## 3.2 Stand alone off-grid solar system with energy storage (direct current)

Where a customer requires the guarantee of a certain power output at any time of the day or night, either some kind of storage device is necessary or the PV system should be combined with another energy supply (like propane, diesel generator).

The latter is known as a hybrid system (see below). Most off-grid systems use batteries to store power during periods of low or no sunlight. Rechargeable batteries are the most effective storage mechanism available. Notwithstanding this, the electrochemical conversion process of the battery utilizes about 20-25% of energy produced, so storage is only about 75% efficient. The storage capacity of batteries is rated in ampere hours, which is the current that it delivers over a set number of hours at a normal voltage at a temperature of 25ºC. Batteries must be protected from the elements.

Fig.3: Off-grid system using SW Inverter with battery backup
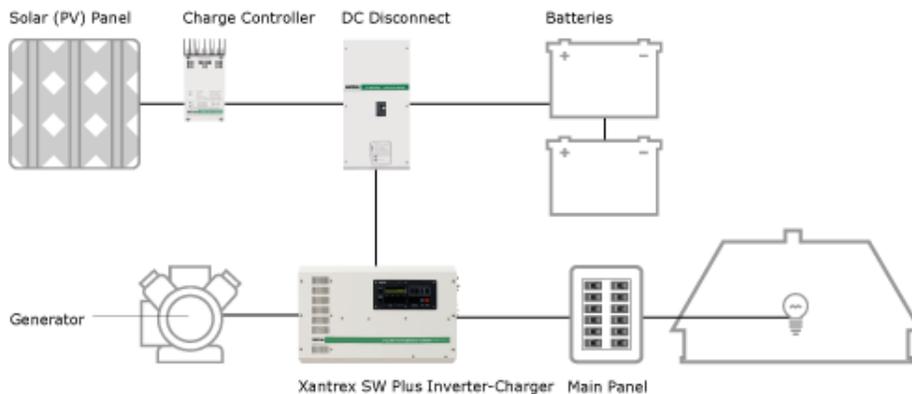
The quality of the regulator is a key factor in the reliability of the overall system, because it will align the depth of discharge with the battery temperature and the rate of discharge. Blocking diodes perform the role of preventing reverse discharge of the battery through the modules at times of low or no sunlight. This prevents damage to the modules and reduces energy losses.

Monitoring current and voltage throughout the system is important for safety and overall system performance. A voltmeter will monitor the performance of the battery, while an ammeter monitors the output of the solar modules. For lighting applications, high quality compact fluorescent lamps are available with good lifetimes; poor quality lamps will blacken quickly and their light output will drop off.

3.3 Stand alone off-grid solar system with energy storage (alternating current)

In addition to the previously mentioned equipment, an inverter is required in this case to convert DC into AC electricity. The conversion process will cause some energy losses, depending upon……