What is "fast," anyway?

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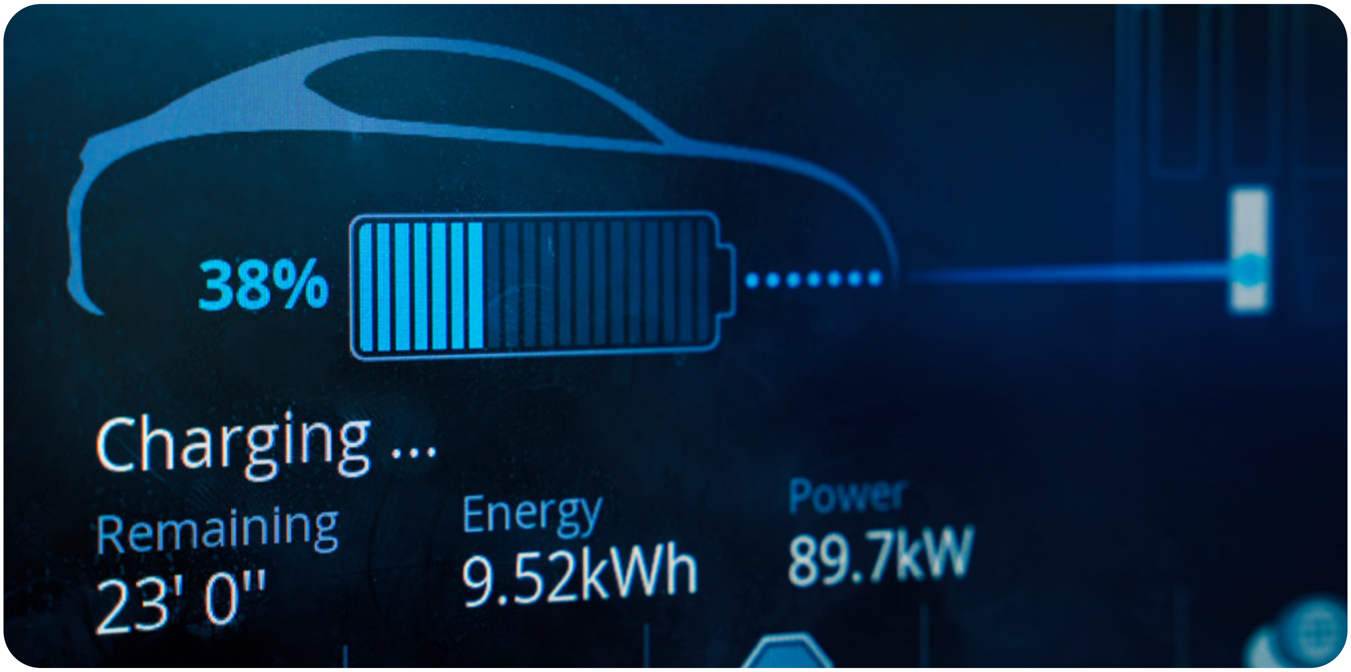

When it comes to EV charging, what is fast? Why – and when – does it matter?

We've owned EVs in our house for a decade. They are remarkably nimble, quick to accelerate, very quiet and fun to drive. 99% of the time we plug it in overnight while we are sleeping. At first, we did that with the "trickle charger" that comes with the car. In about 12 hours, the car would be almost at full capacity.

After someone in our household forgot to plug it in one night when they got home, we decided that something a little bit faster might be a better option just in case someone forgot, so we installed a Level 2 (L2) home charger, that can get you ready to go most places in just a few hours. Added bonus: no need to add a stop at a gas station on the way to or from work or during your precious weekend time.

Recently, I've seen people dismiss L2 chargers as "slow." What they really should say is slower than the DC fast charging (DCFC) you see at malls and public charging stations. L2 gets pooh-poohed as a laggard, as though the whole point of EV charging were to get as many electrons as possible into your car in the shortest time possible every time you charge.

Guess what? That's a bad idea.

First, EVs aren't gas vehicles. You go to gas stations to fill up because gas is noxious, flammable, and dangerous. Gas stations didn't just spring up on corners because we all wanted to have another errand to run, they sprung up because it's neither safe nor feasible to refill at home.

However, you do have electricity at home. And at the office. And curbside. And in parking garages. Places where you tend to leave your car parked for long periods (most cars are parked about 95% of the time). If you were at the mall to watch *Oppenheimer*, say, you wouldn't need to go somewhere special to charge your car in 20 minutes! Three hours of L2 charging in the mall parking lot would net most EVs 80-100 miles of range. Most people in the United States drive a third of that distance in any given day.

Second, DCFC takes a LOT of energy. When you charge your EV that way, you are pumping the equivalent of more than 100 homes' worth of energy into your car.[1] Think of how many refrigerators, air conditioners, blow dryers, and televisions that encompasses!

Here's the math for comparison. In 20 minutes...

The average household expends **0.3805 kWh**	A DCFC charging session* expends **50 kWh**	The DCFC charger expends **131x more energy** than the average household
1.1416 kW x 1/3 h = 380.5 Wh (0.3805 kWh)	150 kW x 1/3 h = 50,000 Wh (50 kWh)	50 ÷ 0.3805 = 131

*Assuming full power can be sustained the whole time.

However, sustaining 150 kW for 20 minutes might be unrealistic because that level of power can usually only be sustained for a smaller range of the battery's state of charge. It is important to verify this by considering the amount of energy it takes to bring that vehicle from 0 to 80% in the 20 minutes.

So, if we modify it a little to assume that the average EV battery ranges from 60 to 100 kWh, then we can take 80% of those values (80% because Li-ion batteries can almost always take full power up to about 80% before they taper off a lot) to bring us to 48 to 80 kWh over the 20 minutes. We notice now that the 50 kWh isn't too unreasonable for the higher capacity batteries but probably a little optimistic for the lower size batteries.

Using this information, we then calculate that the DCFC charger (to charge a battery from 0 to 80% in 20 minutes) for the smaller size 60 kWh battery would use closer to 126 times more energy than the average household.

Why does this matter?

You typically will pay **$ 4-5x more** to get to a full charge with DCFC compared to what you'd pay at home.[3]

One often overlooked reason is accessibility. To protect against all that power, DCFC cables are bulky and difficult to maneuver for anyone, let alone someone with any physical limitations.

All that energy comes at a high cost: it's expensive to both build and use. Making that much energy available all at once puts a lot of demand on the grid, requiring new investments in transformers and lines. After all, you're pushing the equivalent of a housing subdivision into your car battery. And electrical utilities structure their rates with what are called "demand charges," or the amount of energy that would need to be supplied at peak demand. So the costs for delivering electricity to a 150kW DCFC are going to be significantly higher than delivering to a 7kW L2 charger[2] because their peak usage would be so disparate.

1 Average US household consumes roughly 28kWh of energy a day.

2 Average L2 public charger today is roughly 7kW, though they range between 3kW and 19kW depending on age and location.

3 Costs for charging are highly variable, based on how it is being calculated (by kWh or time), the average utility rates, demand, pricing and membership plans, promotions, etc. For example, as I write this, my Electrify America app is showing DCFC at $0.56 per kWh nearby, and EVGo is asking $0.035/minute for a 7.2kW L2. ChargePoint's local L2 charges $2.04 for the first four hours and $5.00 per hour thereafter, and a complex time-of-use schedule for DCFC ranging between $0.52 and $0.66 per kWh. All that said, average cost for DCFC in the US is between $0.41 and $0.50 per kWh. Charging at home on an L2? You'll pay roughly $0.09 to $0.11 per kWh depending on where you live, likely more in the Northeast.

With DCFC, government permits and approvals are much more complex and expensive, with much longer lead times required. And all those costs get passed on to you when you pay the rates for that “fast” charge. Rates vary based on many factors, but you typically will pay four to five times more to get to a full charge with DCFC compared to what you’d pay at home.

I know what you are thinking: what about long distance travel in an EV?

Yes, there is a place for DCFC along highway corridors and for commercial vehicles that require high uptime. Today, most EV owners rely on L2 charging. I’m sure most of my fellow EV owners would agree that to characterize L2 charging as “slow” and lacking misses the point: there isn’t “one size fits all” for charging EVs like there is for fueling ICE vehicles.

Fast is relative, and what you really want is your vehicle to be ready when you are.

WiTricity Halo™ wireless charging as we demonstrate it today is equivalent to L2 charging in terms of time and efficiency. And when all you have to do is park – you can even forget the worry.

I think it’s time to disabuse ourselves of the notion that the speed of L2 charging makes it inherently inferior to DCFC. To take advantage of EVs, we need to think about the right charger for the right time. . . and at the right price.

WiTricity Halo™ wireless charging is **equivalent to L2 charging** in terms of time and efficiency.

WiTricity has many resources to help you stay informed about wireless EV charging.

- Stay in-the-know by subscribing to our monthly **newsletter:** https://witricity.com/newsletter
- Check out our other **white papers:** https://witricity.com/media/additional-resources
- Watch **videos** that bring wireless EV charging to life: https://witricity.com/media/videos
- Read our **blog** with posts featuring keen insights and information on the hot topics surrounding wireless EV charging: https://witricity.com/media/blog

WiTricity is the pioneer in wireless charging for electric vehicles, leading the development and implementation of magnetic resonance technology across passenger and commercial vehicles alike. The company's products are backed by an extensive patent portfolio critical to ratified global EV wireless charging standards including SAE, ISO, and GB. Automakers and Tier 1 suppliers rely on WiTricity to help accelerate the adoption of EVs by eliminating the hassle of plug-in charging and setting the stage for future autonomy. Beyond EVs, WiTricity technology is indispensable to the wireless charging of all products, from consumer electronics to micro-mobility to robotics.

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