Get to Know the Customer

ECEP 480

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The US market for plug-in hybrid vehicles has been growing. With the growth and the EV market there are many different Plug-in hybrid deigns out there and all technologies differ from one another. The range can be dictated by not only the technology but also driving styles, charger level, battery depletion, and many more factors. So, the charging time and capacity is not only bottlenecked by EVSE level being implemented but the battery and charger technology within the vehicle. Table 1. Shows the difference in some of the most popular plug-in hybrids in the US and the different technologies used.

Table 1. EV Charging Details[4]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | Max Charge | ~Miles Added Per Hour | 100% Electric or PHEV | Level 1 Charging Time(Hours) | Level 2 Charging Time(Hours) | Enegery Capacity(kwh) |
| Audi A3 e-tron | 3.3 kW | 11 | PHEV | 8 | 2.15 | 8.8 |
| BMW i3 | 7.4 kW | 25 | 100% Electric / REx | 5.5 | 2.16 | 33 |
| Cadillac ELR | 3.3 kW | 11 | PHEV | 12 | 4.5 | 17.1 |
| Chevy Volt | 3.3 kW | 11 | PHEV | 11 | 3.2 | 18.4 |
| Ford C-Max Energi | 3.3 kW | 11 | PHEV | 7 | 2.5 | 7.6 |
| Ford Fusion Energi | 3.3 kW | 11 | PHEV | 7 | 2.5 | 7.6 |
| Nissan LEAF | 3.3 kW / 6.6 kW | 22-Nov | 100% Electric | 20-25 | 3.3-3.5 | 30 |
| Toyota Prius Plug-In | 3.3 kW | 11 | PHEV | 3.14 | 1.33 | 4.4 |
| Volkswagen e-Golf | 3.6 kW / 7.2 kW | 24-Dec | 100% Electric | 20 | 4 | 35.8 |

Analyzing the data shown in Table 1, the charge time various a great deal as due to two factors the energy capacity of the battery and, the different implementation of each manufacturer. The Chevy Volt, has a 18.4 kwh energy capacity but takes the same amount of time to charge as the BMW i3 on a level 2 charger. The Toyota Prius Prime and the Ford Energi systems, both have a smaller battery and take about the same amount of time to charge. The BMW i3 and Nissan Leaf also seem to have technology that provides very similar charging times.

The EVSE is just the device that brings the AC power to the car, where then it is turned into DC power and fills the battery via the car’s onboard charger. Hence, the bottle neck that is happening is the onboard level and this is the technology difference between all these models of cars. There are three variables to keep in mind. The vehicles acceptance rate or “Max Charge”, Vehicle Battery capacity, and charging station delivery rate Level 1/2.

The rate at which the vehicle can charge is dictated by the “Max Charge”, or how fast is the energy being transferred to the battery. This is works like filling up a swimming pool with water.  The rate, depends on a few things like pool size and the amount of water you have set to come out of the hose. If you turn up the water, it will fill faster.  If you have a large pool it will obviously take longer to fill than a small pool at the same rate. The vehicles battery size would work like the pools size, and the flow of water to the pipe that is filling the pool would be the AC level.

For the purposes of the F-lot project, a few vehicles from Table 1 need to be chosen to test the system properly. Looking at the table the vehicles that would be smart to test would be ones that have low Max charge values and higher Max charge values, even ones that have both technologies. For this project, the Nissan LEAF and the Chevy Volt both look like good test vehicles. The Nissan LEAF comes in two Max Charge capacities 3.3 KW and 6.6 KW and is a full Electric vehicle, and a battery of 30 kwh. While the Chevy Volt has a 3.3 KW Max Charge and is a hybrid with a gasoline supply as well, and a battery of 18.4 kwh. This variety will allow the testability of different loads and different technologies, to ensure that the PV array will work correctly given any type of load given.

[1]S. SILER, "2017 BMW i3: Now with more electric range - official photos and Info," 2016. [Online]. Available: http://www.caranddriver.com/news/2017-bmw-i3-revealed-more-range-leads-the-updates-news. Accessed: Feb. 8, 2017.

[2]"Chevrolet Pressroom - United States - Volt," media.gm.com, 2016. [Online]. Available: http://media.chevrolet.com/media/us/en/chevrolet/vehicles/volt/2016.tab1.html. Accessed: Feb. 8, 2017.

[3]ccadmin, "Three things determine EV charge time," in *Electric Vehicles (EV)*, ClipperCreek, 2012. [Online]. Available: https://www.clippercreek.com/three-things-determine-ev-charge-time/. Accessed: Feb. 8, 2017.

[4]Zach, "Electric car charging 101 — types of charging, charging networks, Apps, & more!," EV Obsession, 2015. [Online]. Available: http://evobsession.com/electric-car-charging-101-types-of-charging-apps-more/. Accessed: Feb. 8, 2017.