OLLI-UA GREEN VALLEY ELECTRIC VEHICLE BASICS CLASS (GV EVBC)

NEWSLETTER # 2, FEBRUARY 28, 2024 SESSION

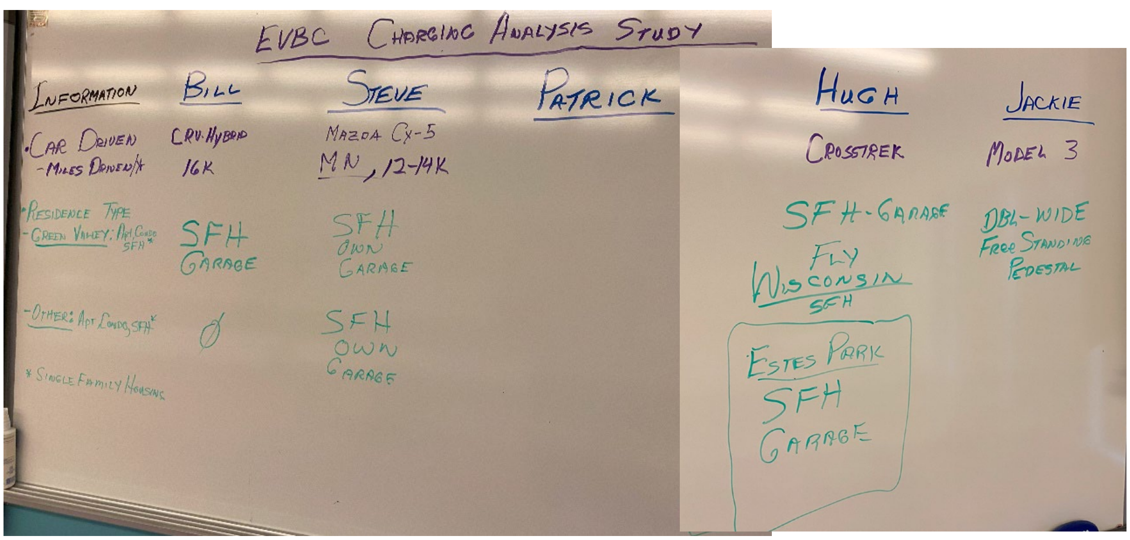
CHARGING – AT HOME, NOT AT HOME

Hello Bill, Steve, Hugh, Jackie, and Patrick 😊

This is the second Newsletter for the Green Valley Electric Vehicle Basics Class (EVBC). It reports on what took place at the CPAC Room 203 Wednesday afternoon on February 28th. So here goes.

EVBC CHARGING ANALYSIS STUDY

I started the class with collecting information from you all about the cars you currently drive, the annual miles you drive and your housing types-here and other places. This was done so as to get a picture of your charging requirements should you get an EV. It helped me customize today's presentations and discussions on Charging.



HUGH'S QUESTION ABOUT EVS AND WHETHER THE GRID WILL HANDLE THEM

I provided Hugh with some printouts of articles addressing this issue. Most said that the grid would be able to support the charging of the EVs when they became the predominant vehicle type. Below are the links to the articles that I provided Hugh. The cnbc.com article was the one that said the EVs may create a major strain on the grid. One of the articles said that the major driver for expansion of the grid in the future wasn't the EVs charging up but all of the appliances and equipment that would be switching from fossil fuel to electricity; e.g., gas/propane appliances going electric, home heating going electric, etc.

By clicking on the links you should be taken to the articles where you can read them or print them out. Sorry they were too big to include even their pdfs in the newsletter.

https://www.nationalgrid.com/stories/journey-to-net-zero/electric-vehicles-myths-misconceptions

https://electrifynews.com/featured/myth-busting-the-grid-can-our-infrastructure-support-electric-vehicles/

https://www.nrel.gov/news/program/2023/evs-play-surprising-role-in-supporting-grid-resiliency.html

https://advocacy.consumerreports.org/research/blog-can-the-grid-handle-evs-yes/

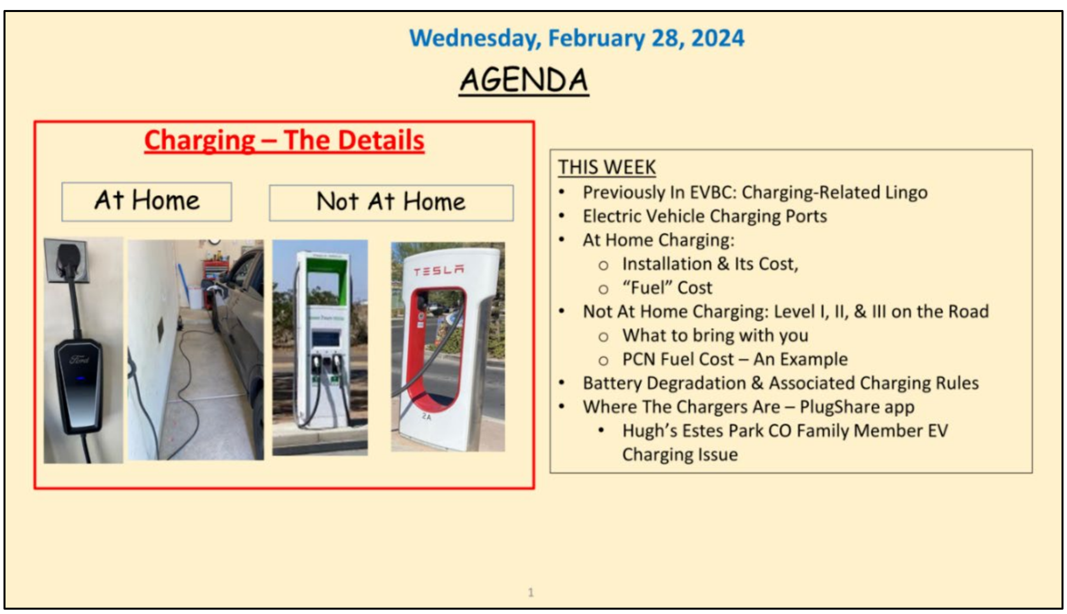
https://www.cnbc.com/2023/07/01/why-the-ev-boom-could-put-a-major-strain-on-our-power-grid.html

https://www.govtech.com/fs/can-the-u-s-power-grid-handle-an-all-electric-future

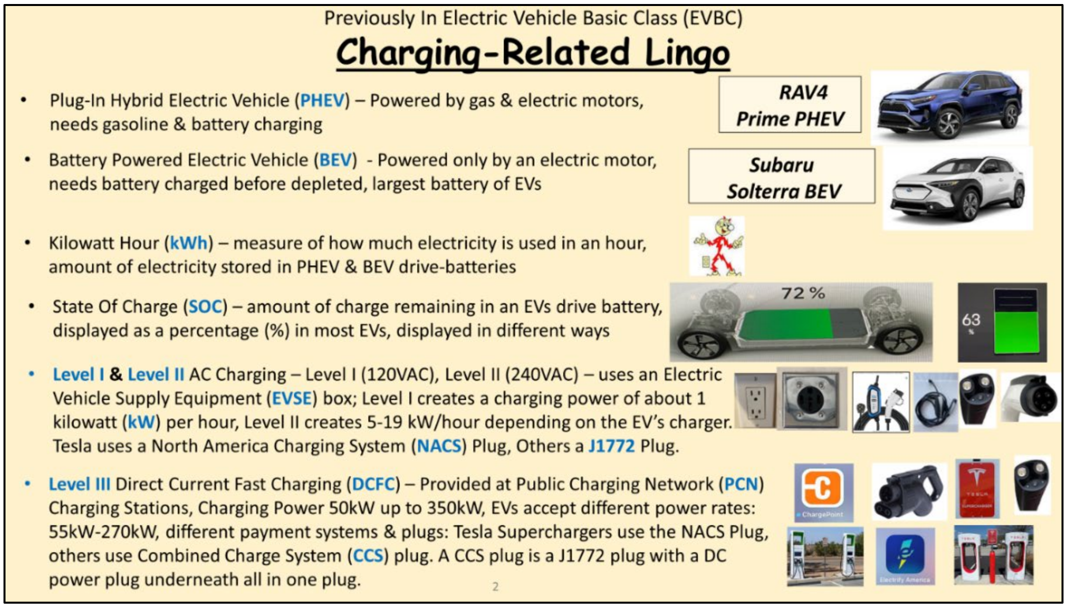
POWERPOINT SLIDE PRESENTATION AND DISCUSSION

As in Newletter #1, less than full size copies of the PowerPoint slides presented in class will be shown in the Newsletter. The order of the slides presented is the order that this part of the Newsletter is organized. They will be shown along with a synopsis and additional explanation of what was presented.

NOTE: Based on the inputs received on my no longer sending you all a pdf copy of the PowerPoint slide file, the Newsletter will be the only handout provided you all that shows the slides. Because of their depiction, some slides may not be completely legible when viewed on a computer screen, but may be more readable when the Newsletter is printed out. HOWEVER, if you wish to have a pdf copy of the PowerPoint slide file, send me an email at damondlosterhus@verizon.net, and ask me to send you one. When the slides are viewed or printed out all slides will be legible.



The planned topics to be addressed in the class session are shown. The focus will be on the At Home Charging and Not At Home Charging. The presentation talks to the details of Level I, II, and III charging.



This slide provides in blue the abbreviations that were presented in last week's class, and are pertinent to the topic of charging.

It is important to differentiate between kW (kilowatts) and kWh (kilowatt hours). Kilowatts is the measure of electrical POWER that chargers (aka EVSE for Level I & II charging) provide when charging EVs. Liken it to water flow rate. It is the rate that electrons/electricity is delivered; i.e., kilowatts per hour. Kilowatt hours on the other hand is the amount of ENERGY provided; liken it to gallons of liquid delivered.

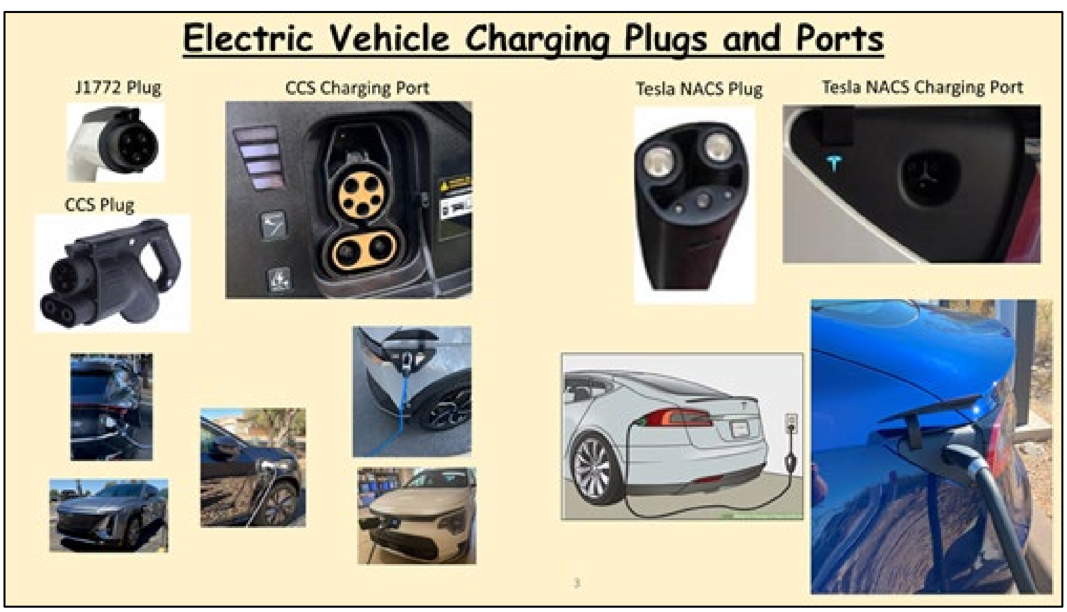
Additional Explanation

Level I, II, and III charging are associated with the different POWER levels provided by charging:

Level I results in a charging Power level of around 1 kW per hour.

Level II results in a charging Power level range of 5 to 19 kW per hour.

Level III (aka DC Fast Charging-DCFC) currently results in a Power level range of 50 to 350 kW per hour



The slide above shows not only the different plugs but also the different locations that they are plugged into.

Additional Explanations.

On the left the J1772 Plug is inserted into the top half of the Combined Charging System (CCS) Charging Port and it is used for both Level I and Level II charging on Non-Tesla EVs. Often the lower two ports have a cover. The entire CCS charging port is used when charging using the CCS plug. The CCS plug is used when doing Level III DC Fast Charging (DCFC).

The 5 pictures below the CCS Plug and CCS Charging Port show the different locations of the charging ports on Non-Tesla EVs: left rear, right rear, in front of door driver's side (front left), in front of front passenger's side door (front right), and in the front.

For the Teslas, Level I, II, and III charging is done using the Tesla NACS through plugging it into the NACS charging port. No other plug is used. The NACS charging port is located on all Teslas at the left rear.

At this point in the presentation the projector decided to stop presenting and went into cool down mode. Which left me the opportunity to do a show and tell on the charging things I brought:

SHOW & TELL OF CHARGING EQUIPMENT

Below are pictures of the actual items I brought and a discussion of them. You will see similar pictures in the slides that follow.





From left to right here's the items and what was said about them:

Things associated with installing Level II 14-50R outlet in a home.

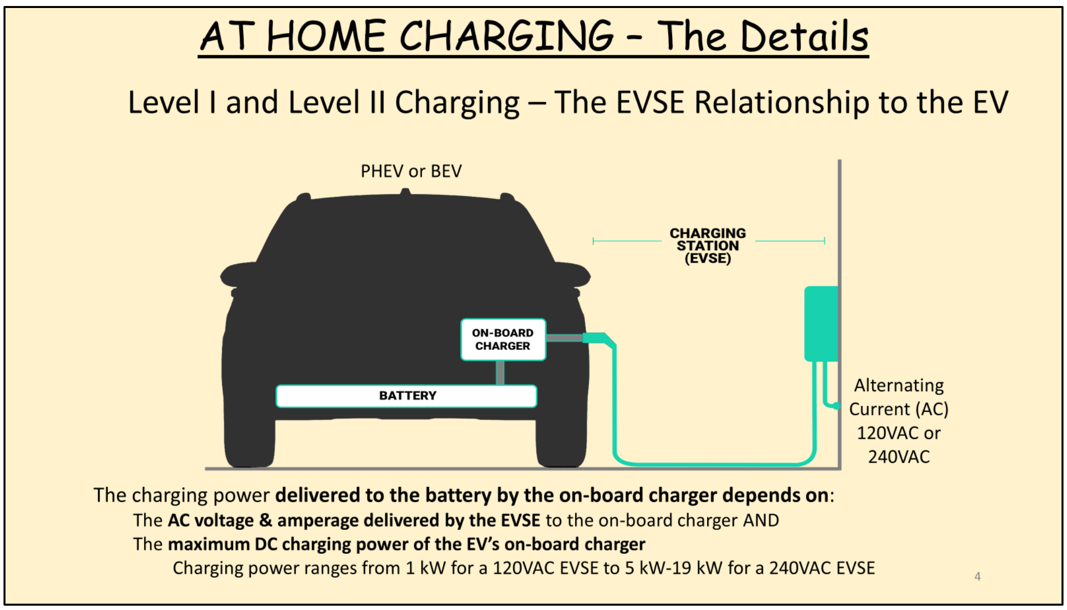
- A length of the 3ea #6 THNN stranded wires plus a 12-gauge solid copper wire used to connect a dual pole 50-amp breaker to the 14-50R outlet. These come with an outer wrap and are called Romex cable. As shown later, Romex cable is not acceptable when hooking up to 60 amp or greater amp dual pole breaker for a 48-amp EV EVSE (commonly called an EV Level II charger). Reason: the wires are held too closely together and aren't allowed to be cooled by the surrounding air.
- Two different 14-50R outlets. One is a cheap $10 one that can be gotten from a local big box hardware store. The other one is a $90-$100 Hubbell 9450. In following slides, I show where the cheap one is susceptible to melting down due to the fact that the wire connections cannot be tightly enough torqued down such that the connections do not come loose and create a lot of heat. Note the torque requirements associated with each. The weight and strength of the Hubbell is indicative of why it should be used. Recommended by Tesla for its Level II home charging installations.
- Two different torque tools that should be used when installing the Level II "chargers". One is a small torque wrench that can torque up to 150 in-lbs and is used to torque the connections on

the Hubbell 14-50R outlet (75 in-lbs). The other is a torquing screwdriver that can torque up to 50 in-lbs, and is used to torque the connections to the dual-pole 50-amp breakers (45 in-lbs).

The 32-amp Level II "Charger" (EVSE) I Use at My House. It is plugged into a 14-50R outlet and has a J1772 plug.

The Tesla Mobile Charger and a J1772 to NACS Adapter. It can be used as a Level I-120VAC or Level II-240VAC plug in charger. As shown, it has a 120VAC supply cord and a 240VAC supply cord. These supply cords plug into the charger. The vehicle plug is a NACS plug. Also shown is an adapter that is attached to a J1772 plug, and allows a Level II charger with a J1772 plug to charge a Tesla by adapting it to a NACS plug. Tesla no longer provides even a 120VAC Mobile Charger. It provides a credit where the buyer and purchase the mobile charger shown. Most people carry the mobile charger with them in the car and have a direct wired (aka hard wired) charger at home. The J1772 to NACS Adapter is supplied with each Tesla.

The Tesla Combo 1 Adapter. This adapter that has to be purchased from the Tesla store, allows Tesla's to DC Fast Charge at all non-Tesla chargers that use CCS DCFC plugs. It costs around $200.



Here's when calling the EVSE a "charger" isn't technically correct, but it's OK to say it's a "charger" since that is what is more commonly understood. The EVSE is a piece of equipment that takes Alternating Current (AC) electricity from a home or business's 120VAC or 240VAC system, and supplies the AC to the EV's On-Board Charger (OBC). The OBC converts the AC to Direct Current (DC) and uses the DC to charge the battery. All batteries are DC devices; they create, and store electricity as DC and require DC to charge.

Additional Information

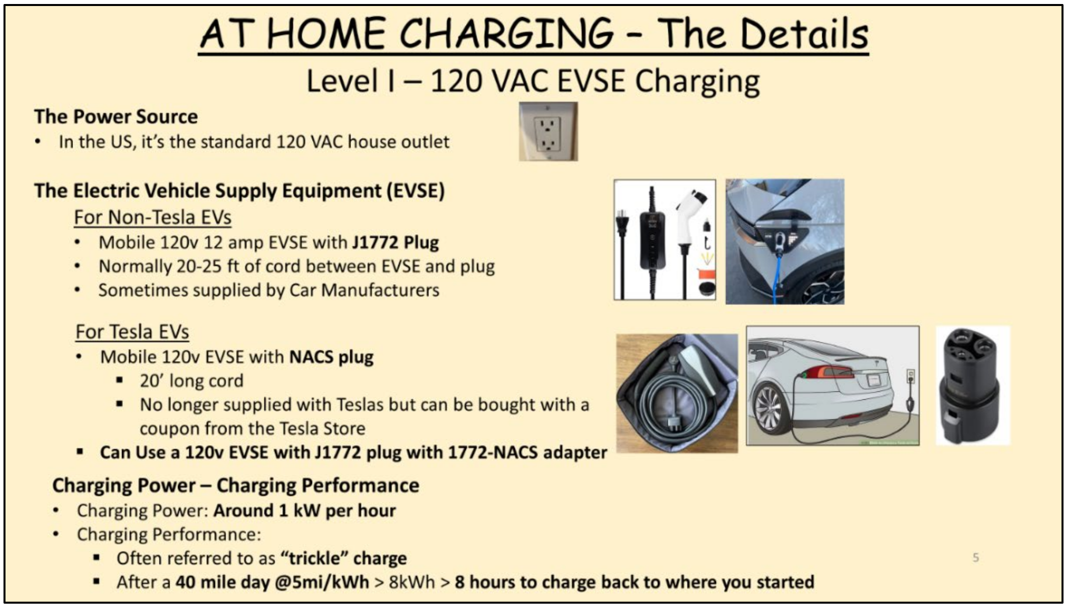
The EV OBCs deliver different levels of DC Power based on their design. They can only accept the designed level of power. That power is measured in kilowatts (kW). EVSEs are designed to draw specific maximums of electric power. That power level is measured in amps.

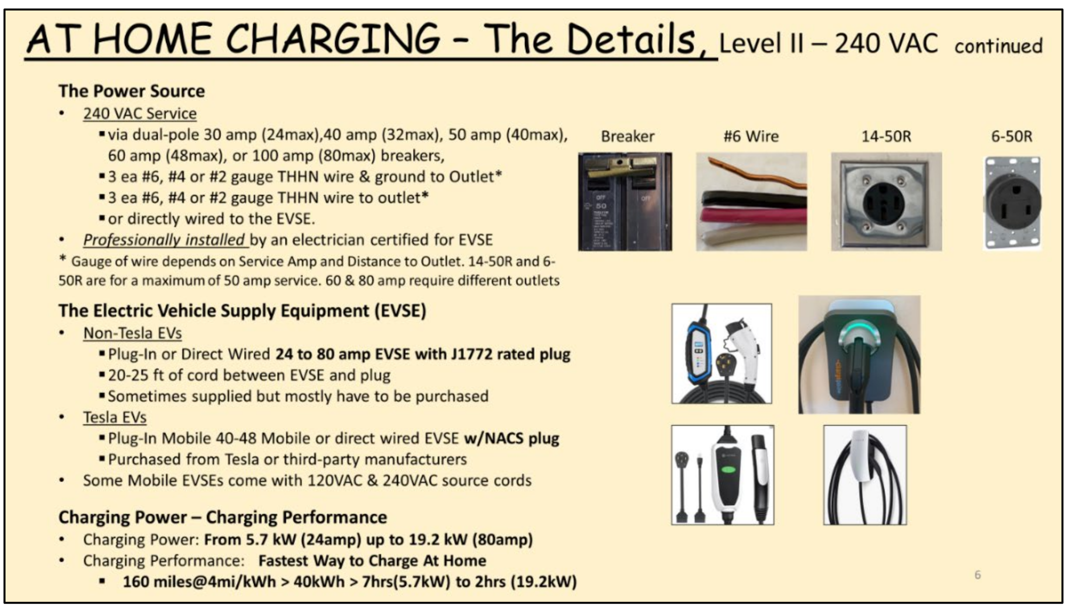
The combination of the EVSE's input voltage, 120 volts or 240 volts, and the amps that the EVSE is set to draw (up to its designed maximum), combined with the EV's OBC designed maximum output dictates how fast the EV gets charged. For example, most Level II 240 VAC EVSE's draw 32 or 40 amps. An EV's OBC may be designed to accept only 32 amps and deliver a charging power of 7.6 kW. Another EV's OBC may be able to accept 40 amps, and then is able to deliver a charging power of 9.6 kW.

If an EV needed only 10kWh to get back to an 80% SOC. A 32-amp input EVSE would take 1hr19min; while the 40amp EVSE would need only 1hr 2min. A 48-amp input EVSE could deliver a charging power of 11.5 kW.

Now to the details of Level I and II charging at Home.

All the following slides on the details of charging at the various levels follow the same format. They are like data sheets for each of the At Home and Not at Home Level descriptions. The important items are bolded. I leave them for your perusal. However, that being said, I do have additional details about the installation of At Home – Level II charging.





Ok. Here comes the "fun" associated with installing a 240 VAC Level II EVSE charger in a home.

First, one needs to determine that one needs and wants to pay for a Level II system. A Level I 120VAC charger may be all that's necessary.

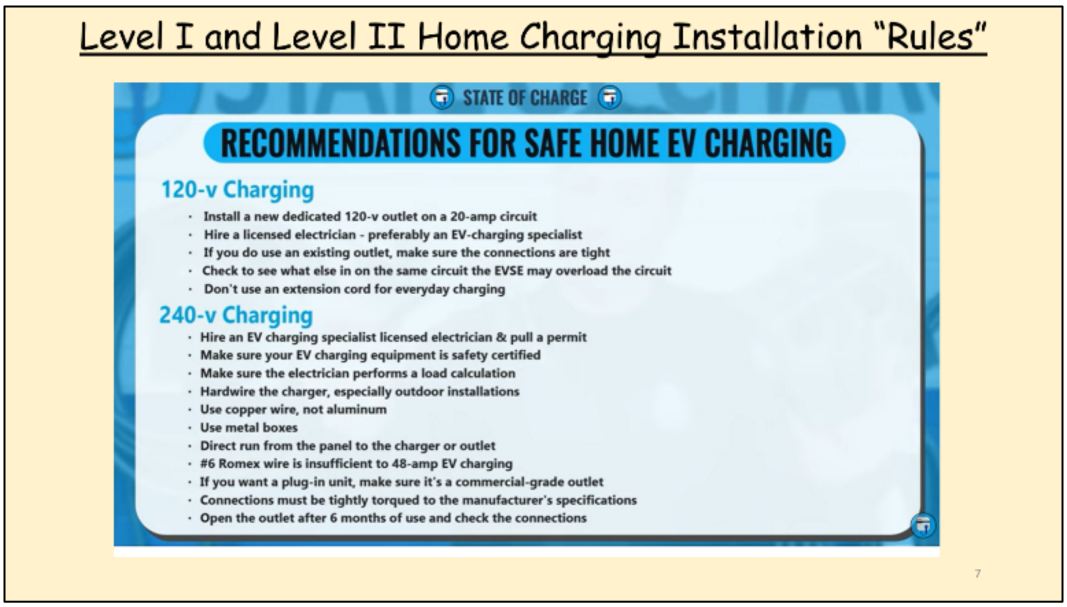
If one only drives the EV a small distance daily like 30 miles or less, and the EV one wants gets a good efficiency, like 3.5 mi/kWh then one only needs 8.5 kWh to charge back up to the level one started at (like 80% SOC). A Level I 120VAC charger would take 8.5 hours to charge. If you only drive the EV back and forth to work, and can afford the 8.5 hours to charge, a 240 VAC Level II charger isn't necessary. Some people try a Level I out for a while to see if the Level I works for them.

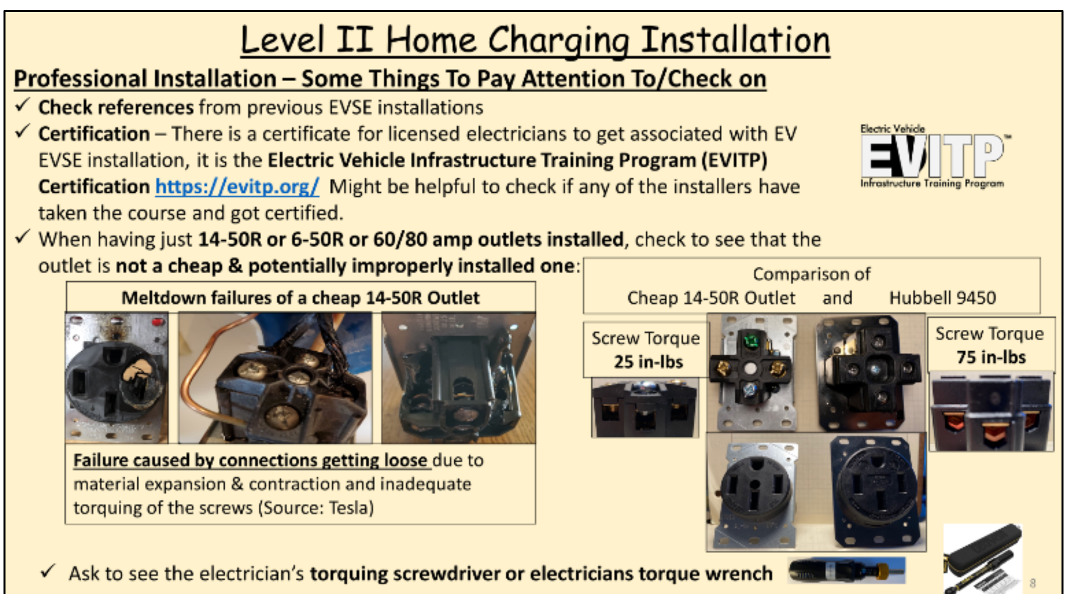
Also, if you get a PHEV, and it has a small drive-battery that would be able to charge in less than 8 hours.

However, if one drives over 30 miles a day or the efficiency is such that one has to charge up daily to more than 9kWh, then a 240VAC may be an overall cost-effective solution...that is, if you are allowed to install one . This requires that you do not live in an apartment or condo, or a house that you are renting; i.e., can't actually install a Level II charging system. An alternative is to charge up at nearby Level III DCFCs when you are able and when necessary. Something that urban dwellers currently do.

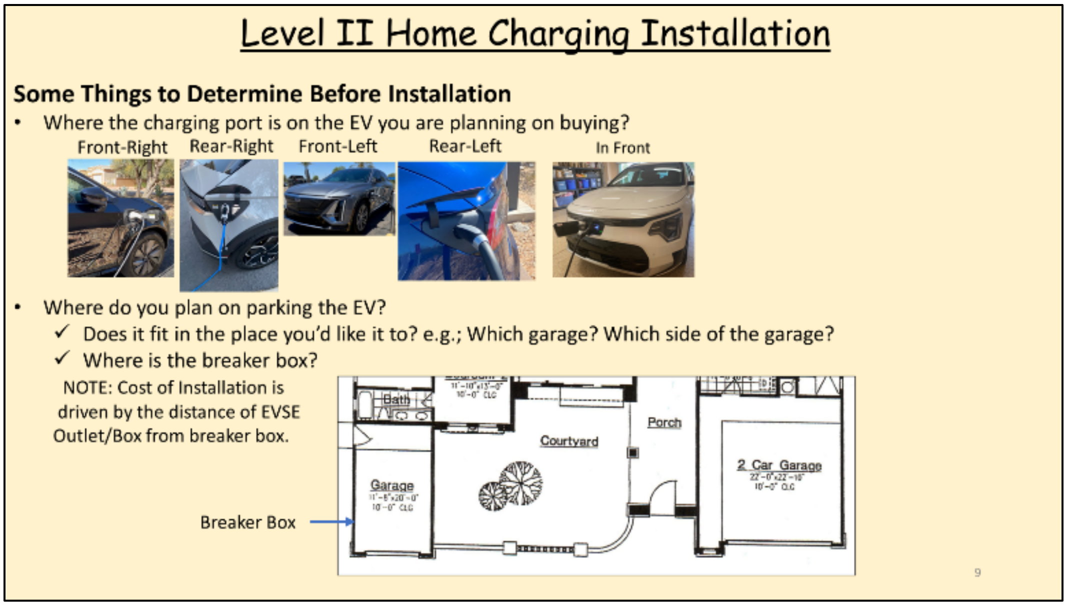
Installation of a 120VAC Level II system is really for those owning a residence and are able to have a Level II EVSE installed.

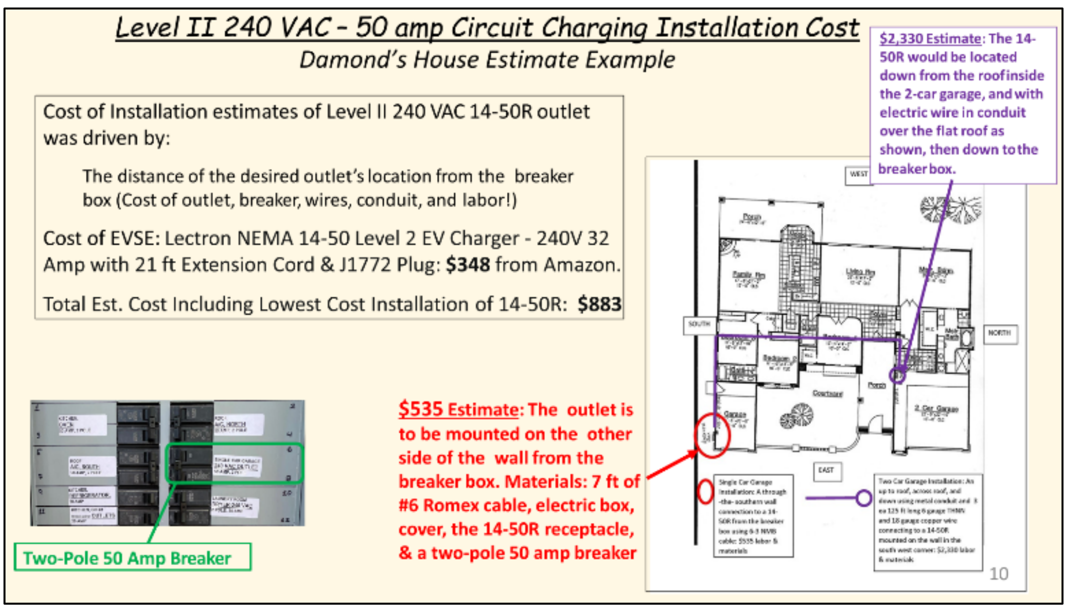
The two slides below provide the guidance associated with installation of a Level II EVSE.





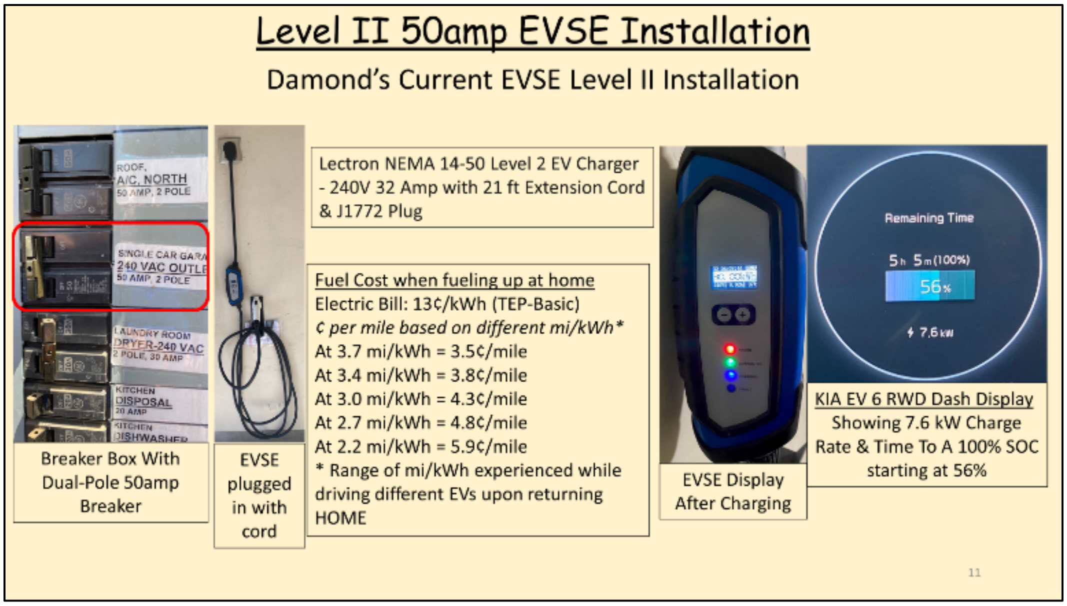
The slides below talk to things one needs to determine before installation, and aspects of getting estimates for the installation when it comes to where you would like the charger to be placed and where the breaker box is. The further away the breaker box is from where you want to have or have to have the EVSE placed, the more expensive it will be.

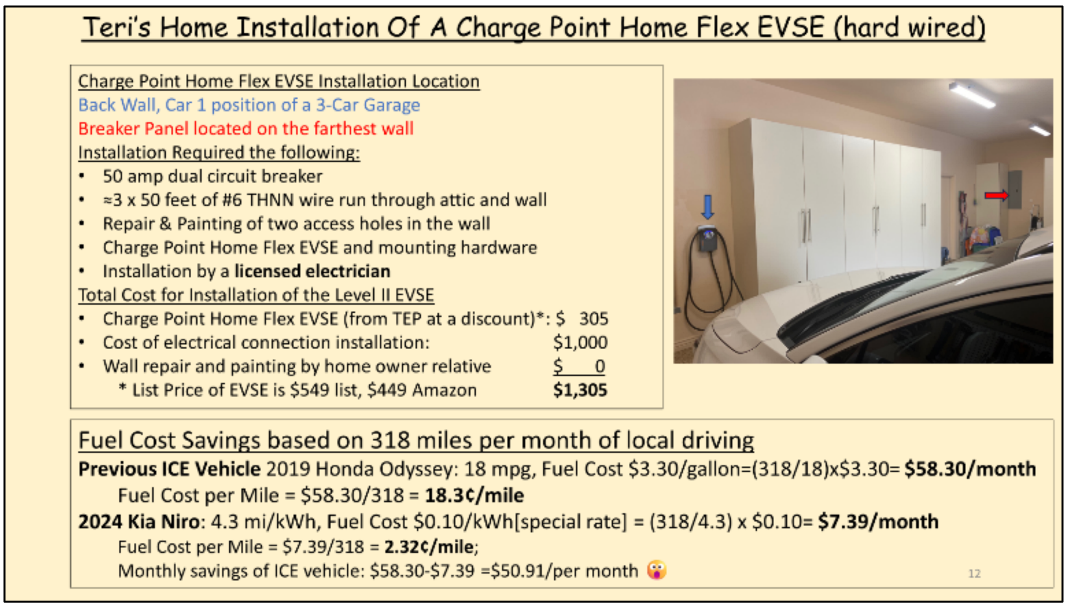




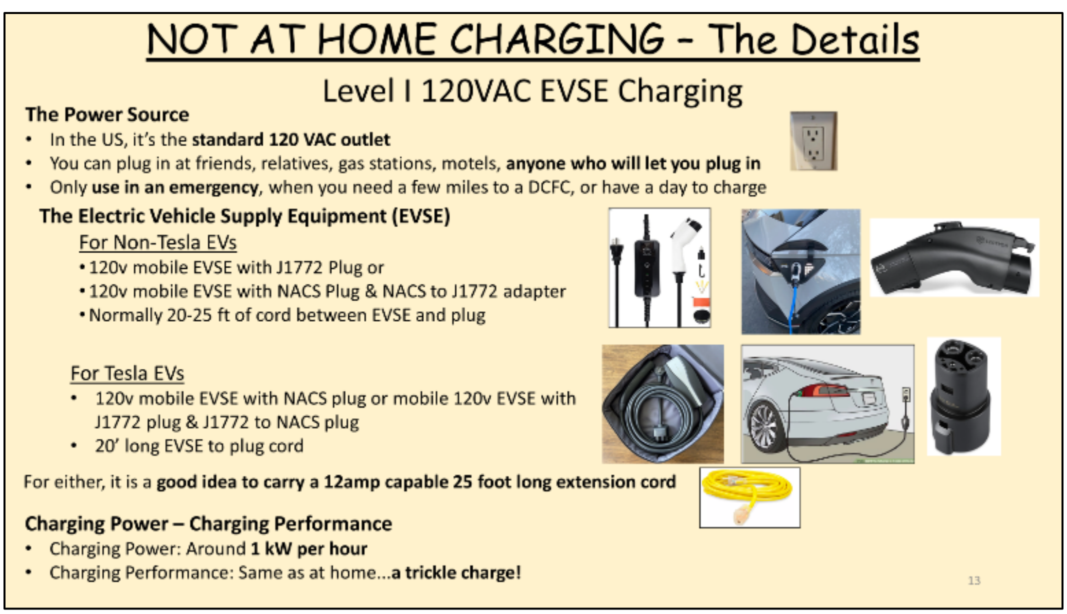
The slides following provide two different examples of the 240VAC Level II installation. Mine is an example of having the 14-50R outlet placed about the shortest distance one could have. Teri's installation is an example of a relatively modest cost given a direct wire EVSE and not a long distance from the breaker box. Had I wanted the installation to be in my two-car garage, the cost would have been substantial.

I have also included the cost per mile figures that I experienced while test driving the several EVs that I have driven. This was on the last leg back to my house and when I charged up there. Also, this is what Teri is experiencing now.



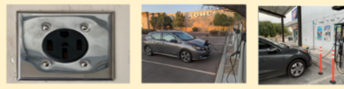


The following slides describe what it is like to do Level I, and Level II charging while Not At Home. As mentioned before, they are like data sheets. I have bolded some of the important things.



NOT AT HOME CHARGING – The Details, Level II – 240 VAC

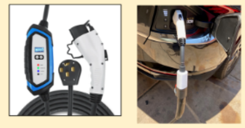
The Power Source
- 240 VAC delivered via a 14-50R Outlet or via a wired EVSE
- Located at stores, dealerships, city/county offices,



Level II Chargers at Kohls & DQ

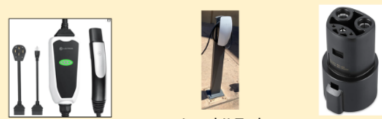
The Electric Vehicle Supply Equipment (EVSE)

Non-Tesla EVs
- A mobile 240v plug-in 14-50r EVSE with J1772 plug
- A wired commercial Level II EVSE with J1772 plug (as shown above)
- 20-25 ft cord
- **A NACS to J1772 Adapter** suited for use with 240 VAC when using a **Tesla Destination Charger or other Level II NACS plug Chargers**



Tesla Destination Charger w/NACS to EV6 J1772 at Marriot Star Pass Using An Adapter-9kW

Tesla EVs
- A mobile 240v plug-in 14-50r EVSE w/NACS plug or a wired Level II EVSE w/NACS plug (Tesla Destination Charger) Available at Hotels, Restaurants
- Some Mobile EVSEs come with 120VAC & 240VAC source cords
- **A J1772 to NACS Adapter** suited for use with Level II J1772 EVSE chargers (as shown above: Kohls and Dairy Queen commercial Level II J1772 chargers)



120v & 240v Source Cord NACS Plug EVSE

Level II Tesla Destination Charger at Marriot Star Pass

J1772-NACS Adapter

Charging Power – Charging Performance
- Charging Power: From 5 kW up to 16 kW
- Charging Performance: Faster than trickle charger but **not even close to Level III DC Fast Charging. Use when only necessary or overnight**

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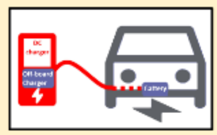
The slides below address the details of Level III DC Fast Charging and the fact that DCFCs do not charge at a consistent power rate like the Level I and Level II AC do. Rather the charging power of the DCFCs varies depending on several factors: the starting SOC, the desired finishing SOC, the outside temperature, the EV battery's temperature (is it pre-conditioned or not), and the performance of the specific DCFC station.

Not At Home Charging – The Details continued

Level III DC Fast Charging (DCFC)

The Power Source

DCFC Stations provide via transformers & inverters, **up to 800 Volts DC of charging power** via charging cables & plugs **directly connected to the EV & drive-battery**



The DCFC Stations

For Non-Tesla EVs
- **Public Charging Networks** (PCN) have a **multitude of charging locations** with upwards of 40 Stations per location. **Electrify America (EA), EVgo, & Charge Point** are **popular PCNs in the desert Southwest.**
- PCNs have **different station designs and different procedures** for starting the charging, and **different methods & rates associated with paying** for the kWh's delivered. All Non-Tesla PCNs have **CCS plugs to charge EVs.**
- Stations are **started using a cell phone app, an RFID card, or credit card**
  - **Payment** is made for the kWhs delivered or charging time **via pre-arranged accounts based on a credit card, or use a credit card** at the station.

For Tesla EVs
- Tesla Supercharger stations currently useable mostly by Tesla owners (changing)
- **Tesla's can use CCS charging stations by using only a Tesla-made adapter.***
- Inserting the **NACS plug into the EV starts the charging**, charging goes to the level set by the EV. **Payment is made via the Tesla account & associated credit card**

*** Both EA and EVgo require only adapters made by Tesla under their Terms of Use**

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Not At Home Charging – The Details continued

Level III DC Fast Charging (DCFC)

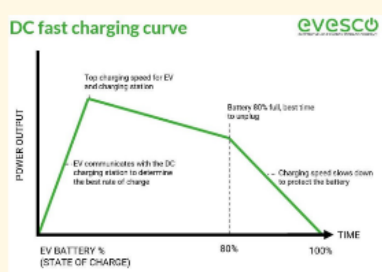
Charging Power – Charging Performance
- Charging Power:
  - All DCFC stations are **rated by their maximum charging power in kWs**
  - They range from **50 kW to 350 kW**

  Each **EV model can accept only a specific maximum initial charging power.** Chevy Bolt-55kW, EV6/IONIQ5-235 kW, Taycan-270kW

  That maximum **governs how fast the drive-battery can be charged.**
  - DCFC charging rates are **affected by the temperature and by use of other stations**
- Charging Performance – How long it takes to charge
  - Governed by the **starting and ending SOC;** e.g., 10%-80% SOC
    - The drive-battery **charges quickly in the beginning** when starting at 20%, but **slows significantly when reaching 80% SOC**.
    - Charging to **100% SOC can significantly increase charging time**

    The EV6 took as little as 12 minutes starting at 235 kW to go from 35-80% but took up to 45 minutes for it to go to 100%
    - **Heat and Cold affect charging** as well. Below 32F and above 100F

*Car makers recommend **routinely charging only to 80%-90% SOC** in order to **preserve the life of the battery**. (prevent degradation)*



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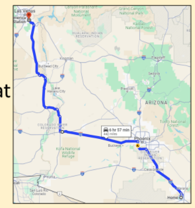
As recently experienced this past winter in the Northeast, it is important that the EV battery be pre-conditioned for charging; i.e., warmed up when cold and cooled down when hot. Like lead acid batteries in ICE vehicles, the chemistry of the batteries does not function very well in accepting or making electricity when exposed to below zero temperatures. I remember my Dad bringing the battery in the house during the winter in MN.

Finally, below is an actual fuel costing analysis when it comes to Level III Charging while on a long-distance trip requiring multiple charging stops. It is the results of the first part of a round trip test drive I made from Tucson to Henderson NV in a 2022 Kia EV6 Wind RWD, June 28, 2023 compared with a similar drive made in my wife's 2019 Subaru Outback. The cost of charging on a ¢/kWh basis was the same throughout the trip, the cost of gasoline was not. The cost of gasoline in Nevada was in the $4.25/gallon range. Luckily, we did not have to buy gasoline in California.

NOT AT HOME Fueling Cost of Level III on a Long Distance Trip

Fueling Cost Example: 2023 Kia EV 6 RWD, Driving From Tucson to Henderson, via Quartzite, 441 miles



- Route: Tucson-Buckeye-Quartzite-Needles-Henderson; I-10/AZ-95/CA-62/US95/I-11/I-215
- Temperature Range: **95F-106F**
- GPS Weighted Moving Average Speed: **63 mph**
- Elevation Range: **2638 down to 1736 ft MSL** (as low as 497 at Needles, as high as 3,500 ft at Searchlight NV)
- Estimated **80-10% SOC Range -180 miles**; 100-0% SOC estimated range miles 257
- Weighted Average Efficiency: **3.4 mi/kWh**
- **Total Cost** of 147.0 kWh billed by Electrify America **$52.13** = 35.5¢/ kWh (discounted plan)
  The undiscounted plan was high as 48¢/kWh at the time of the trip June 28, 2023

Cost per Mile (based on Efficiency and Cost per kWh):

@35.5¢/kWh & 3.4 mi/kWh = 10.4¢/mile

@ 48¢/kWh & 3.4 mi/kWh = 14.1¢/mile

How Much is Just the Fuel Cost for Your ICE Vehicle When Driving on a Long Distance Trip?

My **2019 Subaru Outback** Example on a Similar Trip: **27 avg mpg**, Gas $4.00/gallon or more = **14.8¢/mile**

OTHER COSTS ASSOCIATED WITH ICE VEHICLES NOT EXPERIENCED BY BEVS

Routine Maintenance and Servicing Costs:

- Oil & Filter Changes, Spark Plug replacement, fuel filters, drive belts, transmission fluid changes, etc

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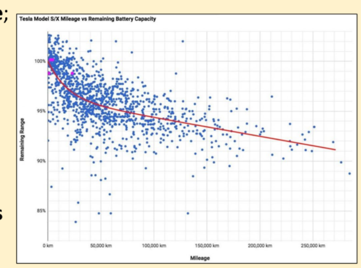
The slide below addresses the issue of EV drive battery degradation. Something that comes up when one wants to sell their EV or wants to buy a used EV. Lithium-ion batteries if treated well lose less than 3-5% of their capacity and that's in the first couple of years. If treated not so well, when it comes to selling or trading it in there can be a disappointment. Several companies such as Recurrent track the degradation of EVs and report to owner's how their specific EV is doing relative to the population of similar Make and Models of their EV. By following the recommendations listed in the slide, degradation is held to a minimum.

Battery Degradation & Associated Charging Recommendations

What is Rechargeable battery degradation?

- **All rechargeable batteries suffer from some loss of capacity over time**; e.g., NiCad, NiMH, Li-ion; cell phones, tablets, and **EVs** (though it can be minimized) 😀
- TheTesla S/X mileage vs Remaining Battery Capacity graph shows the **most degradation occurs in the initial life** of the battery and then **stabilizes after the initial period**
- For Electric Vehicles, the **normal life expectancy of the drive battery exceeds the life of the vehicle.** In general, the life will be **over 10 years** with very little degradation when the following **Charging recommendations** are followed:



- ✓ **Avoid continually charging batteries to 100%;** particularly, Li-NMC batteries ; Ok With LFP batteries
- ✓ **Limit/Avoid DC Fast Charging** particularly when its HOT or COLD & it hasn't been cooled down or warmed up
- ▪ **Never charge to 100% and leave it;** particularly when it is HOT, drive the vehicle soon after DCFC
- ✓ **Avoid letting the EV battery get below 5-10% SOC**; attempt to keep the battery charged between 20% & 80%
- ✓ **It is best to charge an EV battery in small doses**; i.e., from 65% to 80% versus 10% to 80%
- ✓ **Avoid aggressively driving an EV all the time**.

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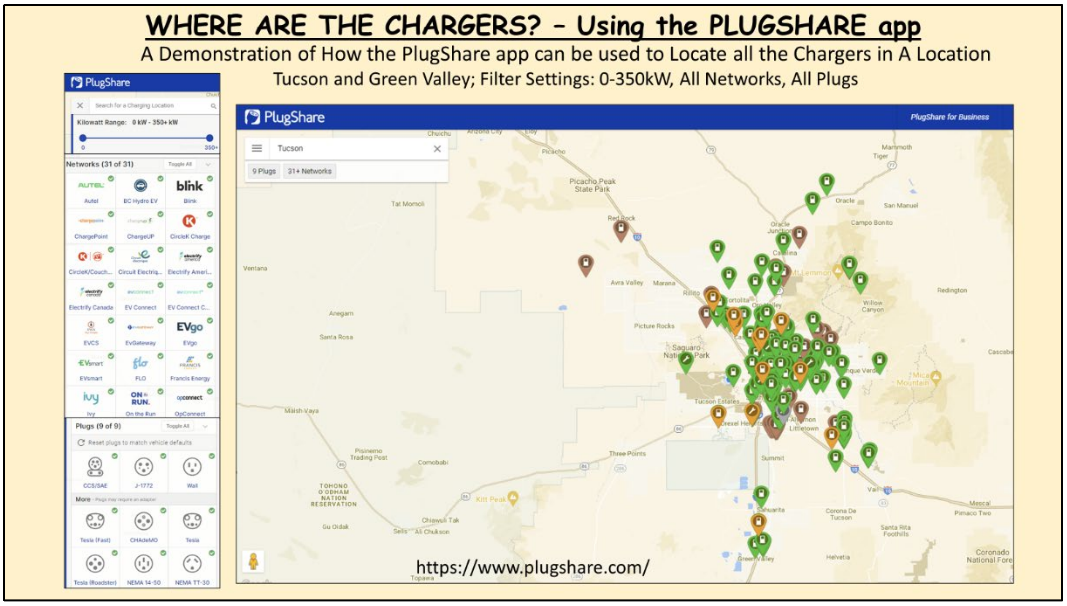
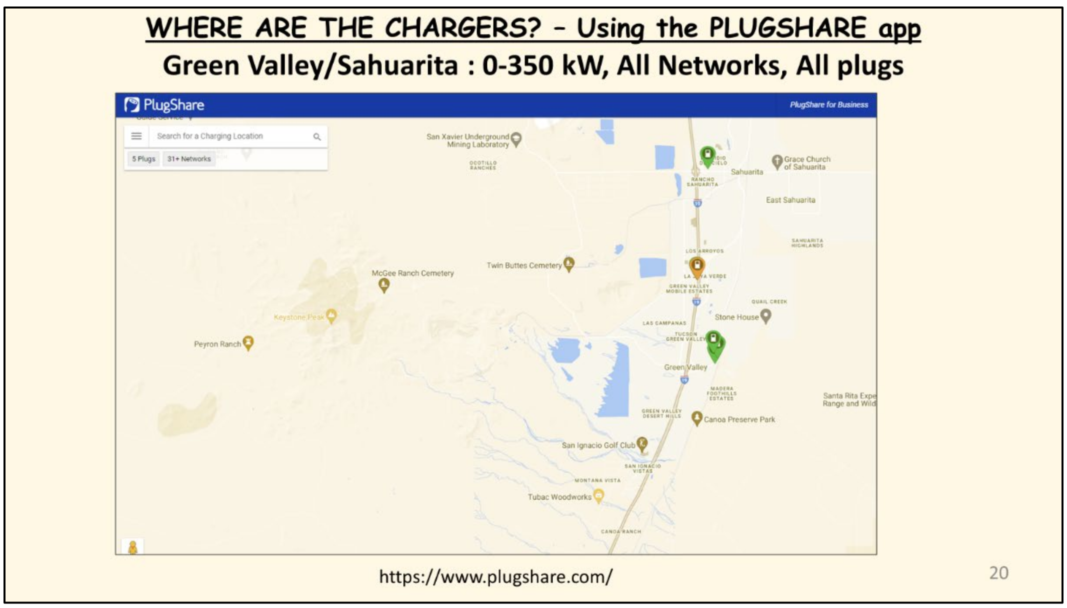
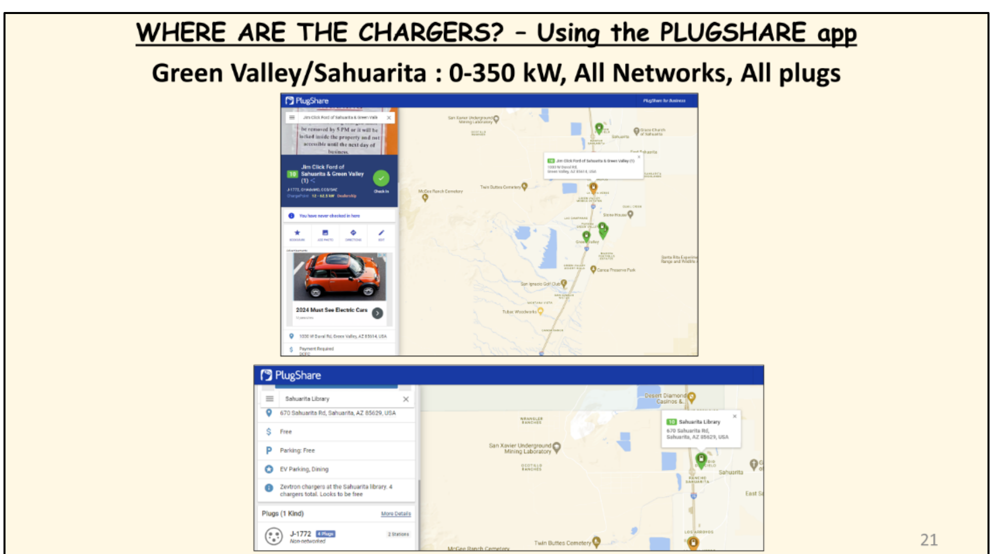
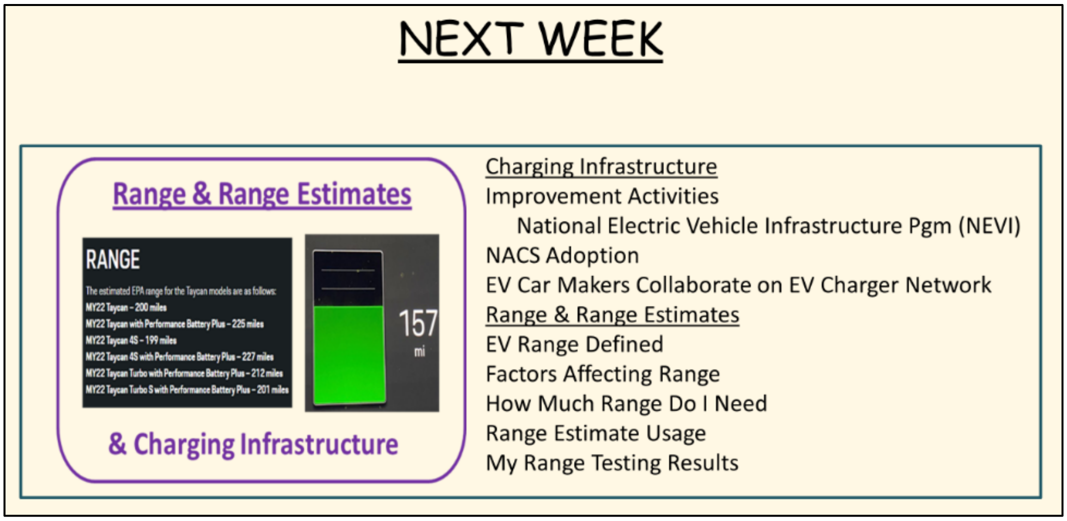
Below are some screen shots of the PlugShare app showing where all the different chargers are at a specific location/area. I also showed examples of PlugShare associated with the Estes Park and Denver area, in response to his question about why his daughter continued to use the Level I charger. Determined that she worked in downtown Estes Park. For space reasons those slides are not shown.









THAT'S ALL FOLKS!

Thanks for listening

Damond