Chapter 6

ENERGY STORAGE

An independent renewable energy system requires suitable energy storage to iron out differences between supply and demand. At this point in history and for the foreseeable future, this means electro-chemical storage in the form of lead-acid batteries. Other battery types such as nickel- cadmium, (Ni-Cad) nickel-metal-hydride (Ni-Mh) or Lithium Ion, (Li-Ion) are either too expensive for general use, or have unsuitable operating characteristics, ie, a sudden loss of power at final discharge, without warning. Lead-Acid batteries exhibit a predictable, fairly linear voltage discharge curve., which is user friendly, in that it gives reasonable warning when energy is running low.

One often hears that batteries are the weak link in the power chain, and that further breakthroughs are required. This is true with electric vehicles, where power to weight ratio is an important factor, but for stationary systems, lead-acid batteries have reached suitable levels of perfection over the past 150 years to deliver satisfactory service. Proper "solar batteries" are relatively cheap, reliable, and the best units such as the UNI-SUN maintenence free, lead / calcium battery, can be charged / discharged over 3,000 times, to 10% depth of discharge, equating to a lifespan of 3000 cycles / 365 days = 8 years !!..With correct voltage regulator setpoints for boost and float,

A battery consists of a number of cells. Lead-acid cells have a nominal potential of 2 volts. A 12 volt battery has 6 cells connected in series + - + - + - + - + - + -. The 6 cells may be in a single case similar to a car battery, or individual 2 volt cells. When connecting batteries in series, it is important to realise that the total ampere-hours do not change, although energy capacity does. Consequently, energy storage systems must be discussed in terms of *Watt-Hours* to prevent confusion when comparing battery systems of various amp-hours and voltage.

This is very simply achieved by multiplying the battery or cell voltage by it's ampere-hour rating. For example, the UNI-SUN 250 Amp-Hour battery has a rating of 250 ampere-hours at the 100 hour discharge rate. Therefore, 250 x 12 volts = 3000 watt-hours (3.0 kilowatt-hours) energy storage capacity . A bank of 4 batteries in series will yield 48 volts x 2500 A/H = 12,000 watt- hours.

Fig 6.1 UNI-SUN Solar Store.
Advanced, maintenance free, lead acid battery bank Safe, clean, and suitable for use in a domestic situation by untrained personnel. Most batteries are not !

The speed of discharge greatly affects total storage capacity. Slower rates allow a more complete chemical reaction to occur, and hence more energy to be extracted. For this reason it should be clear to you that any battery specifications that do not indicate a discharge time factor are virtually meaningless. The 100 hour rate is normally most appropriate when sizing batteries for solar / hybrid power because we are working with several days of capacity. The 100 hour rate is denoted as c100. The 20 hour rate as c20, etc etc. When buying a battery, make sure you are clear on what rate (speed of discharge) the battery is being quoted .