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That Old Musk Magic

Is Musk's battery better than a back-up generator?

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Do you believe in magic?

Plenty of people do, judging from the reaction to Elon Musk's media event announcing "Powerwall," a home battery system. Powerwall would join SolarCity in Elon's double trouble for the utility industry (when he isn't building cars and colonizing Mars).

For Powerwall to make sense you must believe in magic. Let's look at the three value propositions that Elon put on the table: (1) Backup for utility outages, (2) daily cycling to buy cheap power in the night and use during the day instead of buying from the utility, and (3) in pairing with solar (such as is planned with SolarCity).

First value proposition, backup

We put a natural gas generator at our home for backup, a Generac 20 kilowatt (kW) unit, for $10,000 all in. We would need 10 of Elon's 2kw/10 kilowatt-hour (kWh) Powerwall packs to match the 20 kW continuous output of the Generac. Elon said the limit for stacking is nine packs, so let's assume we could get by with nine packs and their 18 kW of continuous supply.

How much would that cost? It turns out Elon's announced price of $3,500 per pack was an illusion. SolarCity has since disclosed retail pricing of $5,000 for a nine year lease or $7,140 to purchase the system, and no cost reduction for multiple packs.

So, nine of the Powerwall packs would cost $64,260. That's more than six times the Generac cost!

And what do you get for all that extra cost? Well, the nine Powerwall packs would provide 90 kWh of storage. Our average use for the last 12 months was 4 kW per hour, so the Powerwall on average would cover us for less than one day of a utility outage. The Generac runs indefinitely.

Second value proposition, daily cycling

Buy cheap at night and use during the day. For starters you have to be able to buy cheap at night. Utilities (and their state regulators) are all over the board in terms of "time of use" (TOU) rates. Our utility Dominion has a relatively good TOU option with a low off-peak rate of 4.8 cents/kWh and an on-peak rate of 17.4 cents/kWh. These compare to our current "around the clock" standard rate of 10.2 cents/kWh.

Now, to look at the economics of the Powerwall under the Dominion TOU rate option I'm going to make some Herculean assumptions, all favorable to the Powerwall. First, I'm going to assume that we can achieve perfect utilization of the Powerwall system – meaning we buy only at the off-peak rate and can store enough each night to meet all of the next day's on-peak usage. We used 35,690 kWh in the last 12 months.

To cover that 35,690 kWh we would need to buy extra to cover the "losses" of the Powerwall itself and of converting AC to DC and back again via an inverter. Elon only gave a loss value for the former (8%) – the inverter losses somehow disappeared (remember, this is magic). But to keep it simple I'm going to assume all the losses are zero, and we just need to buy 35,690 kWh, which at 4.8 cents/kWh comes to $1,713. Our alternative was paying Dominion about 10.2 cents/kWh for a total of $3,640, so our utility bill goes down $1,927 in year one.

For later years, it's important to recognize that the performance of lithium-ion batteries degrades over time, in correlation with the frequency and depth of cycling. Daily deep cycling is going to take its toll, we just don't know how much. But, again, to keep this simple I'll assume zero degradation. Oh, and the batteries don't last forever. The Powerwall will carry a 10 year warranty (the originally posted optional 10 year extension has disappeared from the website, poof!), but to be favorable to Powerwall economics let's assume post-warranty useful life of an additional 5 years, and assume zero maintenance and repair costs for the entire 15 years.

So with all these assumptions what is the Powerwall going to cost over 15 years in order to save that $1,927/year on our utility bill? Well, if we purchase nine of the 7 kWh daily cycling units we'll have 63 kwh of stored electricity for every day and that ought to cover us for the vast bulk of on-peak hours so we can minimize paying the on-peak utility rate (recalling our first Herculean

assumption that we pay the utility for zero on-peak hours). Nine of the 7 kWh daily cycling units will run maybe $60,000 (taking $500/pack off from the $64,260 total for the more expensive backup unit). Amortizing a $60,000 capital cost over 15 years at say 4.5% (the lowest interest rate SolarCity offers for a solar system purchase) is $5,508/year. So the Powerwall cost is almost three times the utility savings – after the Herculean assumptions in favor of the Powerwall.

(P.S., re Elon's environmental claims for the Powerwall, the generation plants running at night to refill the Powerwall will tend towards the coal and nuclear variety.)

Third value proposition, pairing Powerwall with solar

The possible permutations are endless, but the key point is this: Solar can't touch an off-peak rate like Dominion's 4.8 cents/kWh. SolarCity's rate for solar energy sales runs 11-12 cents/kWh – more than double the Dominion off-peak rate. And wherever there is "net metering," which is most states, solar is effectively stored by the utility at no cost. So solar doesn't improve Powerwall economics, and Powerwall doesn't improve solar economics.

Indeed, only days after Elon's announcement, SolarCity fessed up that it wouldn't even offer the daily cycling version of the Powerwall. Why? Well, SolarCity says, the Powerwall "doesn't really make financial sense" for solar energy due to the prevalence of net metering.

And yet … voila! It must be magic.