

EV Upgrade

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My converted electric GMC Sonoma pickup was featured in the article “Born To Be Wired” in HP122. I recently changed my lead-acid (L-A) batteries for a lithium-ion (Li-ion) battery pack, and think your readers will be interested in the results.

In 2007, at the time of the original conversion, knowing the advantages of Li-ion, I checked on the price of these batteries. The cost would have been about \$75,000, considerably beyond my budget. Instead, I used 24 6-volt 240 Ah flooded L-A golf-cart batteries (Trojan T-145), which cost about \$3,300 (a good price at the time). I expected the batteries to last five years.

I only got about half the expected life from the batteries, mostly because I was out of town often, and unable to properly monitor or maintain the batteries. Several times, I let the electrolyte fall below the top of the plates, and I was initially unaware that the charger I selected was overcharging the batteries (which accelerated electrolyte evaporation). As the battery capacity diminished and the vehicle became less usable, I ended up leaving my beloved project unused in the carport until this past spring.

Rising gas prices and more instability in the Middle East prompted a renewed interest in my EV. Realizing that my unpredictable schedule was still incompatible with regular battery maintenance, I decided to investigate Li-ion batteries again. I was pleased to find that the price had fallen significantly, to about \$1.25/Ah/cell (Li-ion cell voltage is about 3.3 V). I choose Manzanita Micro as my source of batteries, and purchased 48 200 Ah Winston lithium iron phosphate (LiFePO₄) cells arranged in 12, 12-volt batteries (about 144 V total) for \$12,000. Fortunately, Washington state exempts EV conversion components from sales tax, which eased the price.

One aspect of Li-ion batteries is that they need a battery management system (BMS) to ensure that each cell is equally charged. Otherwise, some cells can become overcharged, while others remain undercharged, which leads to premature battery failure. So I also purchased Manzanita Micro's BMS for an additional \$3,200.

The result of changing to Li-ion has been dramatic. See the comparison table of the before and after values.

In addition to these measurable improvements, there have been several more subjective improvements. Compared to L-A batteries, my new batteries provide more stable power through nearly the entire discharge curve, they can be discharged much more deeply without any significant reduction in longevity, their capacity is affected very little by cold temperatures, and their capacity isn't affected by sitting idle for several days. I have found switching to Li-ion batteries well worth the extra initial cost. With Li-ion's 3,000- to 5,000-cycle life, the total cost of ownership should easily be less than I had with L-A.



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