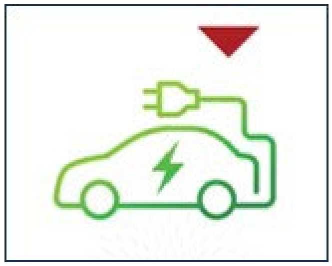


OLLI-UA GREEN VALLEY ELECTRIC VEHICLE BASICS CLASS (GV EVBC)

NEWSLETTER # 3, MARCH 6, 2024 SESSION

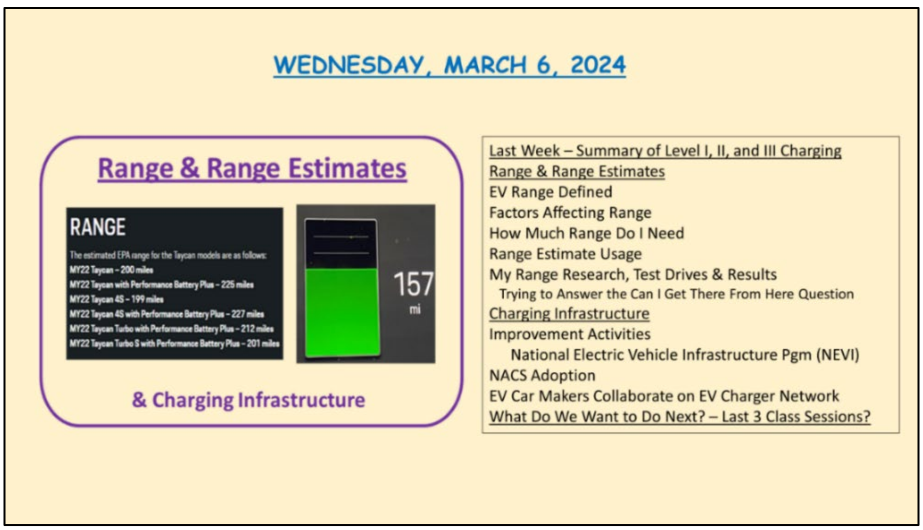
RANGE-RANGE ESTIMATES & CHARGING INFRASTRUCTURE

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

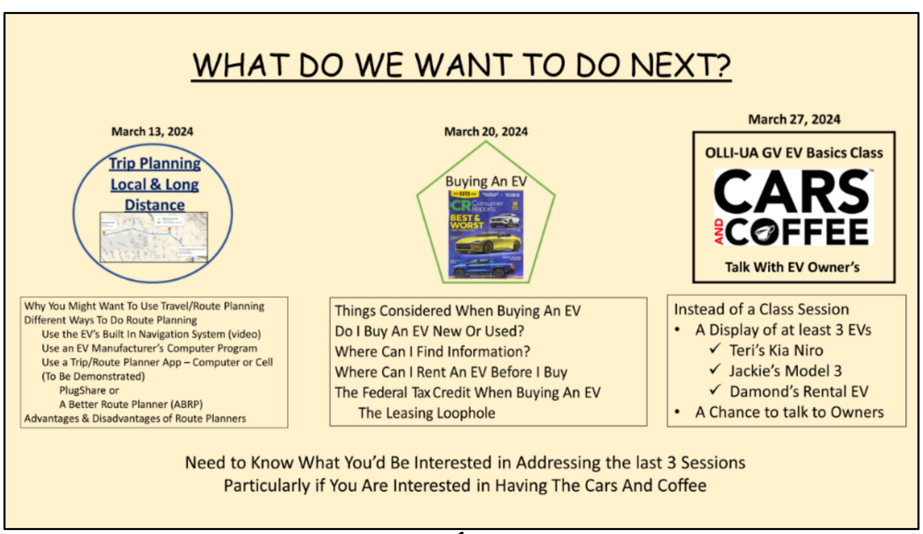
This is the third and last Newsletter for the Green Valley Electric Vehicle Basics Class (EVBC). It reports on what took place at the CPAC Room 203 Wednesday afternoon on March 6, 2024. So here goes.

POWERPOINT SLIDE PRESENTATION AND DISCUSSION

Please note that the slides displayed in the Newsletter are reduced size. Should you find them hard to read when printed out, you can request a pdf copy of the PowerPoint slide file by doing a *Reply to* the transmittal email or directly emailing me at damondlosterhus@verizon.net.



I am going to discuss the results of our conversations as a result of the last slide first.



I asked Bill and Steve (Patrick was absent) if they were at this point planning on buying an EV in the near future, since the last two class sessions involved long distance trip planning, and Buying An EV. (Jackie already has an EV and isn't planning on trading it in in the near future) The answers were no, not in the near future. Steve mentioned that he would not be participating on the 13th of March nor on March 27th anyway. So, the question was what would they each like to talk about during the last sessions they would attend:

Bill said he would be interested in hearing what the next 5 years of EVs would be like. Steve said he was interested knowing what are the recommended parking/storing procedures for an EV when parked in Minnesota for 4 months in the winter.

I agreed to addressing Bill's topic in the March 13th class session, and Steve's subject in the March 20th class session. I also said that there wouldn't be much reason to have the Cars & Coffee on the 27th, so March 20th would be the last class session.

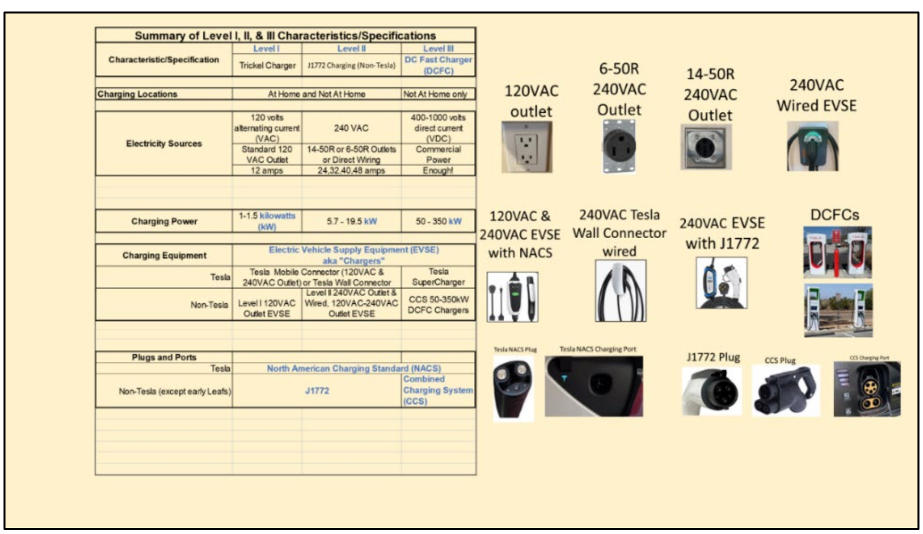
Preliminarily, here's the topics I'll be gathering info on relative to Bill's interest in the next 5 years of EVs:

- EV
  - Sell Prices, and who will be selling them the cheapest.
  - The future of EVs and the Grid and V2X
- Charging and Charging Infrastructure
  - What will happen to CCS-based chargers
  - Where will one be able to charge...on the streets?

Steve, Jackie and I will research the "official" recommendations of Tesla and Other EV makers when it comes to parking an EV for the winter in Minnesota. We will get back with you on March 20th. Hopefully, Bill will find it interesting enough to attend.

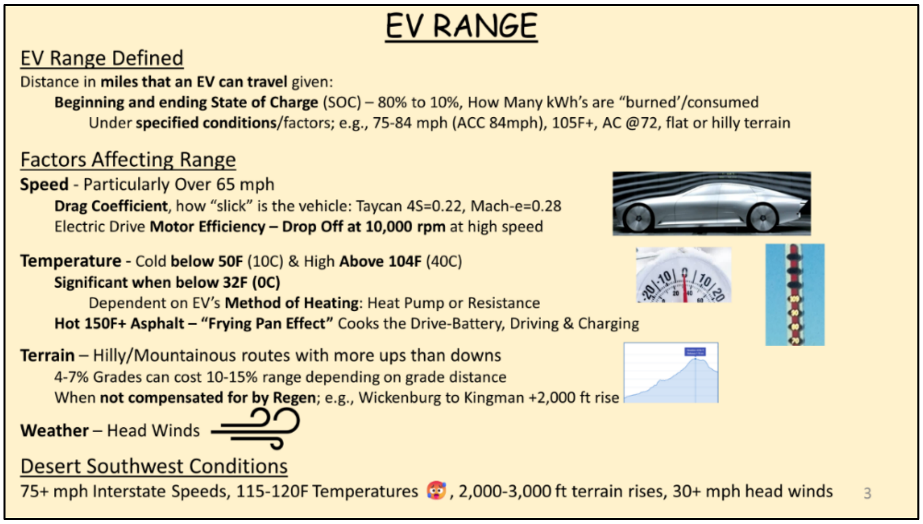
OK. On to the rest of the slides:

The slide below summarizes characteristics of Level I, II, and III Charging. Since it was presented I have also added the DCFCs. The main point I wanted to make is that Tesla uses only ONE plug design for all 3 levels of charging; the NACS plug. A majority of EV manufacturers have now said they will all be going to the NACS SAE J3400 plug and its charging system. In the future you will see NACS plugs and ports becoming the predominant means of Level I, II, and III charging.

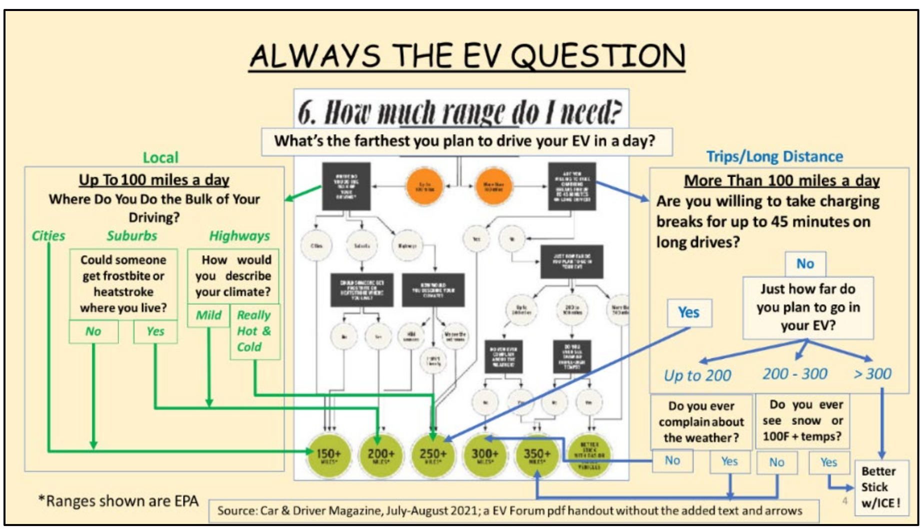


Summary of Level I, II, & III Characteristics/Specifications			
Characteristic/Specification	Level I Trickel Charger	Level II J1772 Charging (Non-Tesla)	Level III DC Fast Charger (DCFC)
Charging Locations	At Home and Not At Home		Not At Home only
Electricity Sources	120 volts alternating current (VAC)	240 VAC	400-1000 volts direct current (VDC)
	Standard 120 VAC Outlet	14-50R or 6-50R Outlets or Direct Wiring	Commercial Power
	12 amps	24,32,40,48 amps	Enough!
Charging Power	1-1.5 kilowatts (kW)	5.7 - 19.5 kW	50 - 350 kW
Charging Equipment	Electric Vehicle Supply Equipment (EVSE) aka "Chargers"		
Tesla	Tesla Mobile Connector (120VAC & 240VAC Outlet) or Tesla Wall Connector		Tesla SuperCharger
Non-Tesla	Level I 120VAC Outlet EVSE	Level II 240VAC Outlet & Wired, 120VAC-240VAC Outlet EVSE	CCS 50-350kW DCFC Chargers
Plugs and Ports			
Tesla	North American Charging Standard (NACS)		
Non-Tesla (except early Leafs)	J1772		Combined Charging System (CCS)

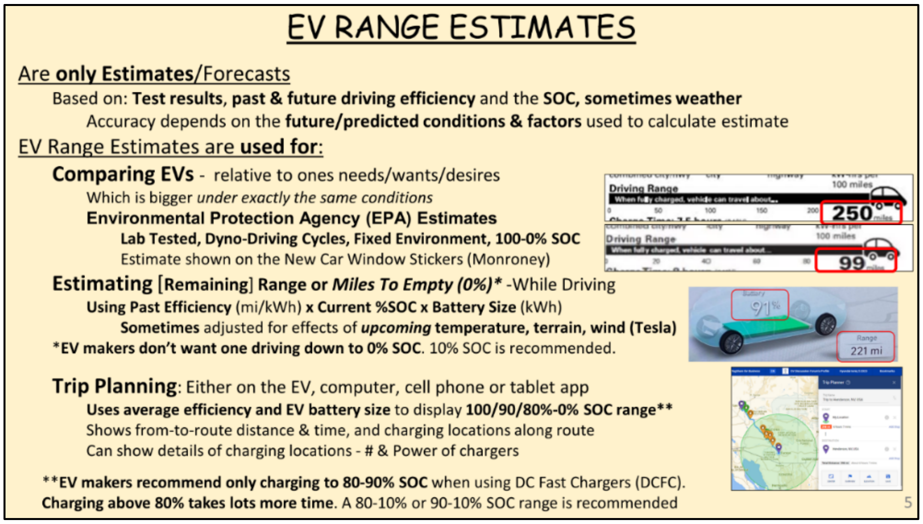
This next slide defines range, and talks to the 4 factors that affect the range of an EV. Specifically, it addresses the Desert Southwest Conditions that affect range. Pretty self-explanatory.



Below is an annotated screen shot of a decision flow chart taken from a July-August Car and Driver magazine. I had to make clear what the flow chart stipulated. Essentially I wanted to show that both the local and trip/long distance queries addresses the weather as a factor in selecting an EV's EPA range: Local – frostbite or heatstroke, mild or really hot & cold; Trips/Long Distance – Complain About the weather, snow or 100F+ temperatures.



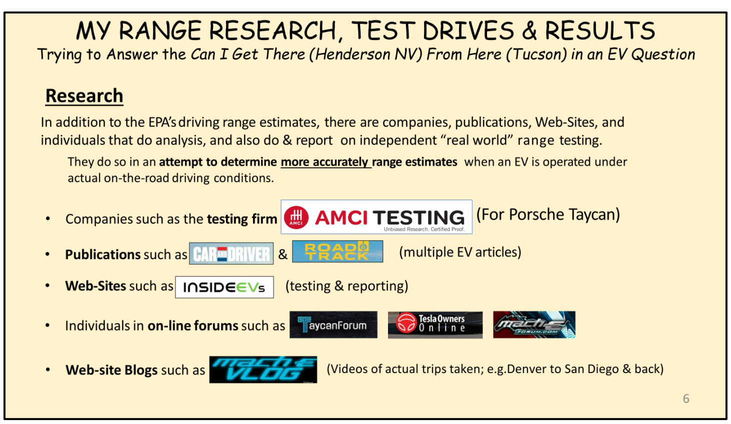
The slide on the next page addresses the subject of EV Range Estimates and the 3 main uses of the estimates. The most important thing to me is that estimates are estimates and like predicting the weather depend on the inputs used in making them. Garbage in/Garbage out. The other thing I need to emphasize is that the EPA estimate is good for comparing the ranges of EVs; a longer range is better than a shorter range. One should never expect the EV they purchase to get that range😳

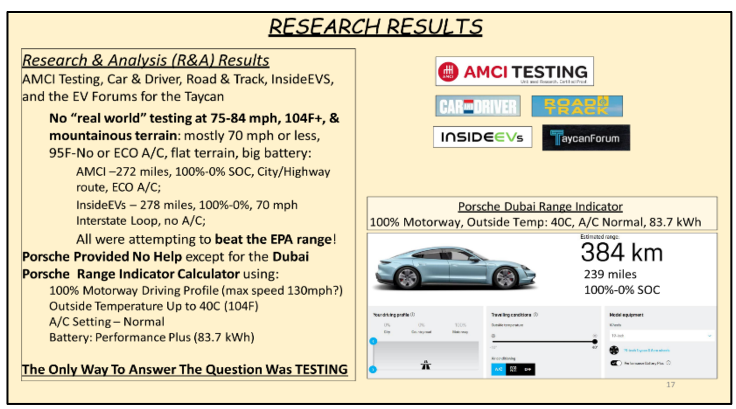


The next 10 slides reflect the results of my research and the specific results of test driving the Porsche Taycan 4S, the Tesla Model 3, the Ford Mustang Mach-3, the Hyundai IONIQ 5, the Cadillac Lyriq, and the Kia EV6. I will not show them all in full size but will discuss the important points shown in the analysis sheets.

These two slides talk to me research efforts. I researched results from a testing firm, car magazines, web-sites, on-line forums, and web-site blogs all in an attempt to determine what happens when an EV is driven at Interstate speeds (75- 84 mph), in very hot weather (over 104F+), and in mountainous terrain. Part of finding the answer to the Can I Get There from Here (CIGTFH) Question.

The result was I could not find the answer via research alone. Most testing was done around 70mph and 70F and no A/C. The only estimator that came close was the Porsche Dubai Range Indicator: 100% Motorway driving, 40C (104F), Normal A/C, 83.7kWh battery, and standard size tires. That resulted in 239mile, 100%-10% SOC [≈167 miles 80%-10%]. Doing my own testing was the only way to see what driving in Desert Southwest Conditions would help answer the CIGTF question.

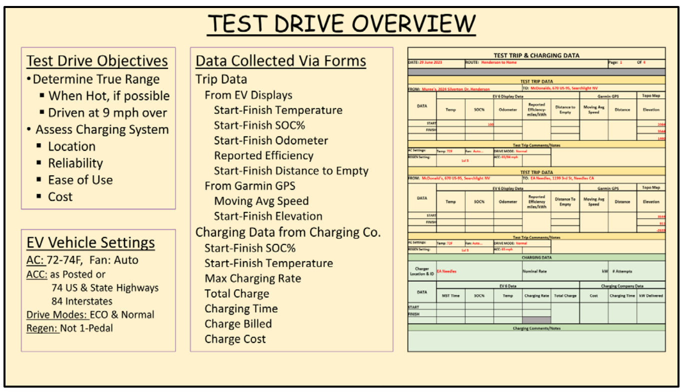


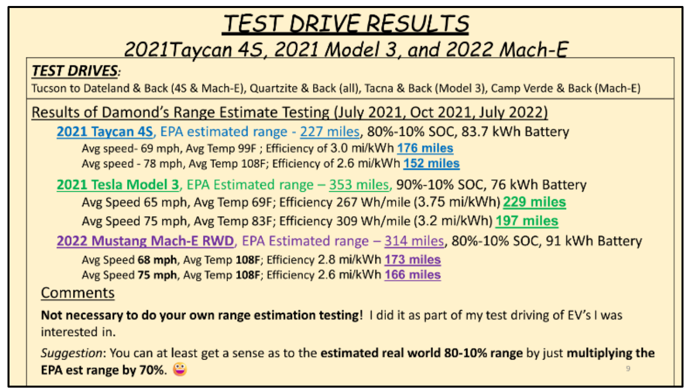


The first of the two slides below show all the data elements collected during each leg of a test drive, and the paper data collection sheet. The data collection sheet shown has two legs driven before collecting charging information. Works when having to make a rest room stop between charging stops.

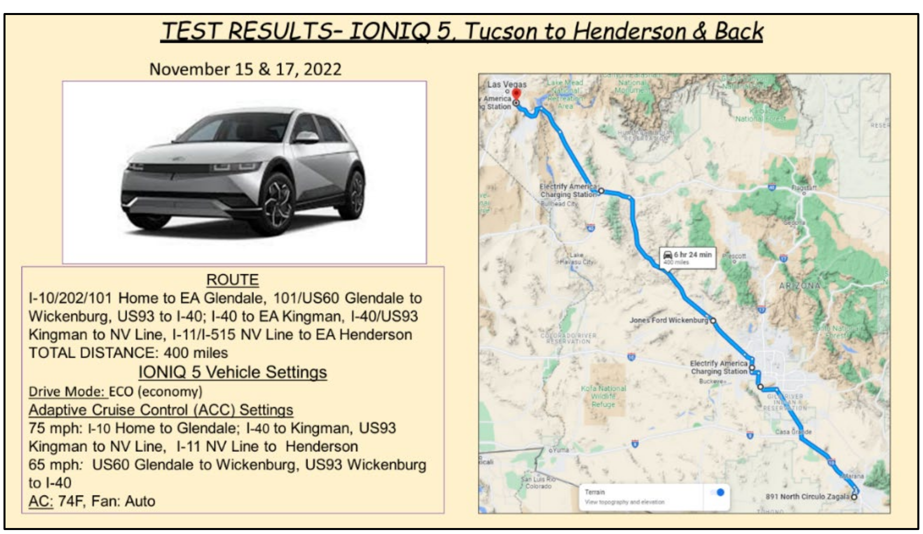
The second slide shows the results of having test driven the Taycan 4S, the Model 3 and the Mach-e on round trip drives to Dateland AZ -235 miles (Taycan & Mach-e), Quartzite-500 miles (all 3), and Tacna-275 miles (Model 3).

At avg speeds of 65-68mph and 75-78mph, and average temps 69-108F. The 80%-10% SOC calculated mileages from the data collected were: Taycan 4S, 176-152 miles, low to high speed; Model 3 229-197miles, low to high speed; and Mach-e 173-166 miles, low to high speed. It is 175 miles from Glendale AZ to Kingman AZ when taking the Tucson-Glendale (via Wickenburg)-Kingman-Henderson route. The Model 3 looks like when driven at an average of even 75 mph could make it to Kingman from Glendale with 20 miles to spare. HOWEVER, the tested routes did NOT include the 2000ft + increase in elevation between Glendale and Kingman. Though, the Model 3 could easily make it, since there are Tesla Superchargers in Wickenburg and it is only 127 miles to Kingman.





The test drive of the IONIQ 5 was the first attempt to drive an EV to Henderson NV and back on the Tucson-Glendale-Wickenburg-Kingman-Henderson route using US93 between Wickenburg and Kingman. The slides below reflect that test drive. In order to reduce the chance for "range anxiety", I charged up to 100% SOC at Glendale, and then tried the only Non-Tesla charger at Jones Ford in Wickenburg and charged up there to 99%. Both 100% charges added 40-50 minutes to the trip over what would have been shorter if charged to only 80%; HOWEVER, as shown on the data results on the slide following the one below, it would have been "close" if I had only charged up to 80% SOC at Glendale, and skipped charging at Wickenburg.



The slides below show the results of driving from Tucson to Henderson with stops at Glendale, Wickenburg, Kingman and Henderson on the way out, and Henderson-Kingman-Glendale-Tucson on the way back.

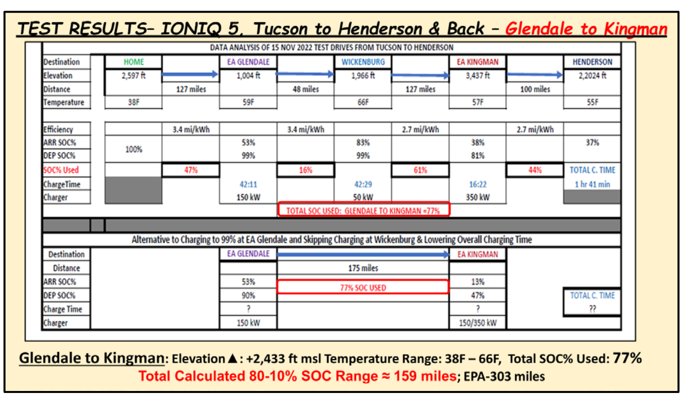
The important thing to see from the first slide is that the drive from Glendale to Kingman took 77% of the SOC and went from 1004ft MSL to 3,437 ft MSL; a rise of 2,433 ft. If I had only charged up to 80% in Glendale and skipped the slow 42min29sec, 83-99% (16%) SOC charging at the Jones Ford, it would have been a anxious 3% SOC remaining when rolling into the Smiths in Kingman. The 80-10% SOC range was calculated to be only 159 miles. It is 175 miles from Glendale to Kingman. 😮

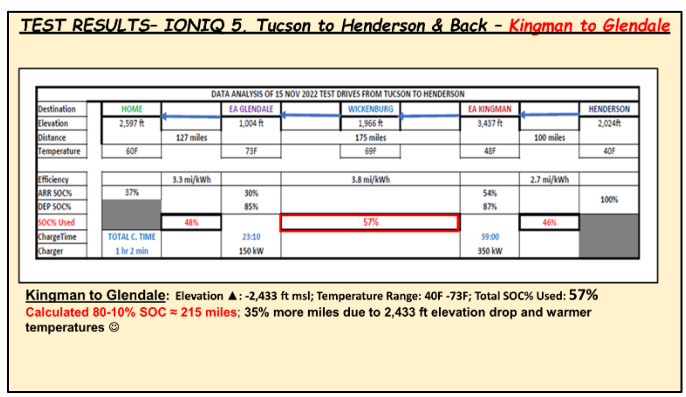
However, as shown in the second slide, it took only 57% SOC to go from Kingman to Glendale. It was a good thing that going downhill saved so much SOC BECAUSE the charging station at Jones Ford was unavailable because non-EVs were parked all around the charger. The charger sits just outside the entrance to the Jones Ford service bays. The 80-10% SOC range was calculated to be 215 miles.

Still, the only way one could drive somewhat anxiety free roundtrip from Tucson to Henderson in the IONIQ 5 is to charge up to 100% SOC in Glendale, and drive the 175 miles to Kingman and get there with ≈20% SOC, or even charge up to 90% SOC and arrive with ≈ 10%SOC. That's with the mode. set at ECO, with the AC at 74F, and adaptive cruise control set at the posted speed limits of 75mph on the Interstates and 65mph on the State Highways. Except for the 100% at Glendale, all other chargings need only to be made at 80% SOC.

The rest of the story is that I will never again be allowed to drive the US93 route in an EV or in any of our ICE vehicles. I had my wife with me, we had to run across US60 in Wickenburg at the Jones Ford, dodging semis and other cars driving at 55 mph, in order to get lunch at the closest restaurant, a Burger King, BUT discovered that there was no cell phone service along US93 30 miles out of Wickenburg until about 40 miles from Kingman (about 50 miles without service along a very desolate roadway). AND there were only 2 emergency telephones along the 127 miles between Wickenburg and Kingman. Each about 50 miles apart. 😮

Later in the presentation I talked about the alternate EV route to Henderson that any EV, Tesla or non-Tesla can make because of the location of chargers.





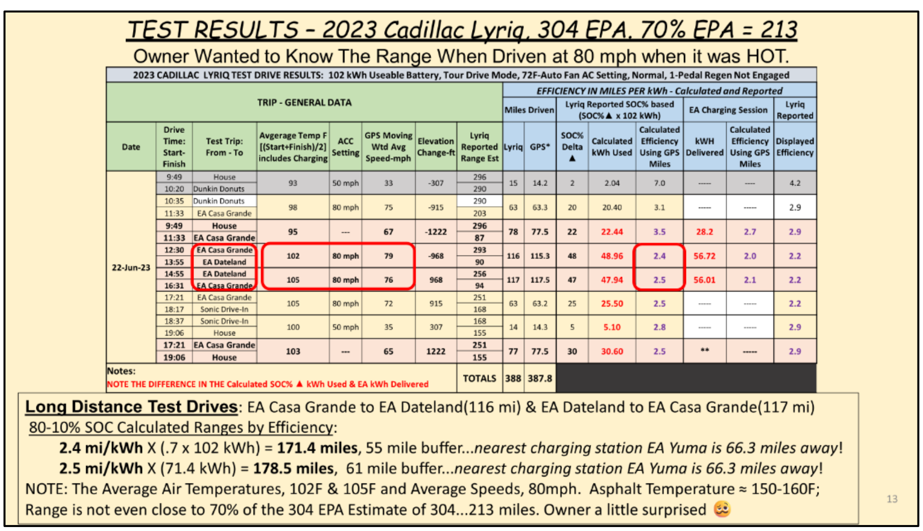
The slide below shows the results of a test drive that a fellow OLLI-UA member wanted me to do in his 2023 Cadillac Lyriq. He wanted to test it at 80mph, along I-8, between Casa Grande and Dateland, a distance of 116 miles each way, when it was hot. I was able to get close to the 80mph speed (avg 79mph & 76mph), but only average 102F and 105F.

Still, the effect of speed and some temperature showed up in the efficiency of 2.4 & 2.5 mi/kWh on I-8 vs as high as 3.5 mi/kWh when driving more slowly and at cooler temperatures.

I measured the asphalt temperature at the Electrify America charging station at Dateland with a FLIR IR gun. It showed that the asphalt in the charging area was as high as 165F. 😵 I figured that driving both I-8 and parking at the charging station I encountered what could be called the “frying pan” effect. This affected the battery temperature while driving along the asphalt highway, and when charging. The HVAC system was pulling electricity to cool the drive batteries.

The 80-10% SOC ranges going and coming, when combined with the distances between available charging locations reflect what is common here in the Desert Southwest. There are, long uninhabited distances between charging locations, and it is critical that there be reliable chargers at such locations as Dateland, and Quartzite. Dateland is 116 miles to a charging station in Casa Grande, and 66 miles to a charging station at Yuma AZ, that’s 182 miles. The Lyriq demonstrated only between 171.4 and 178.5 mile 80-10% SOC range. The current solution given that there are no other charging stations along this route, would be to slow up to 65 mph, and/or charge up to 100% SOC when faced with the possibility of having to drive 182 miles, should Dateland be out of commission. NOTE: Last summer the power to Dateland was out, and because the charging station had no backup generator or batteries, there was no EV charging there. 😲

Hopefully, the slide is somewhat readable when you print the Newsletter out. Again, if you want a pdf copy of the PowerPoint slide file for this class session, just do a Reply to the transmittal email, directly email me at damondlosterhus@verizon.net, and I will gladly send the copy to you.



TEST RESULTS – 2023 Cadillac Lyriq, 304 EPA, 70% EPA = 213

Owner Wanted to Know The Range When Driven at 80 mph when it was HOT.

2023 CADILLAC LYRIQ TEST DRIVE RESULTS: 102 kWh Useable Battery, Tour Drive Mode, 72F-Auto Fan AC Setting, Normal, 1-Pedal Regen Not Engaged

TRIP - GENERAL DATA								*EFFICIENCY IN MILES PER kWh - Calculated and Reported*							
								Miles Driven		Lyriq Reported SOC% based (SOC%▲ x 102 kWh)			EA Charging Session		Lyriq Reported
Date	Drive Time: Start-Finish	Test Trip: From - To	Avgerage Temp F [(Start+Finish)/2] includes Charging	ACC Setting	GPS Moving Wtd Avg Speed-mph	Elevation Change-ft	Lyriq Reported Range Est	Lyriq	GPS*	SOC% Delta ▲	Calculated kWh Used	Calculated Efficiency Using GPS Miles	kWH Delivered	Calculated Efficiency Using GPS Miles	Displayed Efficiency
22-Jun-23	9:49 10:20	House Dunkin Donuts	93	50 mph	33	-307	296 290	15	14.2	2	2.04	7.0	-----	----	4.2
	10:35 11:33	Dunkin Donuts EA Casa Grande	98	80 mph	75	-915	290 203	63	63.3	20	20.40	3.1	-----	-----	2.9
	9:49 11:33	**House EA Casa Grande**	**95**	---	**67**	**-1222**	**296 87**	**78**	**77.5**	**22**	**22.44**	**3.5**	**28.2**	**2.7**	**2.9**
	12:30 13:55	**EA Casa Grande EA Dateland**	**102**	**80 mph**	**79**	**-968**	**293 90**	**116**	**115.3**	**48**	**48.96**	**2.4**	**56.72**	**2.0**	**2.2**
	14:55 16:31	**EA Dateland EA Casa Grande**	**105**	**80 mph**	**76**	**968**	**256 94**	**117**	**117.5**	**47**	**47.94**	**2.5**	**56.01**	**2.1**	**2.2**
	17:21 18:17	EA Casa Grande Sonic Drive-In	105	80 mph	72	915	251 168	63	63.2	25	25.50	2.5	-----	-----	2.2
	18:37 19:06	Sonic Drive-In House	100	50 mph	35	307	168 155	14	14.3	5	5.10	2.8	-----	-----	2.9
	17:21 19:06	**EA Casa Grande House**	**103**	---	**65**	**1222**	**251 155**	**77**	**77.5**	**30**	**30.60**	**2.5**	**	-----	**2.9**
Notes: NOTE THE DIFFERENCE IN THE Calculated SOC% ▲ kWh Used & EA kWh Delivered							TOTALS	388	387.8						

Long Distance Test Drives: EA Casa Grande to EA Dateland(116 mi) & EA Dateland to EA Casa Grande(117 mi)

80-10% SOC Calculated Ranges by Efficiency:

2.4 mi/kWh X (.7 x 102 kWh) = **171.4 miles**, 55 mile buffer...*nearest charging station EA Yuma is 66.3 miles away*!

2.5 mi/kWh X (71.4 kWh) = **178.5 miles**, 61 mile buffer...*nearest charging station EA Yuma is 66.3 miles away*!

NOTE: The Average Air Temperatures, 102F & 105F and Average Speeds, 80mph. Asphalt Temperature ≈ 150-160F; Range is not even close to 70% of the 304 EPA Estimate of 304...213 miles. Owner a little surprised 🥴

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Finally, the last two slides reflect the results of my driving a 2022 EV 6 Wind RWD, not once but twice from Tucson to Henderson and back. The first was done 28 & 30 March 2023, and the second trip was done 28 & 29 June 2023. The last test drive was an attempt to drive the EV 6 in really hot weather with the same car, along the same route to see what the impact of hot weather would have on the efficiency. Unfortunately, I missed the really really hot weather in July 2023

As compared with the IONIQ 5 route, the EV 6 test drives were along routes that permitted charging to 80% SOC. The route was: from Tucson to Buckeye – 141 miles, Buckeye to Quartzite – 99 miles, Quartzite to Needles – 102, and Needles to Henderson – 99 miles; for a total of 441 miles.

TEST RESULTS – 2022 EV 6 RWD

Same Exact Car, Same Exact Route, Same Vehicle Settings: 28 & 30 March; 28 & 29 June 2023

ROUTE

I-10 Home to EA Buckeye & EA Quartzite; AZ95/CA62 EA Quartzite to US95 Vidal Junction; US95 Vidal Junction to I-11 Boulder City; I-11 Boulder City to I-515 EA Henderson TOTAL DISTANCE: 441-444 miles

KIA EV 6 RWD Vehicle Settings

Drive Mode: Normal

AC: 72F, Fan: Auto

Adaptive Cruise Control (ACC) Settings

84 mph: I-10 Home to EA Buckeye & EA Quartzite; US95/I-11/I-515 CA-NV Line to EA Henderson

74 mph: AZ95/CA62 EA Quartzite to Vidal Junction, US95 Vidal Junction to CA-NV line

As shown in the slide below, there isn't a lot of difference in the efficiency or the calculated 80-10% SOC range. In fact, the warmer temperatures in June made for more consistent efficiencies. Drive batteries do like being 85-95F. The average speeds along this route are slower because almost half of it is on slower two-lane 65mph roadways. The benefit is the acceptable distances between charging locations and the resultant shorter charging times to 80% when the chargers can charge at their maximum capacity! Electrify America had turned down most of its chargers to around 50kW along the entire routes on these trips so charging times were not good

TEST RESULTS – 2022 EV 6 WIND RWD

Route Summaries: Temperature, mi/kWh, and 80-10% SOC Calculated Range

MARCH 28 & 30 , and JUNE 28 & 29 2023 TEST DRIVES: 2022 KIA EV 6 WIND RWD with 77.4 kWh Drive Battery, AC-72F, FAN: Auto; DRIVE MODE: Normal											
Route & Trip Data							miles/kWh & Range - Calculated & Reported EV 6 mi/kWh Used Using Reported SOC% & 80-10% SOC (.7) Range EPA 100-0% Range = 310 Miles x .7 = 217 miles				
DATE	Test Trip Route: From - To	Test Trip Data: From - To	Avg Temperature [(Start + Finish)/2] & Temp Range	ACC Setting - mph	GPS Moving Wtd Avg Speed-mph	Elevation Change - ft MSL	Miles Driven	SOC% Used	kWh Used- 77.4 x SOC % Used while driving	Calculated wtd mi/kWh Using GPS Miles	80-10% SOC Range > 54.2 kWh - miles
MARCH 28 & 30, 2023 TEST DRIVE DATA RESULTS: HOME TO HENDERSON NV AND RETURN via Home to Buckeye & Quartzite I-10; Quartzite to Needles AZ95, CA62, US95/I-40; Needles to Henderson NV I40, US95, I-11, I-515											
March 28, 2023	Home To Henderson NV	ROUTE TOTALS	51F - 78F	74 & 84	66.5	2638>1736	442	165	127.7	3.5	190
March 30, 2023	Henderson NV to Home	ROUTE TOTALS	50F-68F	74 & 84	67	1736>2638	444	186	144.0	3.1	167
JUNE 28 & 30, 2023 TEST DRIVE DATA RESULTS: HOME TO HENDERSON NV AND RETURN, via Home to Buckeye & Quartzite I-10, Quartzite to Needles AZ95, CA62, US95/I-40; Needles to Henderson NV I-40, US95, I-11, I-515											
June 28, 2023	Home To Henderson NV	ROUTE TOTALS	95F-106F	74 & 84	63	2638>1736	441	172	133.1	3.3	180
June 29, 2023	Henderson NV to Home	ROUTE TOTALS	90F-106F	74 & 84	68	1736>2638	441	173	133.9	3.3	179

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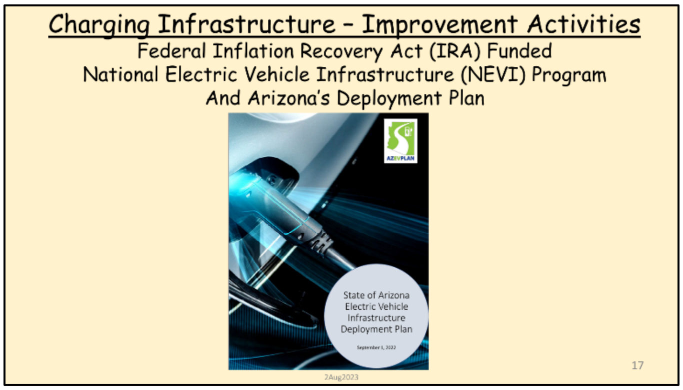
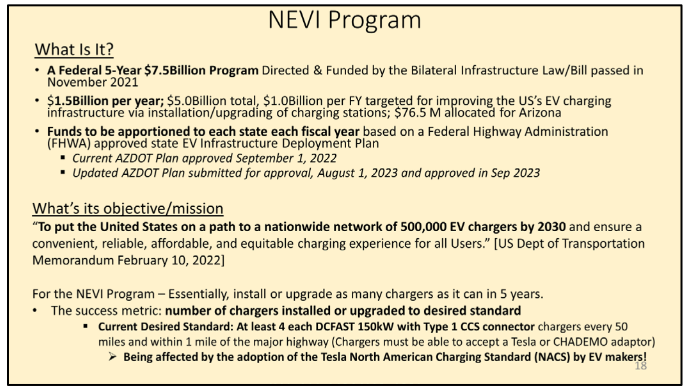
The remaining slides presented in this class session deal with the Charging Infrastructure improvement activities currently taking place.

The first is the Federal National Electric Vehicle Improvement (NEVI) Program, and Arizona's Dept of Transportation (AZDOT) involvement.

The following slides deal with what the NEVI Program is and its status. Basically, it is a Federally funded program that focuses on the installation of DCFCs along Federal Highway Administration designated Alternate Fuel Corridors (AFC). Initially the AFCs only were Interstate Highways. Each state is to be given funding for installation and maintenance of DCFCs based on an approved plan. Originally the locations were to have as a minimum of 4 ea DCFCs of 150 kW power and CCS connectors.

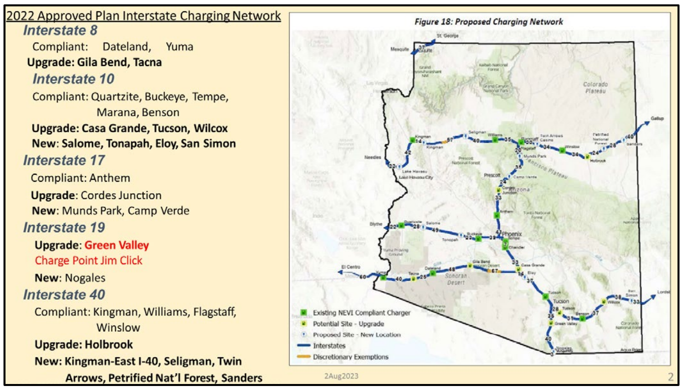


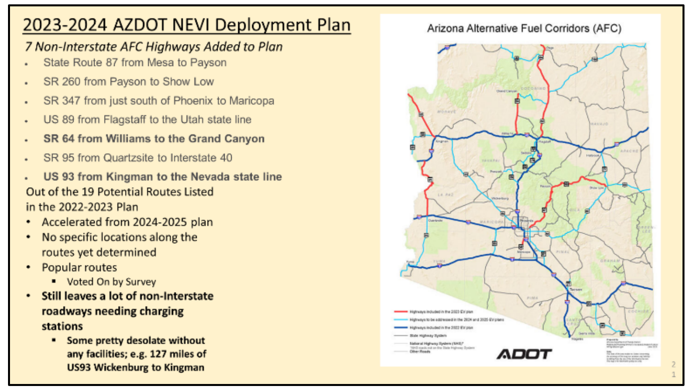


The slide below reflects the current status of Arizona's NEVI Deployment Plan Status and it's planned contracting. As shown, 33 states have already released RFPs, 16 have already made awards and 4 have already opened NEVI-funded charging stations. Arizona isn't the slowest, but its not the fastest.

The left-hand slide below depicted the original 2022 AZDOT NEVI Deployment Plan charging station location siting that is being solicited right now. It shows both upgrade and new DCFC charging station locations along I-8, I-10, I-17, I-19, and I-40. The RFP currently addresses 21 areas for the opportunity to submit bids for the installation and maintenance of NEVI funded DCFC location. NOTE: Green Valley, specifically mentions the Charge Point chargers at Jim Click as an area identified as a site that needs Upgrading.

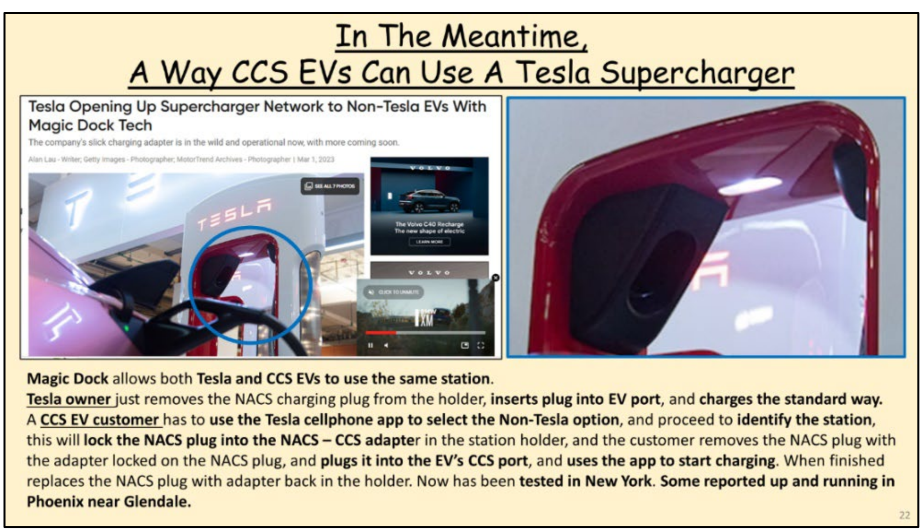
The right-hand slide shows that the 2023-2024 approved AZDOT NEVI Deployment Plan now includes 7 non-Interstate/US & State highway routes that are included as opportunities for DCFC station installation. This was a result of Arizona nominating to the Federal Highway Administration (FWHA) these routes as Alternate Fuels Corridors (AFC). They were approved as AFCs, and so now can be candidates for the NEVI program funding. Some of the most important ones are SR64 from Williams to the Grand Canyon, and US93 from Kingman to NV state line (Hoover Dam). Both are needing Charging stations along popularly travelled routes.



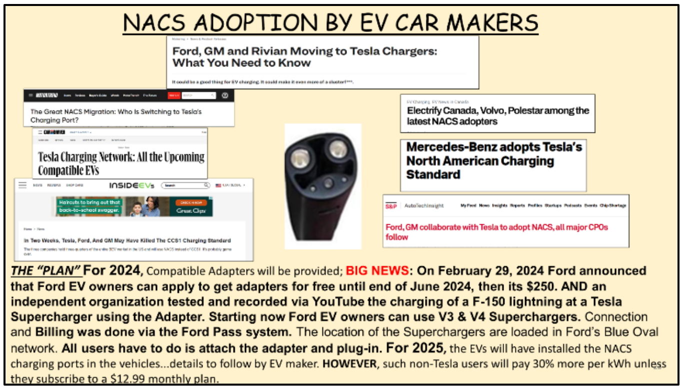


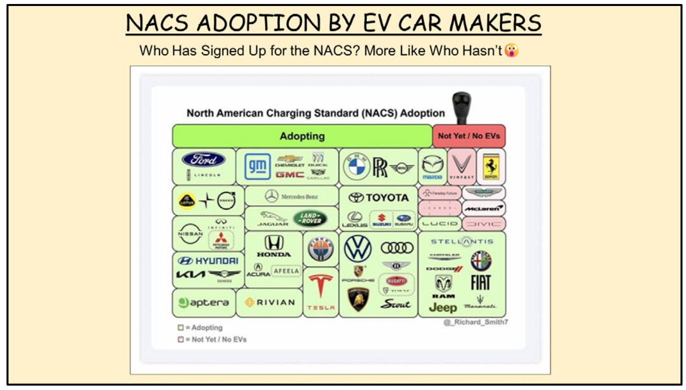
Ok. In the interim there are several things happening that will ultimately open up the Tesla Supercharging network to non-Tesla EVs. This is an addition of over 15,000 Tesla Superchargers that can be used by non-Tesla EVs.

The Tesla Supercharger Magic Docks are the first of the Tesla Superchargers being made available for use by non-Tesla EVs. The slide below shows what it looks like and how it works.

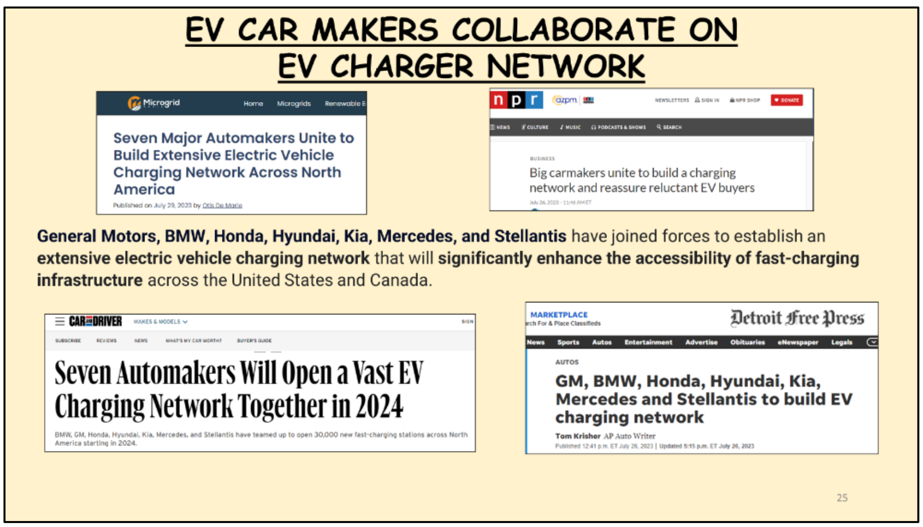


The next and the most powerful activity to improve the overall charging infrastructure for non-Tesla EVs is the adoption of the NACS charging system, and as a result 15,000 Tesla Superchargers, by almost all EV makers. Below the two slides reflect what is happening. What is **exciting** is the announcement that Ford EVs can now charge at Tesla Superchargers by using a Tesla designed and manufactured adapter.





Finally, the other activity that is currently underway is the EV makers themselves are getting together to install charging stations. They have discovered that in order to sell EVs they need to do what Tesla did 10 years ago, build charging stations. They initially sat back and thought that the others would build the stations as long as they built the EVs. Well, the if they build the EVs the stations will come was wrong. Here's just a taste of what the EV makers are planning on doing. Already, GM-FlyingJ/Pilot Travel Centers-EVgo are installing chargers at existing Flying J & Pilot Travel Centers.



Thanks for listening

Damond