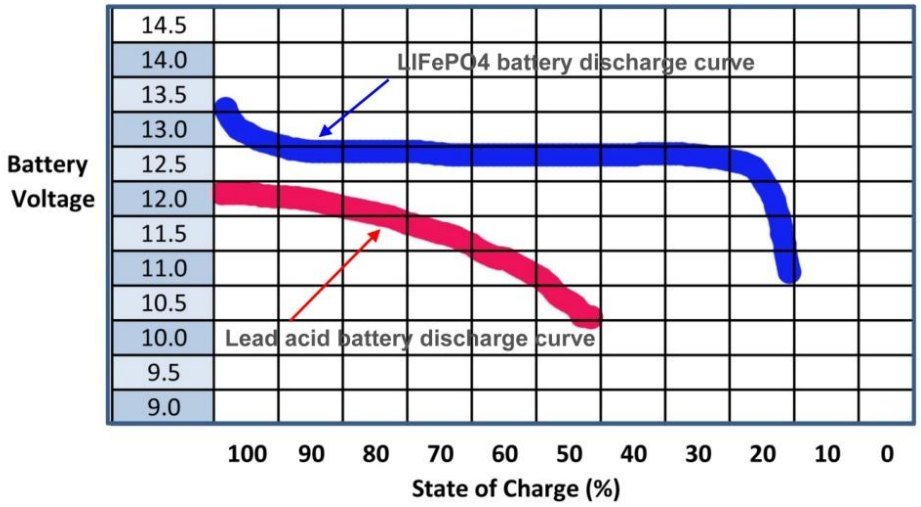
A better emergency/backup battery

If you're the type of Amateur who only uses power from the 120 volt grid, then this article may have limited appeal. However, if you like to be able to use your Amateur Radio equipment when we have a power blackout, or if you wiah to be ready to contribute your time and energy to assist with emergency communications then you will be interested in the type of power that you will have available. Among the various power possibilities you'll certainly include a battery source. When we're looking for a suitable type battery for emergency or backup power for our radio equipment, we have generally stayed with the lead acid type battery because (a) reasonable cost and (b) they are readily available. However, they are large and heavy and carry a string of maintenance tasks. When using one as a power source for emergency use, transporting one and constantly keeping them ready for emergency service can be a real headache. My comments about regular lead acid batteries apply almost as much to the SLA (Sealed Lead Acid) type batteries. SLA batteries are also heavy, have critical maintenance requirements, but at least are completely sealed against acid leakage. We are now in a technological transformation with battery power - the latest lithium type batteries are far superior to any lead acid battery. I'm thinking in particular of the Lithium Ferrite Phosphate ($LIFePO_4$) battery. Here are some comparison points between lead acid batteries and $LIFePO_4$ batteries.

Lead acid Big & heavy
$LIFePO_4$ 50 to 70% smaller & lighter

Lead acid Can use only 50% of available capacity before its voltage drops to an unsafe level. Discharge curve drops steadily.
$LIFePO_4$ Can use > 80% of available capacity.
Discharge curve is constant until the maximum discharge point is reached. (This advantage all by itself could obviate any need for a Battery Booster dc to dc converter - saving approximately $200.00). Battery boosters take any voltage source between a pre-determined minimum (can be selected but should be at or above the safe level). A dc to dc converter converts the output voltage to 13.75 volts. I should mention though that the $LIFePO_4$ battery will maintain a close to constant voltage, but it will be around 12.4 volts, not the 13.75 volts that a battery booster would supply. The graph below shows how the voltage of a lead acid battery drops as it is discharging. On the same graph is the voltage discharge rate for a $LIFePO_4$ battery.

Discharge rates for lead acid batteries compared to $LIFePO_4$ batteries



Lead acid	Battery life is typically < 500 cycles and three years
$LIFePO_4$	Typically > 3,000 charge cycles and ten years, a shelf life that far exceeds the service life of other batteries.
Lead acid	Self discharge requires periodic recharging even without a load.
$LIFePO_4$	Virtually no self discharge.
Lead acid	Discarding old battery is environmentally toxic.
$LIFePO_4$	Chemicals are "green" and non-toxic.
Lead acid	Have acid that is subject to spills. Regular (non sealed lead acid type) must always be kept upright. Can generate hydrogen gas if over charged.
$LIFePO_4$	Are completely sealed, so can be stored and used in any position. They are inherently safe, and use stable chemical compounds. (Cell phones and other lithium battery powered devices use Lithium Cobalt Oxide ($LiCoO_2$) chemicals - a different animal entirely). $LIFePO_4$ batteries are thermally and chemically stable without the possibility of fire or explosion.

Lead acid batteries also require very careful attention to ensure (a) safe operation and (b) long life. The battery should be in a plastic box with a plastic lid (ventilated). Working around it with the top exposed and with metal tools is an accident waiting to happen. The typical lead acid battery can pump several hundred amps if the terminals are shorted. Keep wedding rings well away - a wayward screwdriver and a gold wedding ring accidentally touching the battery terminals could make that ring glow red hot in a fraction of a second!

There are negatives related to $LIFePO_4$ batteries, the biggest concerns are cost and availability. Cost is at least three times more than a deep cycle lead acid battery. (Note that total life cycle cost is approximately the same or even lower than a regular lead acid battery when you take into account that $LIFePO_4$ batteries will outlast lead acid batteries by at least a 4 to 1 ratio).

Also, try finding a source of $LIFePO_4$ batteries here in Canada. I recently searched for a Canadian supplier with no success. I finally bought one from Bioenno Power, based in California.

(https://www.bioennopower.com/collections/12v-series-lifepo4-batteries).

They have a terrific reputation for both starter and deep cycle $LIFePO_4$ batteries of all sizes. I bought a 12 volt, 15 Ah deep cycle version complete with special 4 Amp charger for $169.99 U.S. However, shipping costs amounted to $44.99 U.S. via UPS Ground. (The U.S. does not allow the transport of lithium batteries by air). I was also charged brokerage by UPS as I had it shipped to my home this side of the border. The total cost was substantial. I would recommend having Bioenno Power ship any battery that you buy from them to a Niagara Falls NY address and pick it up yourself.

This battery weighs only 4.3 lbs. (1.9 kg.) The size is 5.5 in. X 4.3 in. X 3.2 in. (137mm x 77mm x 78mm). It has a maximum continuous discharge current of 30 amps and comes with Anderson Powerpole connectors. Despite the upfront costs I'm really pleased with this battery

Figure 1 LIFePO4 12 volt 15Ah battery P/N BLF-1215A

This particular Bioenno 15Ah version is just one of a number of sizes in the deep cycle series (LFP) ranging from 3Ah up to 40Ah. A Google search will list many other $LIFePO_4$ battery sources (in the U.S.) and a range of sizes.

A very big factor with any battery, but especially with the lead acid type, is to ensure that when in use the discharge does not cause the battery voltage to drop below defined limits. e.g. for lead acid type this is around 10.5 volts. If the battery is allowed to continue supplying current and dropping the voltage below 10.5 volts, then the battery life could be much reduced. I recommend buying a digital voltmeter and checking the battery voltage accurately and regularly. Small, low cost (but accurate) digital voltmeters are readily available on the Internet. They cost less than ten dollars and could save you from damaging or shortening the life of your battery.

Also, with lead acid batteries the self discharge rate means that if the battery is not in use, it must be periodically charged. This can be accomplished with either a trickle charge, or by using a regular charger approximately once a month, making sure that you disconnect the charger once the voltage has risen into safe limits. (Over charging is also a good way to damage a battery).

In comparison, a $LIFePO_4$ battery can be safely stored for a year or more without any ill effects. However, the rule about ensuring that a $LIFePO_4$ battery does not drop its voltage too much also applies. Also, $LIFePO_4$ batteries require special consideration when charging. $LiFePO_4$ batteries need two steps to be fully charged: step 1 uses constant current (CC) to reach about 60% State of Charge (SOC); step 2 uses constant voltage (CV). This kicks in until each cell attains a voltage of 3.6 volts (14.4 volts for a nominal 4-cell 12 volt battery). The charging voltage should be maintained around 14.4 volts. Most $LIFePO_4$ battery suppliers sell suitable chargers as a special deal when buying the battery. In my case I paid $20.00 to get a 4 amp $LIFePO_4$ battery charger when I ordered the battery.

In conclusion I am positive that as Amateurs involved with emergency preparedness, (or any Amateur who wants to be able to communicate even when the grid is down), we will in time switch away from lead acid and SLA batteries and use the $LIFePO_4$ deep cycle type instead. As this type of lithium ferrite phosphate battery matures, the costs will drop, making them more affordable. The dramatic move towards electric powered vehicles has triggered hugely expensive research into improved battery technology. I suspect that we'll see some amazing progress in battery design. This is all good news for us Amateurs looking for better emergency/backup power, Building and maintaining a reliable and long-life battery system for our shack or for emergency readiness requires some smart decision-making from the get go. The extra money invested upfront will be repaid many times over.

This is one of a series of articles I am writing on the subject of power sources for emergency readiness and backup purposes. I am not an expert in this; nor am I a professional engineer, so I present these thoughts on a strictly personal level. You'll need to verify for yourself that what I have written is useful to you. All the above is offered without any guarantees or promises.

Enjoy!

73 Denis ve3kve
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PS: right on time, take a look at this, the biggest lithium battery in the world! Built by Tesla in Australia and fed by a huge Wind Farm. It will be capable of powering 30,000 homes. A $50 million backup battery.

http://www.cbc.ca/news/technology/tesla-powerpack-battery-south-australia-1.4416028