



Zero Beat

March 2022

General Meeting
Wednesday March 9th
At 7:30 pm at the
Hazel Park Library
and on Zoom
With Socializing
At 7:00 pm

Club Officers

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Lithium Batteries vs. The World!

Chris Warren February 15, 2022 21 Comments on Lithium Batteries vs. The World!

Battery envy.

I recently received a very nice email from Mike in Missouri where he described converting his home off grid system to lithium batteries, at a cost of over \$7000.00 USD! My own home system is still on old school flooded batteries because I have not recached a point of financial bounty where I can afford to cross over to lithiums. I'm truly envious of Mike and folks like him who have the means to pull it off.

It did get me thinking, though: What is the true cost of lithium vs. other types of batteries? What are lithium users really getting for their money, and is it "worth it"?

It's not as straightforward as I thought it would be.

As it goes, making an objective "apples to apples" comparison was not as easy as I thought. Manufacturers give themselves generous wiggle room when publishing specifications about their products, and real world data is hard to come by. Furthermore, our goal here is not to consider only battery performance. If that were all that mattered, there would be nothing to talk about. Lithiums would easily win, and it wouldn't even be close.

What I'm doing instead is evaluating batteries on a "bang for the buck" basis. Although my analysis is not as scientific as I'd like it to be, I think I got close enough to give off grid radio amateurs a good frame of reference to make confident battery decisions.

Accounting for variables.

It is very difficult to calculate meaningful numbers when there are so many variables. For example, in the “dollars per charge cycle” category, I provided a range based on the highest and lowest values for each type. But what about everything in between? This illustrates the futility of trying to pin down exact values for every possible scenario. If it could be done at all, it would fill hundreds or even thousands of lines on the spreadsheet.

The ground rules.

The analysis was based on a 100 amp hour battery of the type that would be used in a permanent home installation. I also assumed that the system was built and maintained by the average hobbyist paying retail prices. So, we are not looking at **high end batteries** made specifically for solar power. Most radio amateurs buy their batteries from a big box or on line retailer, so I approached it with that viewpoint.

Also, I did not include small batteries used for portable or QRP operations. Absorbed glass mat (AGM) and lithiums are affordable in lower capacities. Since hardly anyone uses flooded batteries in these applications there no benefit to analyzing them. If there is reader interest, I'll do a separate article comparing AGM to lithium for portable & QRP.

I included median costs in some of the categories. This is probably the best way to even out the inconsistencies and offer a firm number for each type of battery

The results were...interesting.

Placing the numbers side by side provided some surprising insights. I thought for sure the lithium batteries would sweep every category. If all we cared about was battery performance, they would. Yet, let's not go into this looking for a pre-determined outcome. The dollars per amp hour purchase cost is the true price you will pay upfront for the battery. The dollars per charge cycle is the price of the battery amortized over its entire service life. Or, put another way, what it will cost every time you charge the battery.

As expected, the old school flooded batteries have the lowest initial purchase cost. But does that low price tag pay off over the long run? Well, actually, they cost more, but not a lot more, than lithium battery technologies in terms of the lifetime ownership amortization. The AGM batteries are the most expensive to own over-time. *“But,”* some hams will say, *“flooded and AGM batteries will need to be replaced more often than lithium.”* That is true. Does it matter?

So the question now is, do how many flooded batteries can one buy for equal to or less than the cost of one lithium or AGM battery?

Some basic math.

Let's run some examples using our median numbers. The median price of a 100 amp hour lithium battery is \$600. Therefore:

$$\$600 \div \$131.00 \text{ (median flooded battery price)} = 4.60$$

$$\$600 \div \$275.00 \text{ (the median AGM battery price)} = 2.20$$

FLOODED VS. LITHIUM VS. AGM BATTERIES

	FLOODED	LITHIUM	AGM
Amp hours	100	100	100
Cost	\$90-\$150	\$300-\$900	\$200-\$350
Charge cycles	300-1000	2500-3500	500-1200
\$/charge cycle	\$0.30-\$0.15	\$0.12-\$0.25	\$0.40-\$0.29
Median \$/charge cycle	\$0.23	\$0.18	\$0.35
\$/amp hour-purchase price	\$1.11-\$1.50	\$3.00-9.00	\$0.50-\$3.50
Median \$/amp hour			
-purchase price	\$1.31	\$6.00	\$2.75
Charge below freezing?	Y	N	Y

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What this means is for the purpose of replacement, 4.6 flooded batteries or 2.20 AGM batteries equals one lithium. Here's what you get for your money in terms of long term use:

Lithium: 1.00 batteries x 2500 to 3500 charge cycles per battery= 2500-3500 charge cycles.

Flooded: 4.60 batteries x 300 to 1000 charge cycles per battery= 1380-4600 charge cycles.

AGM: 2.20 batteries x 500 to 1200 charge cycles per battery= 1100-2640 charge cycles.

What this tells us is that when evaluated for total charge cycles as a function of cost, flooded and AGM batteries compare very favorably to lithiums, and depending on the situation, can even exceed lithiums. Wait, rewind this article a few paragraphs. Didn't I just say that flooded and AGM batteries actually cost more? Yeah, I did. This illustrates the frustration of making this analysis. What is "better" and "cheaper" depends on what data one uses to formulate a decision.

A huge hole in all of this.

Before all you accountants & statisticians out there pepper me with critical comments and emails picking apart my numbers, let's preemptively get a few things out of the way.

These calculations are based on medians, averages, and manufacturer provided data that we all well know is padded. As they say, "your milage may vary." How batteries are used, stored, and maintained can profoundly effect performance and service life. There is also an issue of build quality. Are \$300.00 off brand lithium batteries as good as the \$900.00+ popular name brands? Will you get the same performance? I don't know, but my gut says probably not. If you are a survivalist/prepper or EM-COMM person, do not let your mission-critical communications depend on the cheapest battery you can find.

If any reader out there is qualified in statistics and would like to address this issue in more/better detail, please reach out to me and we'll do a follow up.

Other things to think about.

Many charge controllers cannot be used on lithium batteries. If you are switching to lithium from another type and you have an incompatible controller, that expense will have to be added to the total cost of the upgrade.

Also, you can use lithium batteries at almost any temperature but they cannot be charged when they are below 32F/0C. This refers to the internal temperature of the battery, not the ambient air. Charging at sub-freezing temperatures will permanently damage Lithium batteries. But don't worry, they have internal circuitry that does not allow charging if they are too cold. Flooded and AGM batteries can be used or charged at any temperature a ham may experience, but the performance degrades at the high and low extremes.

So what battery should you get?

What battery is "best" for you cannot be determined by an internet blogger. The purpose of this article is to give off grid amateurs a perspective other than electrical characteristics and performance. As you can see, the ownership cost of any type of battery depends on personal priorities.

I'm not trying to promote or disparage any particular battery technology. As for what I would personally pick, if I had the money I'd dump my flooded batteries immediately and go with lithiums. As economies of scale bring the cost down, lithiums will become more attainable. At some point the numbers will tighten and flooded/AGM batteries will no longer be price competitive. As the data shows, the true cost of ownership is more complicated than just the initial purchase price.



Chairmen

Repeater	Joe WB8ADX
W8JXU Trustee	Bill N8QVS
Swap	John KD8NYF
Field Day	John AA8UU
Education	Jerry W9NPI
Sunday Net	Bob N8REL
Zero Beat Editor	Rick KB5OO
Public Information Officer (PIO)	Rick KB5OO
Webmaster	Mike K8WU
Banquet	John W8TOY
Club Picnic	Jay WB8SBI

HPARC Nets

HPARC Official Sunday Night 2-meter Phone Net

Every Sunday a 9:00 Pm local time on the DART repeater, 146.64 (PL 1 00), catch up on club news and information, and just to keep in touch. All amateurs are welcome to check in.

ARPSC Thursday Night 2-meter phone net

Every Thursday at 8:00 PM on the W8OAK repeater, 146.90 (PL 100). The Hospital radio check net takes place on the last Thursday each month at 7:30 PM on the W8OAK repeater. <http://www.arpdc.com>

Around Town

HPARC Buddy Breakfast every Saturday at 9:00 AM (or so)

Cozy Cabin Diner, 2129 E. 12 Mile Rd, Warren, MI
Come in early for the socializing. Park in the restaurant parking lot.

Volunteers

LoTW Manager	Murray KE8UM
Refreshments	Brenda N8AQ
Club Cook	Bill N8QVS
Holiday Meeting	Board of Directors
Equipment Inventory	Jim K8ABZ
Audio/Video Specialist	Ken KE8LIG
Lark in the Park	John AA8UU
Meeting Greeter	OPEN
Net Control Operators	Lee KD8TBC John W8TOY Mike K8WU Bob N8REL
HPARC Media Dream Team	Hugh KE8BED Rick KB5OO Al K8ALH John AA8UU Mike K8WU Jim K8ABZ John W8TOY

Oakland County ARPSC Siren Testing, 1st Saturday at 1:00 PM.

March through November. Contact Marsha, N8FE, at n8fe@arrl.net, to volunteer and be assigned a siren to test.

Amateur Radio Licensing Testing

Jerry has announced that license testing will begin again on The first Tuesday of every even month at 7:00 PM at the Oak Park community center.