

Note: As soon as the presence of a PV system is suspected or confirmed, an electrical exclusion zone should be considered, it may not be required where there is no reason to suspect system malfunction.

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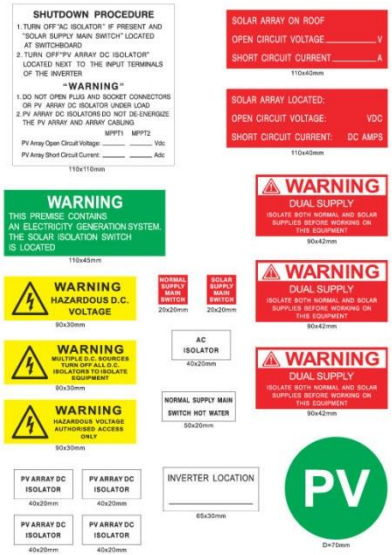
If the solar panels were not visible upon arrival or where obvious indicators of a PV system are not evident—such as in cases where the panels are on a flat roof or the inverter is located indoors. A common way to note a PV system is to look at the labels on the switchboard. The labelling may be on the outside or inside of the main switchboard.



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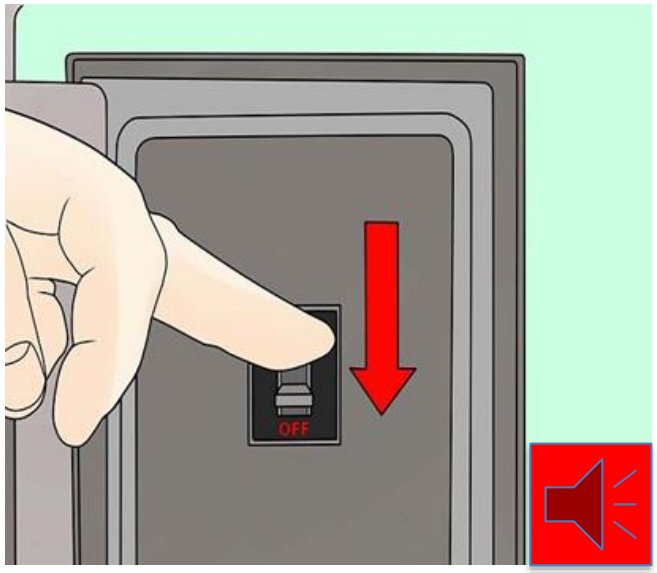
The different types of grid connected systems aren't always easy to identify, so the isolation method is simplified to a generic "one size fits all" method. Isolating the AC power at the switchboard (or by the power company) is the first step as per SOPs upon arrival. As previously stated, with all grid tied systems this will shut the inverter down ceasing AC power production.



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Locate inverter

Turn off inverter AC switch

Turn off Inverter DC switch

UNNECESSARY

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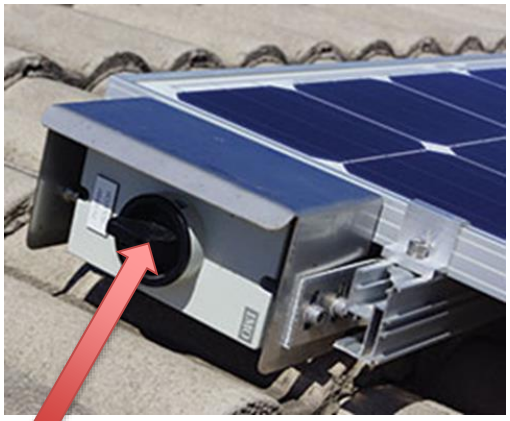

DC Isolator

The next step is Isolating the DC. ONLY IF REQUIRED BY A RISK ASSESSMENT.

Switching the DC isolator off at the panels (making sure if there's more than one isolator we switch them all off), or covering the panels with non-light penetrating material such as black plastic salvage sheet/s. As soon as the sun is blocked from coming into contact with the solar panels the energy production ceases

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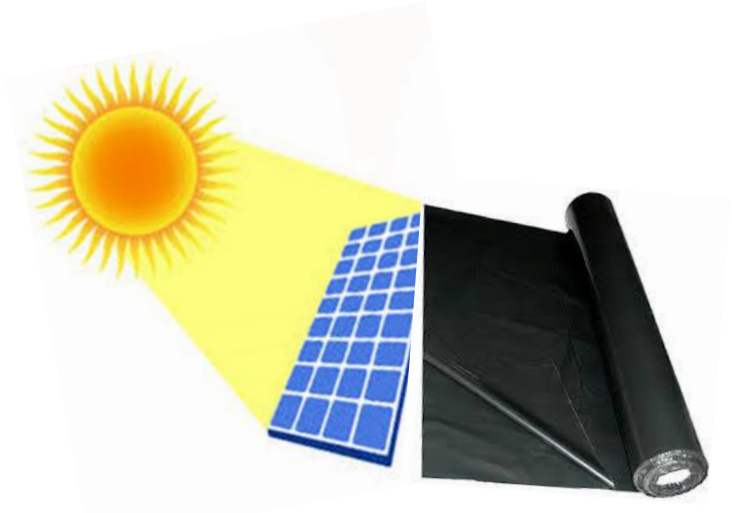
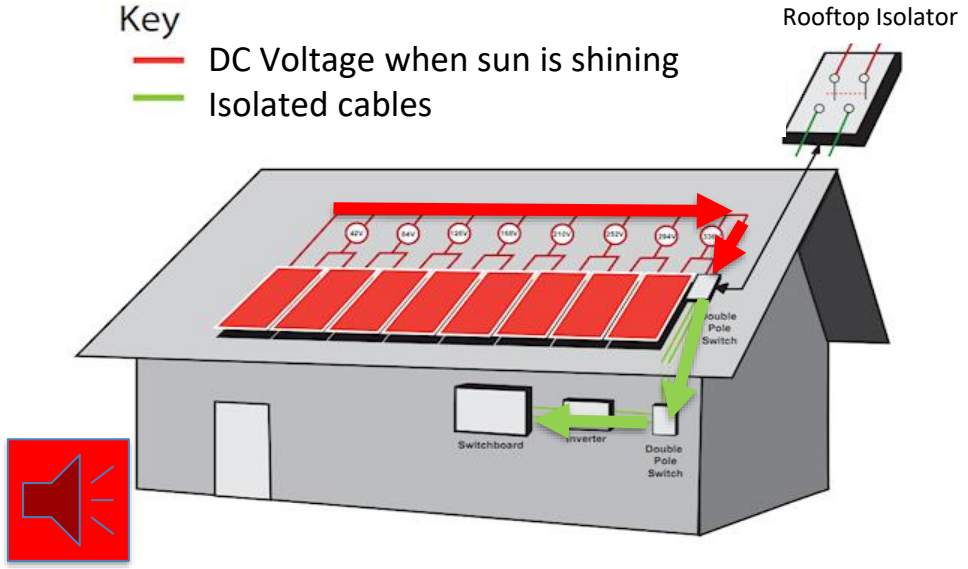
In the case of switching off the solar panel isolator, be aware that during sunlight the panels still produce energy and supply it through the cables to the isolation point. Similar to turning off a tap, the water stops flowing, but is still available at the tap. So as long as the sun is shining there may be DC energy available. Therefore covering the panels is the best method.





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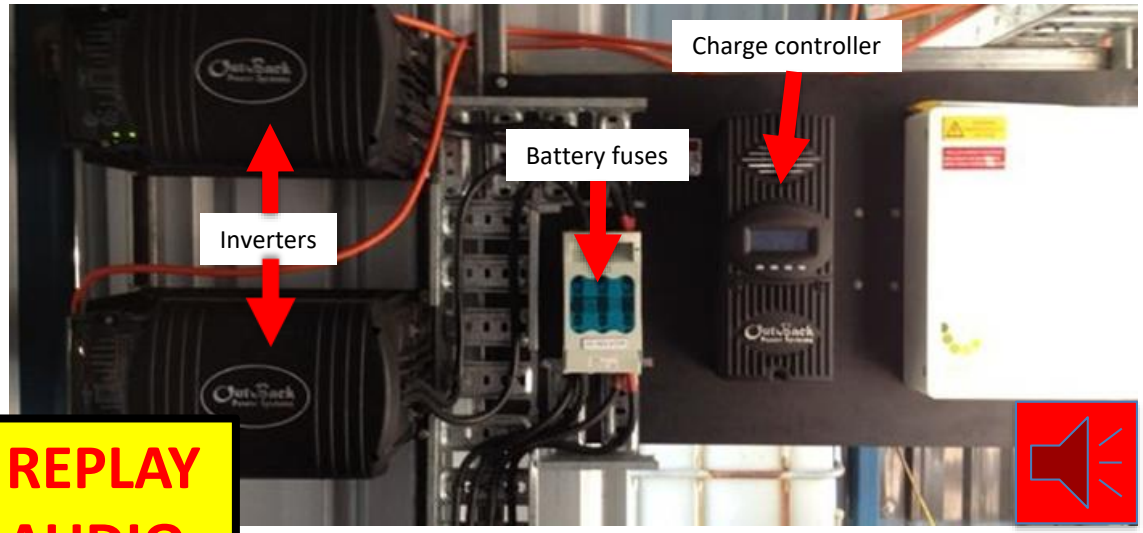
Stand alone systems have more circuits to consider. Firstly, AC power and PV array isolation (or cover the panels) as per normal. The extra step is associated with the batteries in these systems, they need to be isolated via a main DC battery disconnect (Usually a set of large fuses between the battery bank and the control equipment) to fully de-energize the systems. Also Isolation of any supplementary alternative supplies needs to be considered (if installed).



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Studies conducted by the US Fire training association has identified the application of water to burning solar panels is not as dangerous as you might think.

- A direct jet of uncontaminated water will not conduct electricity beyond 6 metres from the panels.
- Opening the jet to just a 10 deg fog pattern reduces that distance to 2 metres at 1000vDC
- 6m minimum is recommended

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FUTURE TECHNOLOGY

Due to the reduction in feed in tariffs for generated electricity, there has been a huge shift in research and development to electricity storage systems. There has been some major breakthroughs in battery technology and there has been a few new products developed;

- Large scale battery storage at wind generation sites,
- “AC” batteries
- Tesla Powerwall

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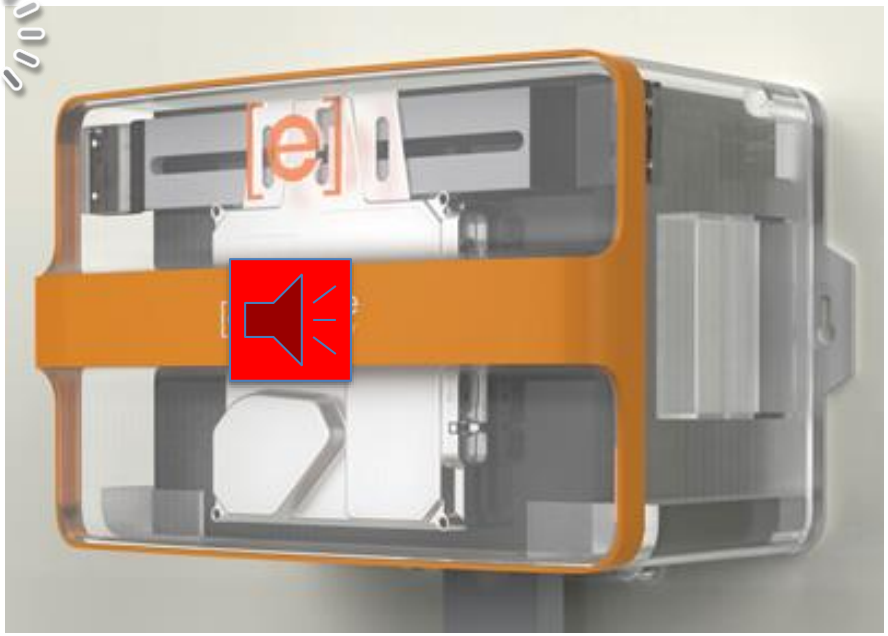
AC battery storage is technically impossible, but AC batteries are essentially standard DC Lithium-ion batteries with a micro inverter attached, which inverts the stored DC energy in the battery to 240VAC. The systems are modular and can have multiple units attached together using a plug in arrangement. The system is Grid connected with anti-islanding, which means when AC power is isolated they will shut down automatically, turning them back into a standard Lithium-ion battery.



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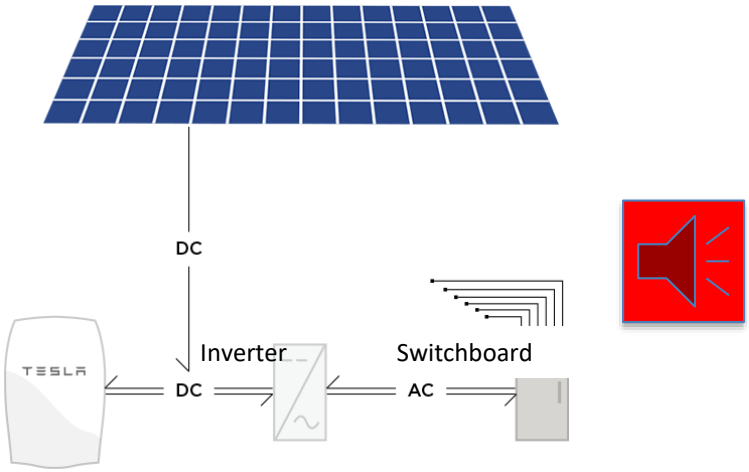
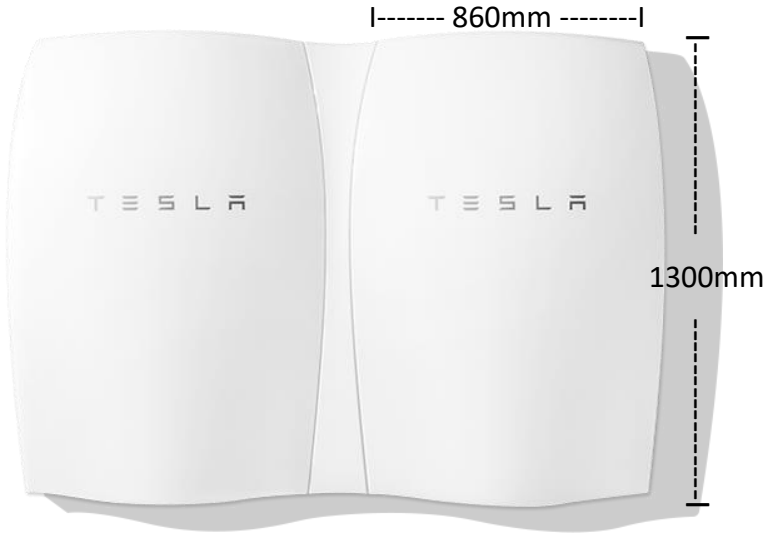
Powerwall is essentially a large battery back up system that is newly available on the market, DC electricity generated by solar panels during the day is stored in a rechargeable lithium-ion battery bank. The DC is inverted to AC and it supplements power to your home in the evening/when there is no sun, and provides back up power in the event of an electricity company outage.





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The Powerwalls are 1300 mm high x 860 mm wide x 180 mm deep and come in 2 capacities, a 10 kWh and a 7 kWh with various colours. They are modular, with the ability to have up to 9 modules, providing up to 63kWh or 90kWh respectively.

kWh = kW usage x hours of use
1kWh = 1kW for 1 hour
10kWh = 2.2kW for up to 4.5 hours

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END SHOW

Summary of solar isolation process

1. Isolate the mains AC power and tag out as soon as possible.
2. After conducting a risk assessment and it's found to be necessary, locate the solar array and switch the isolator to the off position (if installed). Note: this will not cease DC production, simply stops it getting into the building. If not installed or the incident requires it, cover the solar panels with black plastic salvage sheet, or other 100% light blocking material (this will completely cease all DC production in the panels).
3. For stand-alone systems, isolate the battery input by removing the battery fuses between the batteries and the inverter.

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