Looking Into Electric Cars

Session 4 : Range (and its anxiety)

There’s a reason lots of people call it the . . .

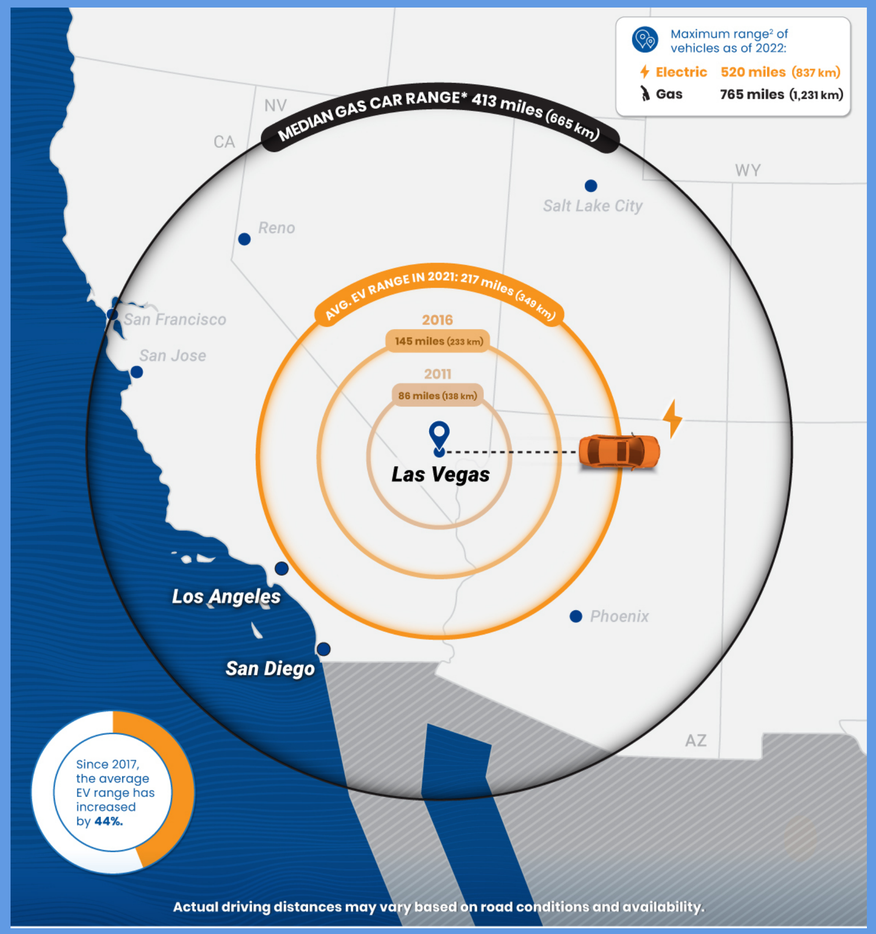
The Guess-o-Meter

Past performance does not guarantee future results

Anxiety can make you do strange things

Range anxiety = not knowing how far you can actually drive. And is that enough to drive to the next adequate charger.

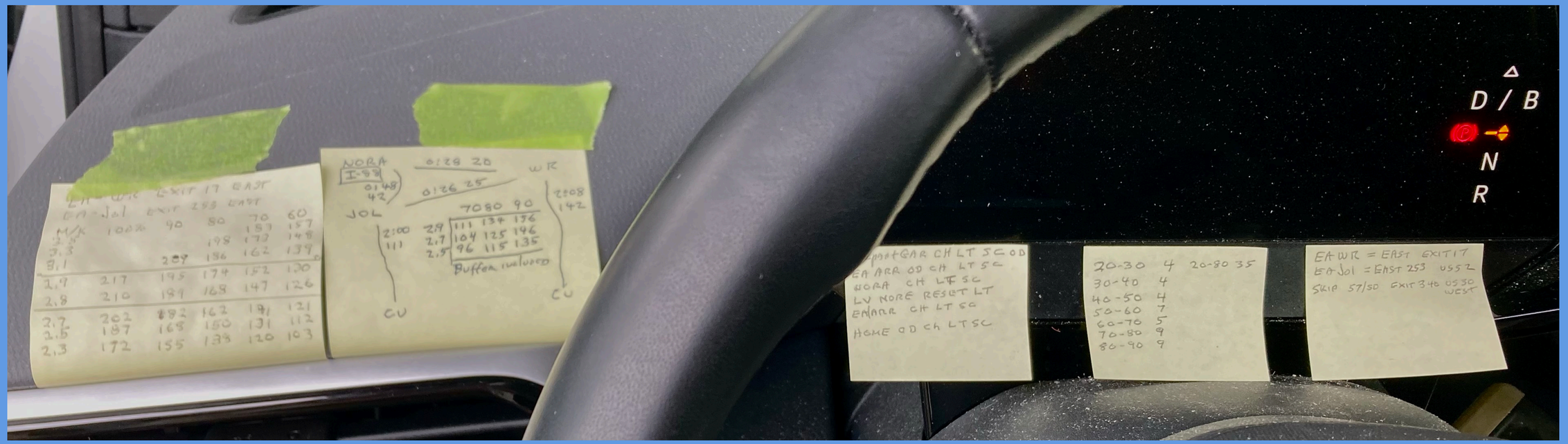
Session 4 : Range



Possibly some anxiety is the result of how recently EVs with the longest range still didn't go that far. And still recently, there are a lot of horror stories out there. Some from people who just bought a car and took off down the road. Some from automotive press writers with a short time with a vehicle and little real life EV experience.

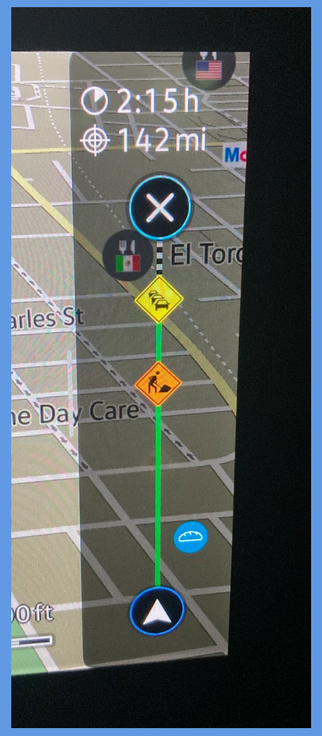
Session 4 : Range

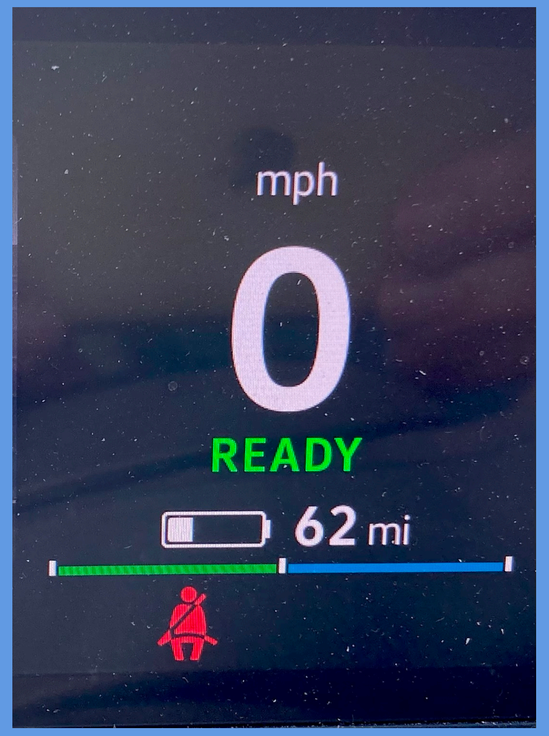
Past Performance vs Future Results

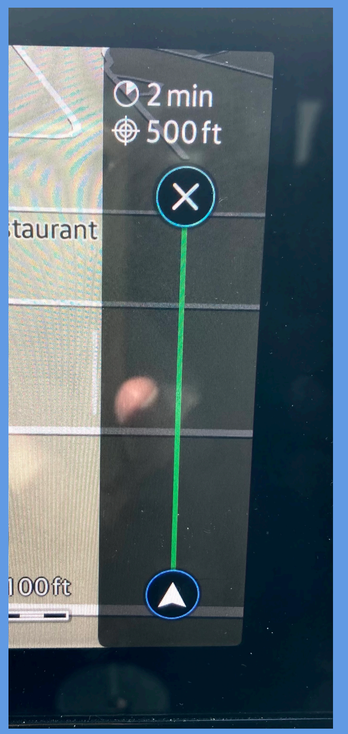


If you didn’t already know I’m a wonky nerdy geek, you will soon. Previous sessions have been about driving electric. This one is a little Science and Math. Range for distance is mostly about turbulence.

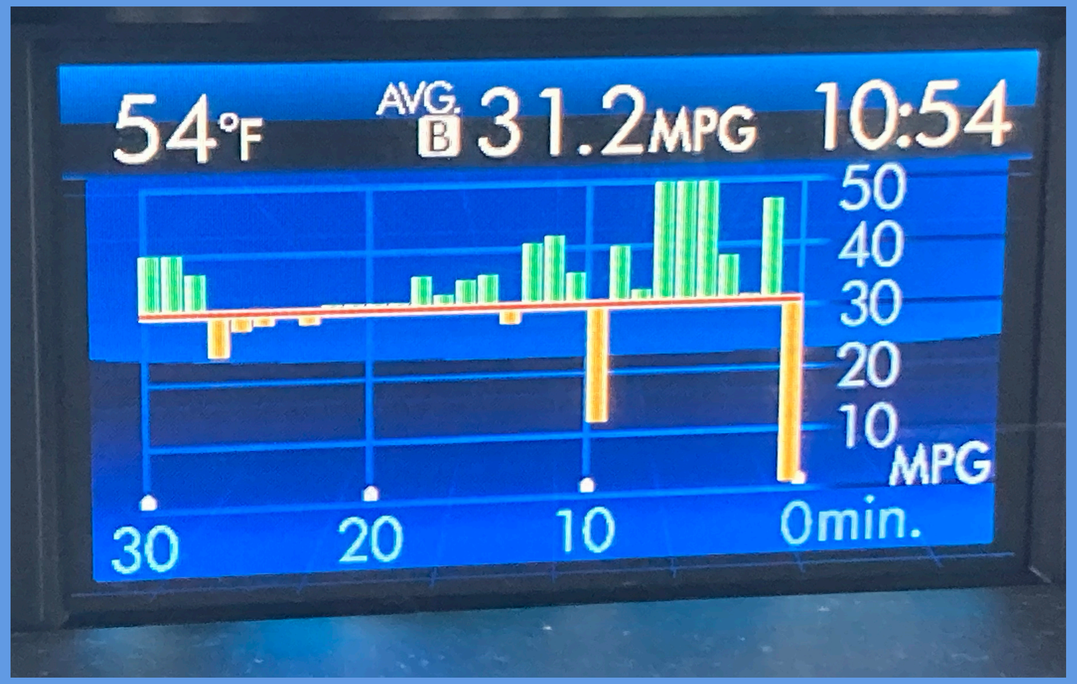
A recent trip to Chicago







267 miles of range at start of trip. After driving 142 miles, the range is said to be 62 miles. If original was correct, the end of trip range should be 125 miles. “Range” was off by 65 miles.

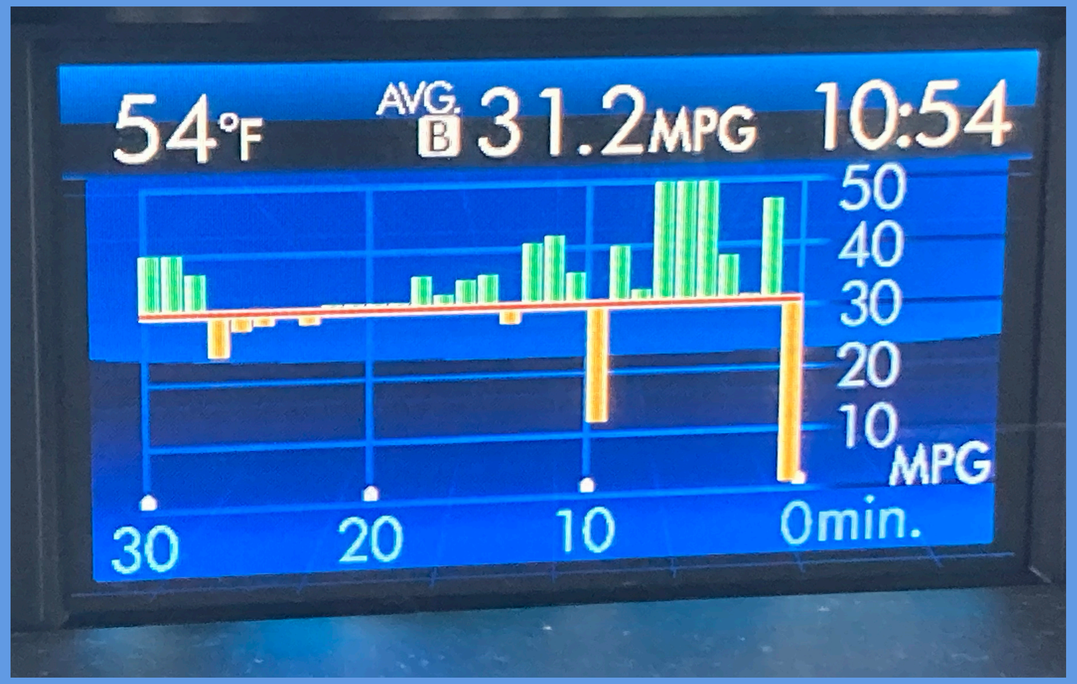


Tesla has a similar screen in the Model 3, but my VW doesn't.

Since efficiency can change at any time, it might be more surprising if the range estimate was accurate.

This usage is from a gas Subaru hybrid. Efficiency of both gas and electric varies with wind, speed, temperature and load. Its just more obvious with electric.

Past Performance vs Future Results



31.9	30.6	31.6
25.9	28.2	31.2
32.9	27.7	32.9
33.6	18.1	30.1
34.3	25.8	30.4
30.0	23.6	32.1
31.7	30.6	30.8

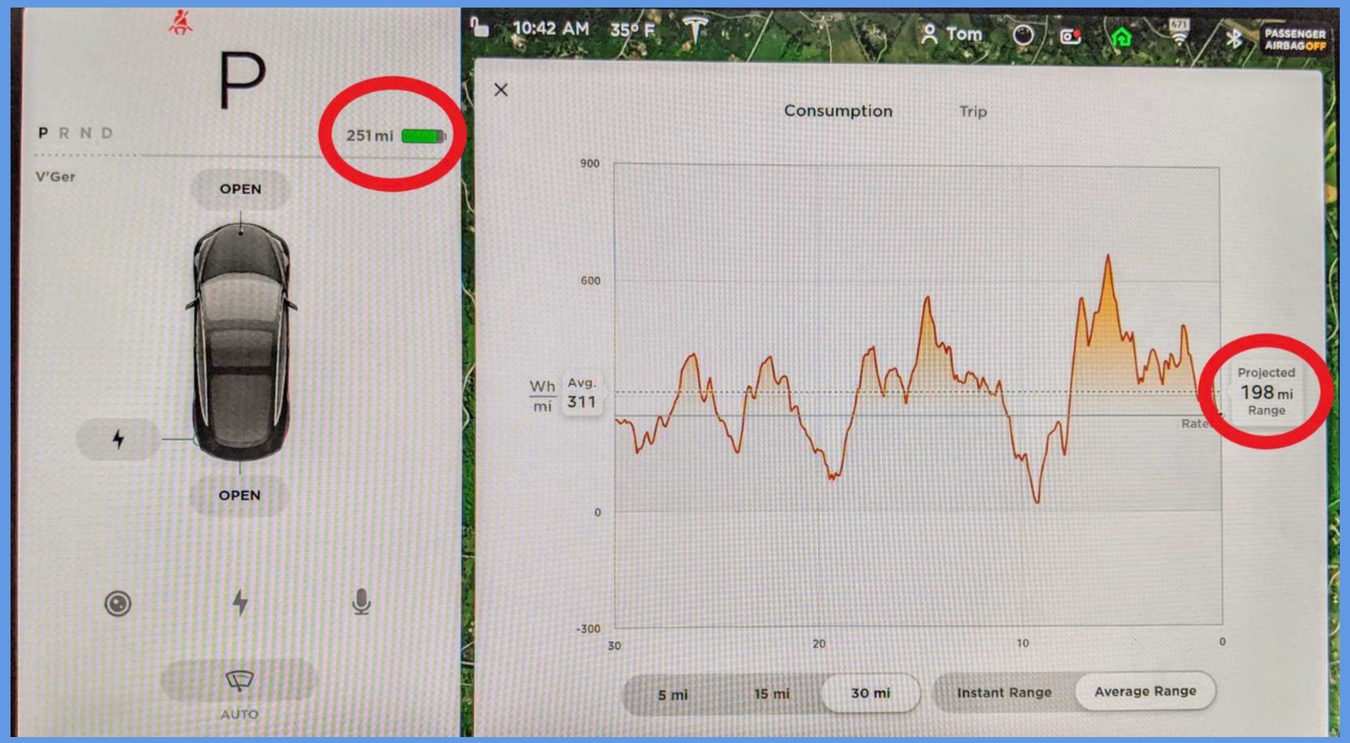
Efficiency can change at any time and throughout the year.

This a 30 minute graph of a Subaru hybrid as the MPG varies. On the right, a list of average MPG with each tank of gas in the last year that I owned the car.

Yes the 18.1 mpg was for late January.

Session 4 : Range

Past Performance vs Future Results



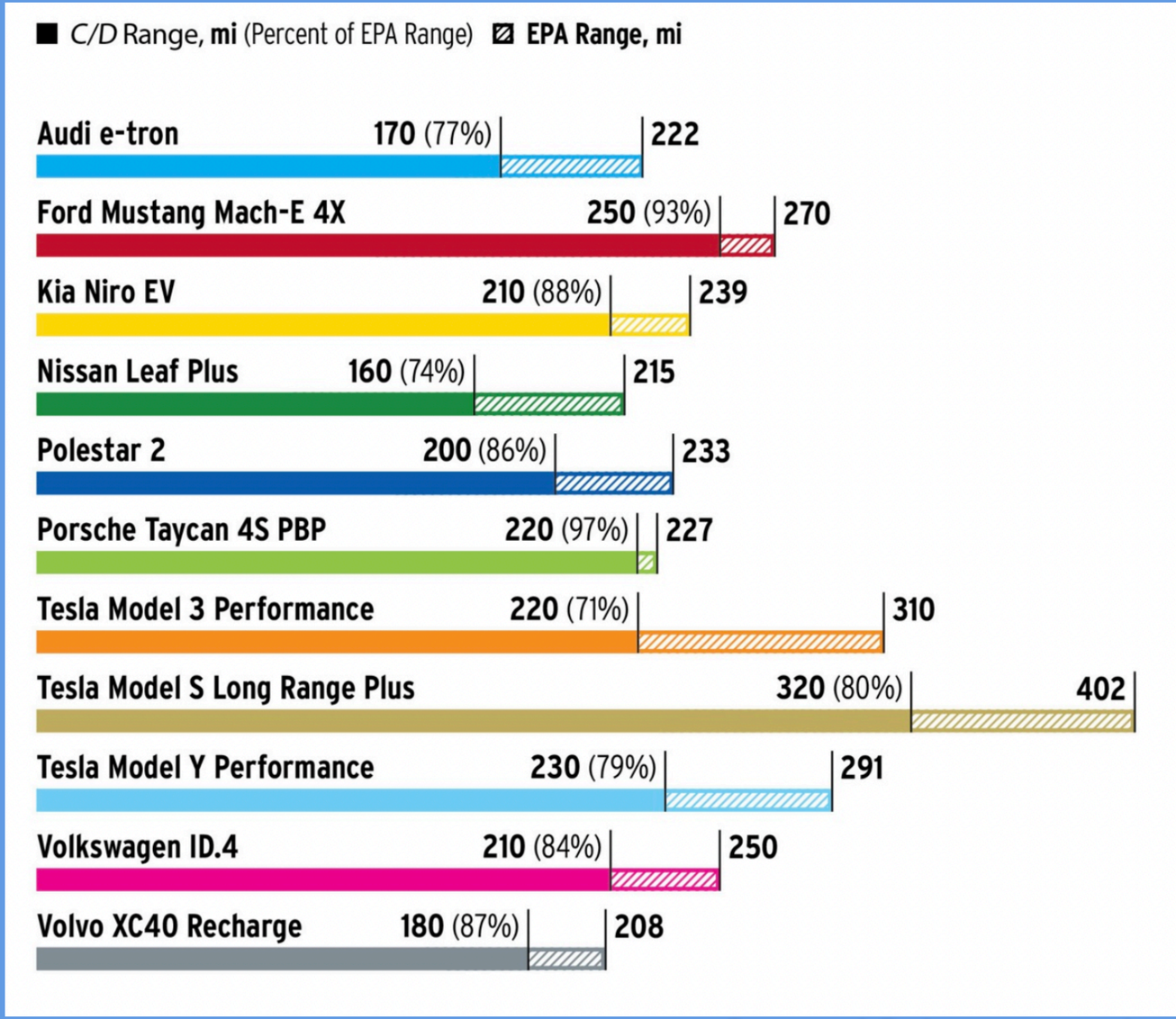
Tesla screen in the Model 3, The graph is useful but still has a discrepancy between the two range predictions.

Efficiency can change at any time and throughout the year.

Since I don't own a Tesla model 3 to play with, I have basic idea of what this represents but I am not sure. In my VW I get miles/kWh and this is WH per mile. One is the inversion of the other. You adapt to the one you get.

Session 4 : Range

Past Performance vs Future Results

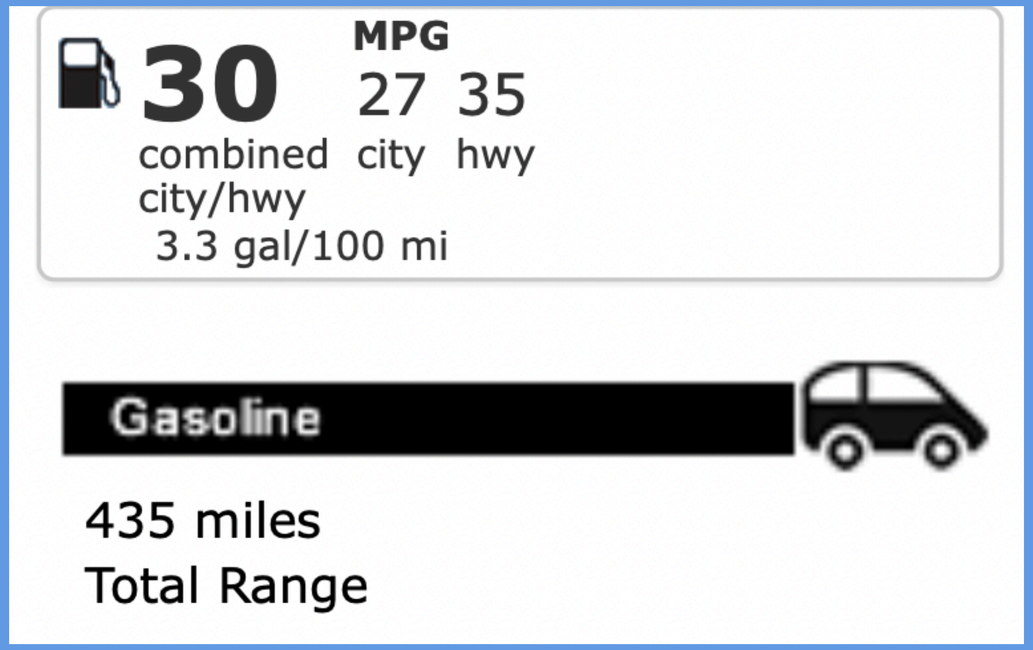


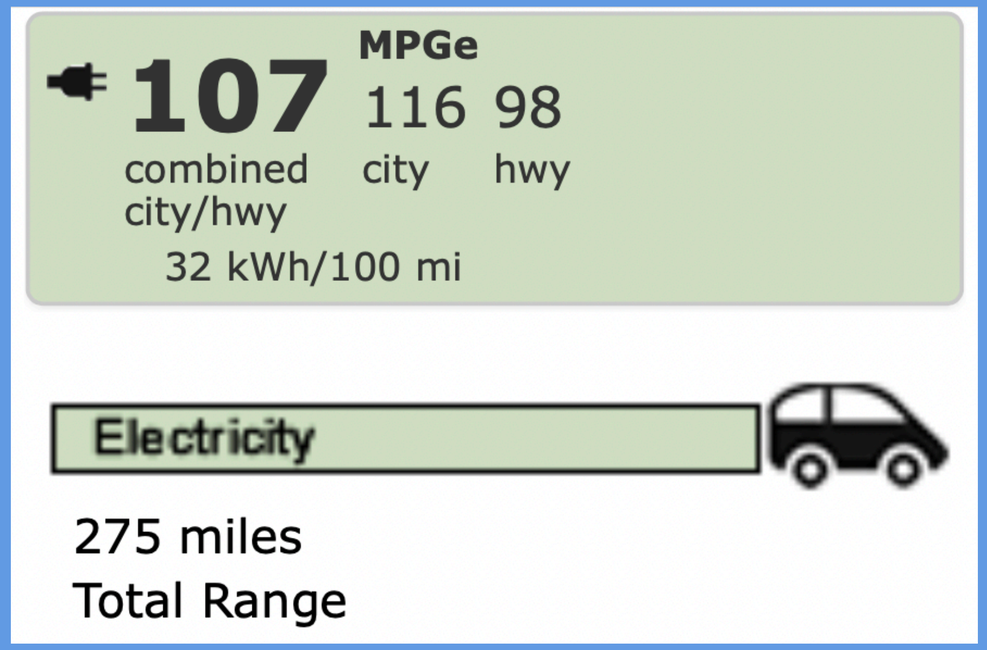
Car and Driver magazine

The variations with wind, speed, temperature and load results in disagreements . Different organizations arrive at different mile numbers for that range. And this disagreement is for range tests done at similar conditions.

Session 4 : Range

Past Performance vs Future Results

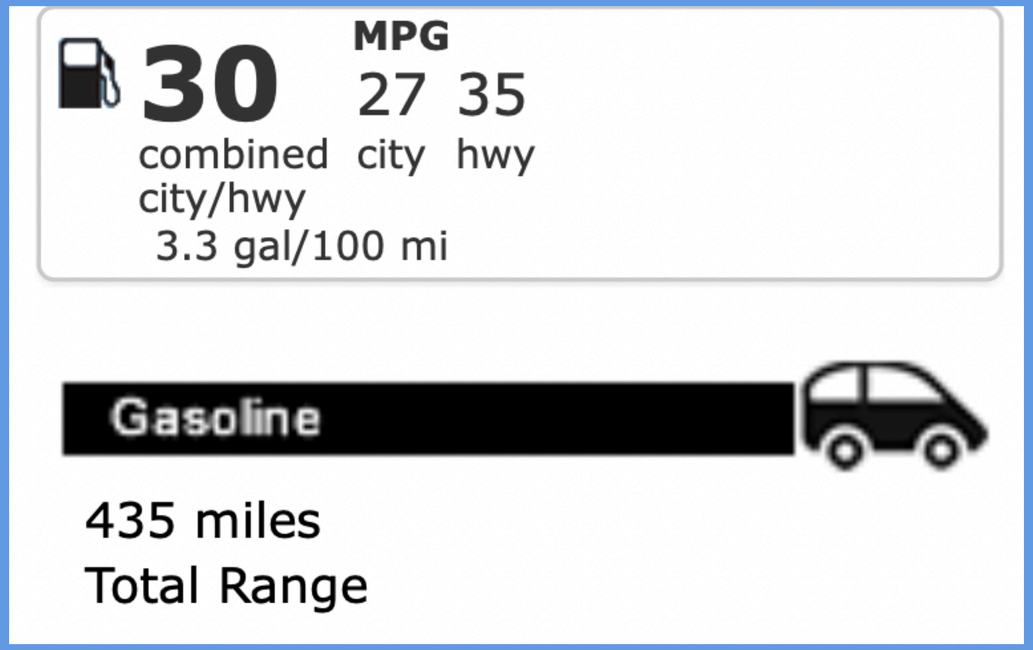


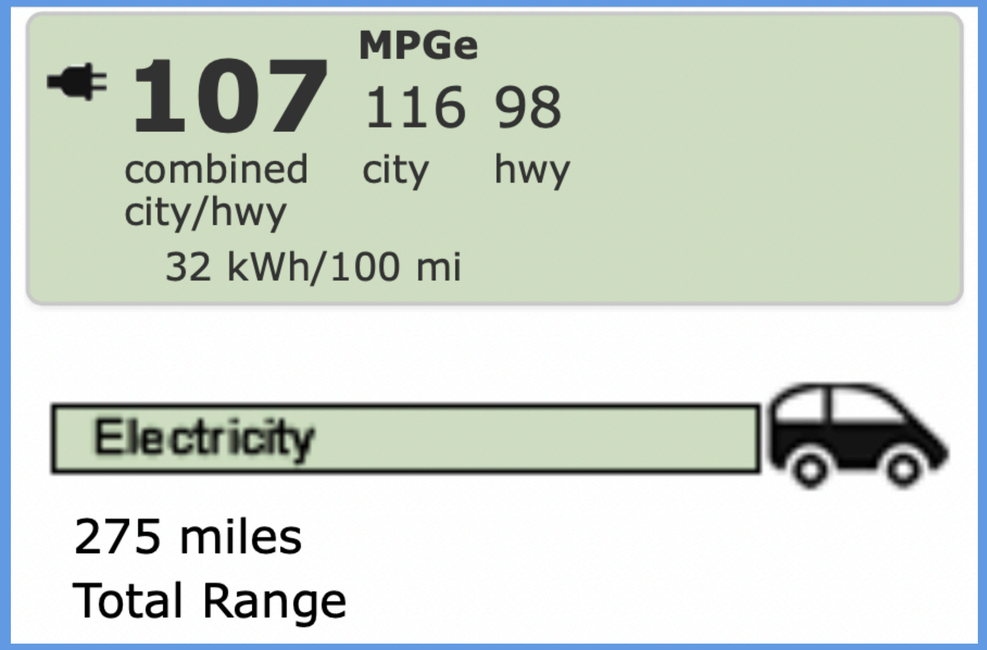


Epa numbers

At 27 - 30 - 35 a gas Vehicle is more efficient on the highway

At 116 - 107 - 98 an EV Vehicle is more efficient in the city





Epa numbers

This is one of opposite characteristics of gas vs EV cars. One more efficient on the Highway the other more efficient in town. But buyers of both are mostly interested in the highway numbers.

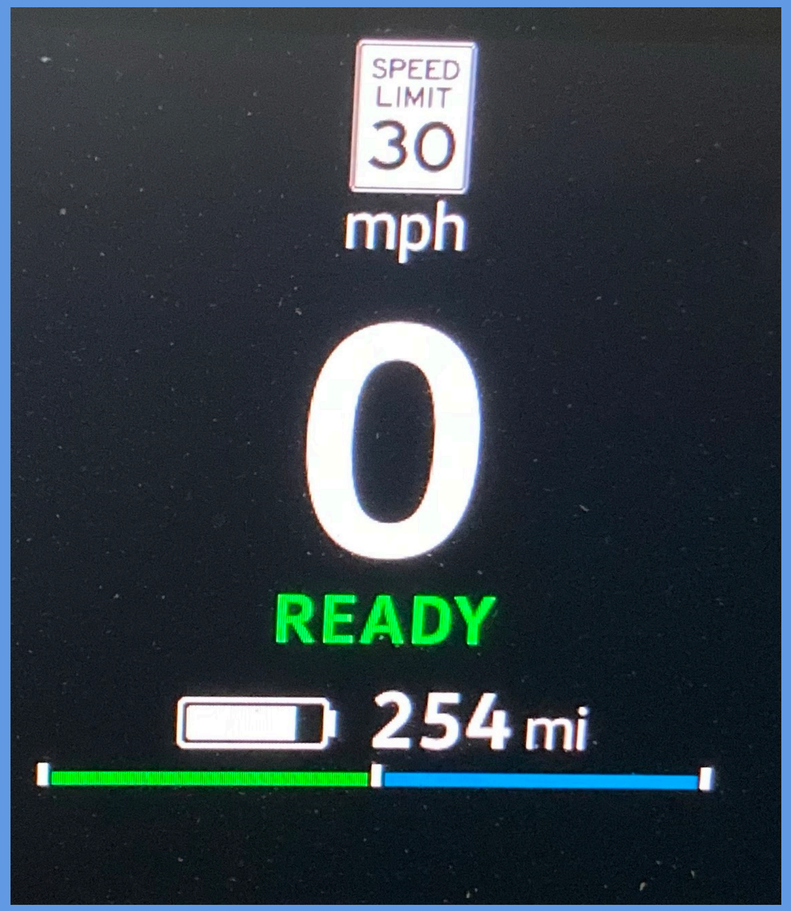
It is the variation of the highway efficiency that causes range anxiety. Combined with the limited charging available on the road.

Since we don't worry about range in the city, we need to examine variation of range on the highway.
And November 5th was a good day to look at it.

November 5th was a 60 degree day, wind of 30 miles out of the south and not a good day for passing at the Illinois vs Michigan State game.

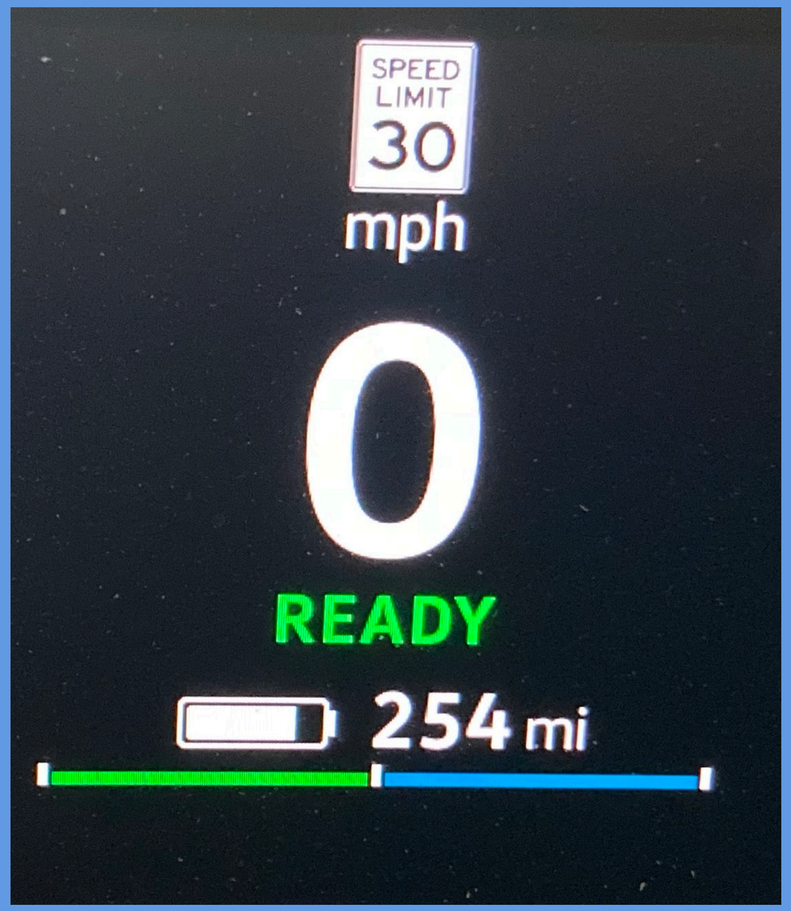
I took the VW out to play in the wind.

The starting point

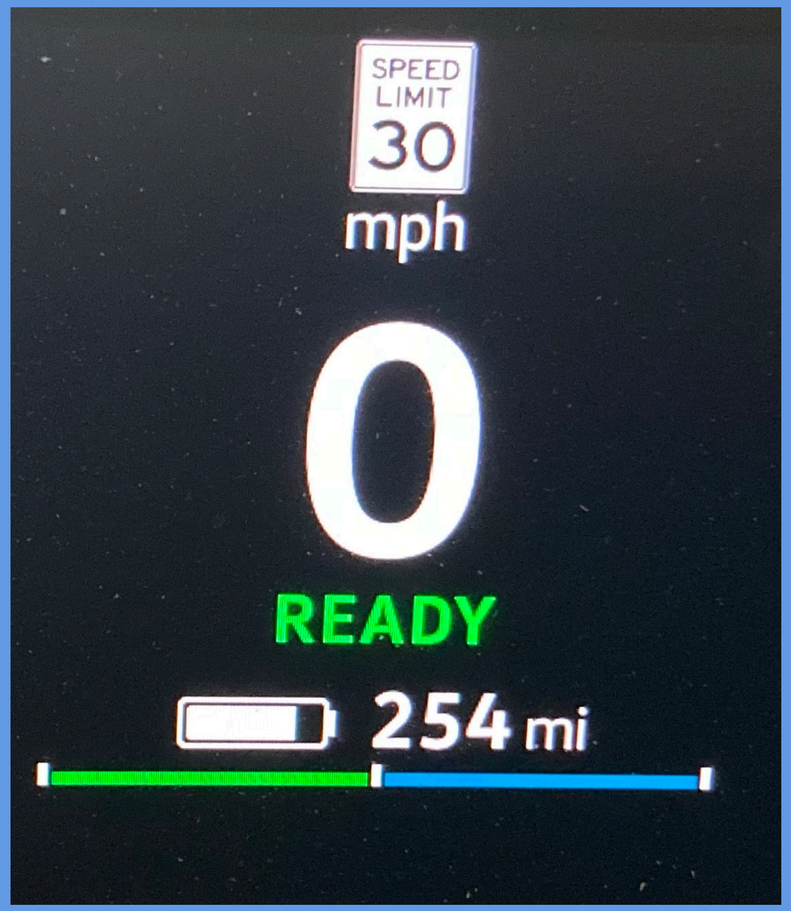


Using the almost universal estimate of 3mile/kWh the range of my VW should be about 230 miles. Yet the range of 254 with 80% charge computes to 320 miles.

The starting point

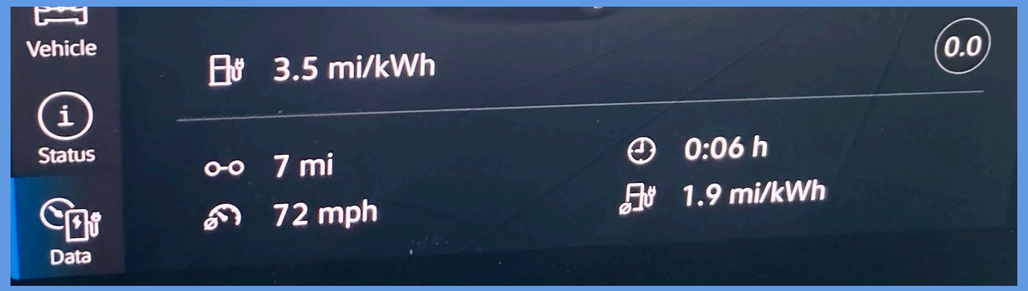


Again : the range of my VW should be about 230 miles. Yet the data screen of a 17 mile drive on I57 at 72 mph said I was getting 4.0 miles/kWh. Which was actually true. That would make the total range of the car 308 miles.



This 72mph was with the tailwind. It would have been a completely different trip returning on the same day.

Session 4 : Range



And against the wind – same direction but different speeds.

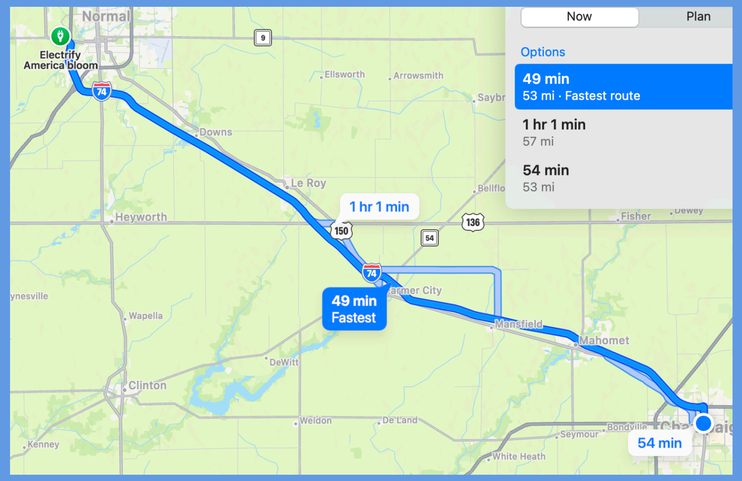
62 mph	2.3 m/kWh	177 miles
65 mph	2.2 m/kWh	170 miles
68 mph	2.1 m/kWh	162 miles
72 mph	1.9 m/kWh	146 miles

Compared to a standard range of 230 miles .

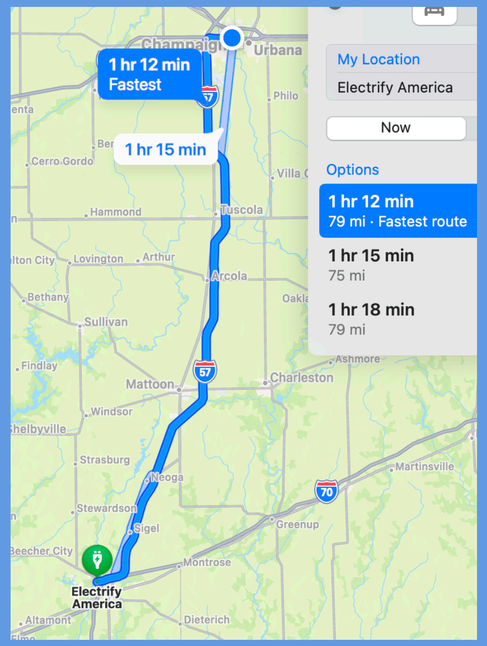
Worth noting: gas cars also have this extreme variation in efficiency.

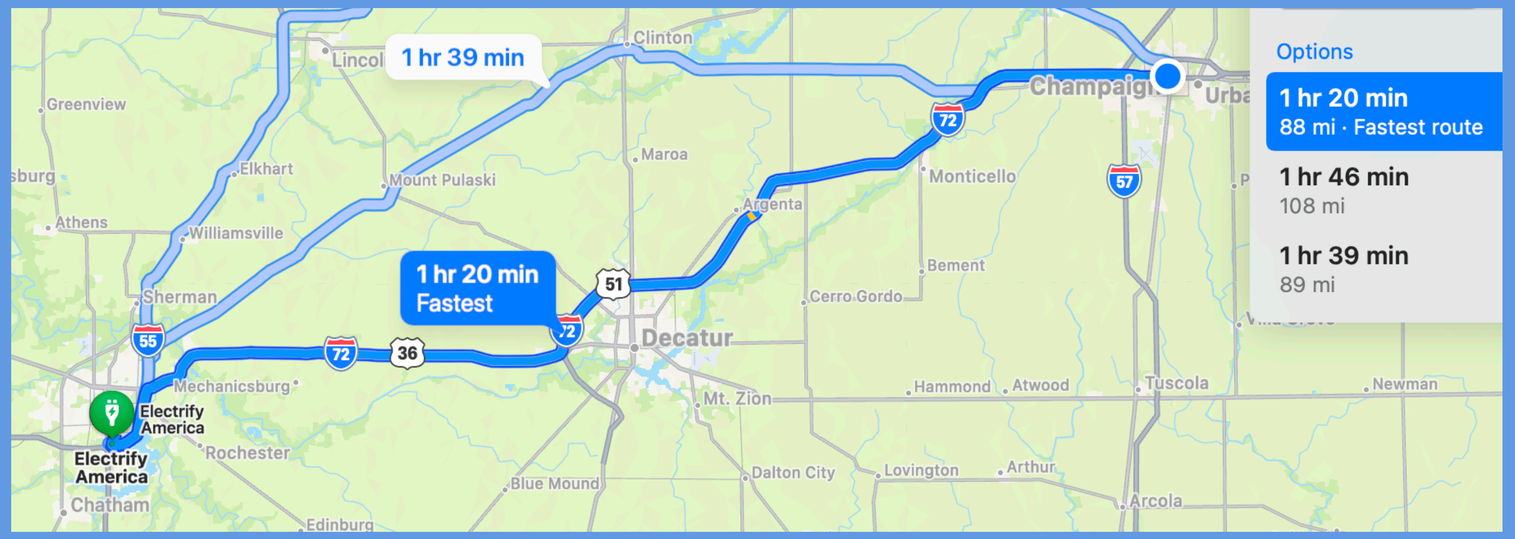
We will leave these THEORETICAL numbers for a moment and apply it to a REAL world map. After seeing how it works IRL (net speak for “in real life”). I’ll show you some other numbers that won’t look as bad when practically applied.

Session 4 : Range



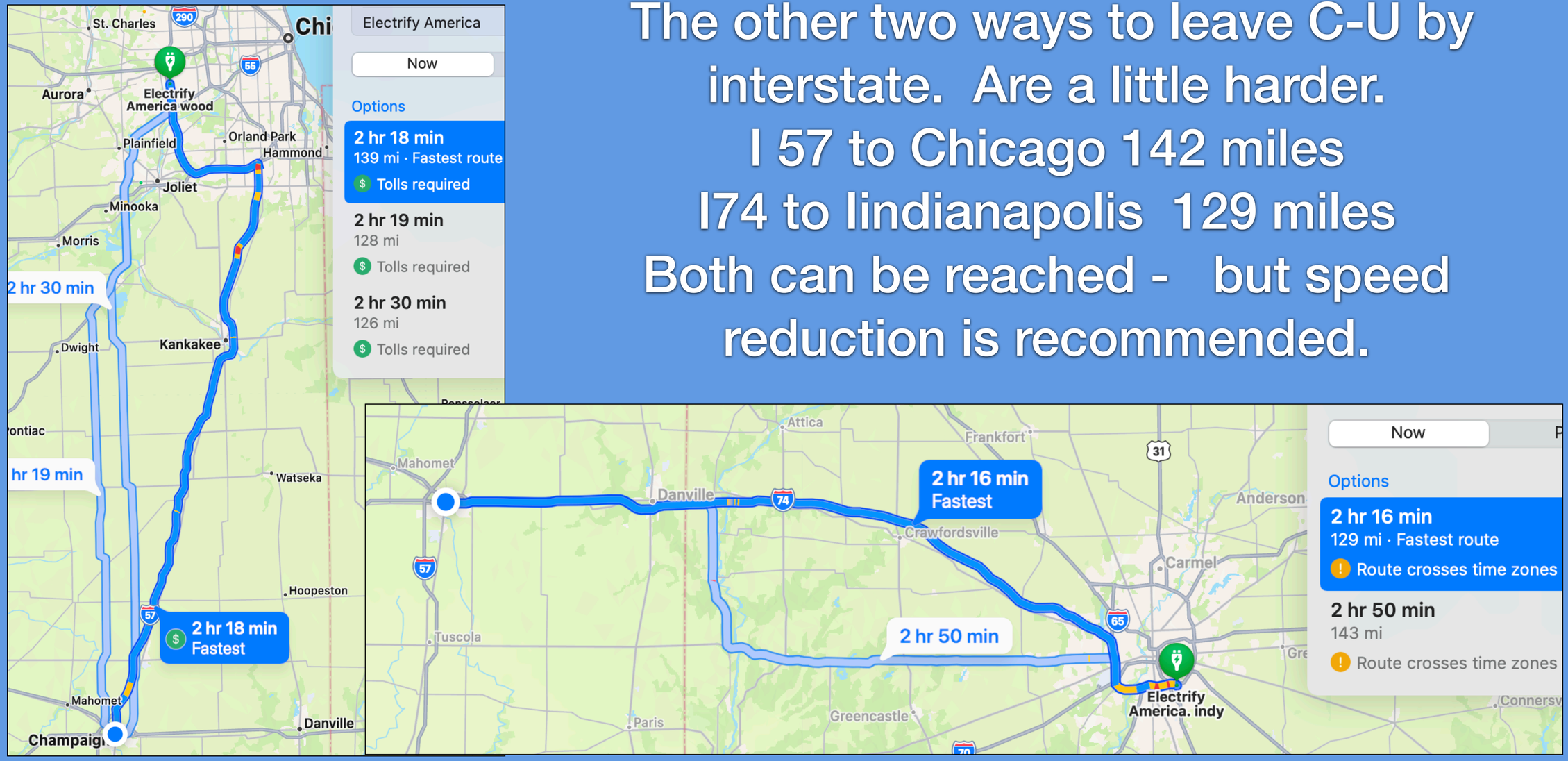
There are five ways to leave C-U by interstate.
Here are three of them.
I74 to Bloomington 50 miles
I 57 to Effingham 79 miles and
I72 to Springfield 88 miles
All can be easily reached in terrible conditions

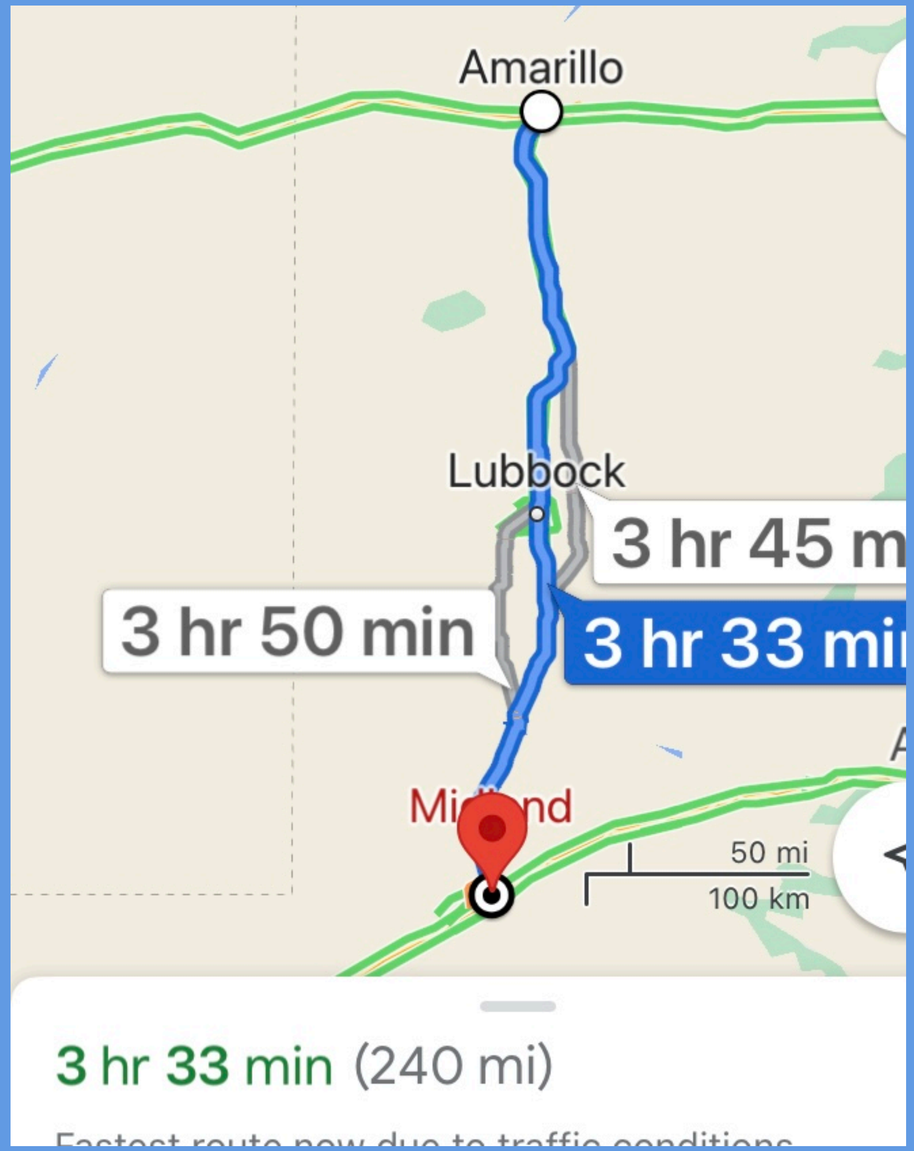




Session 4 : Range

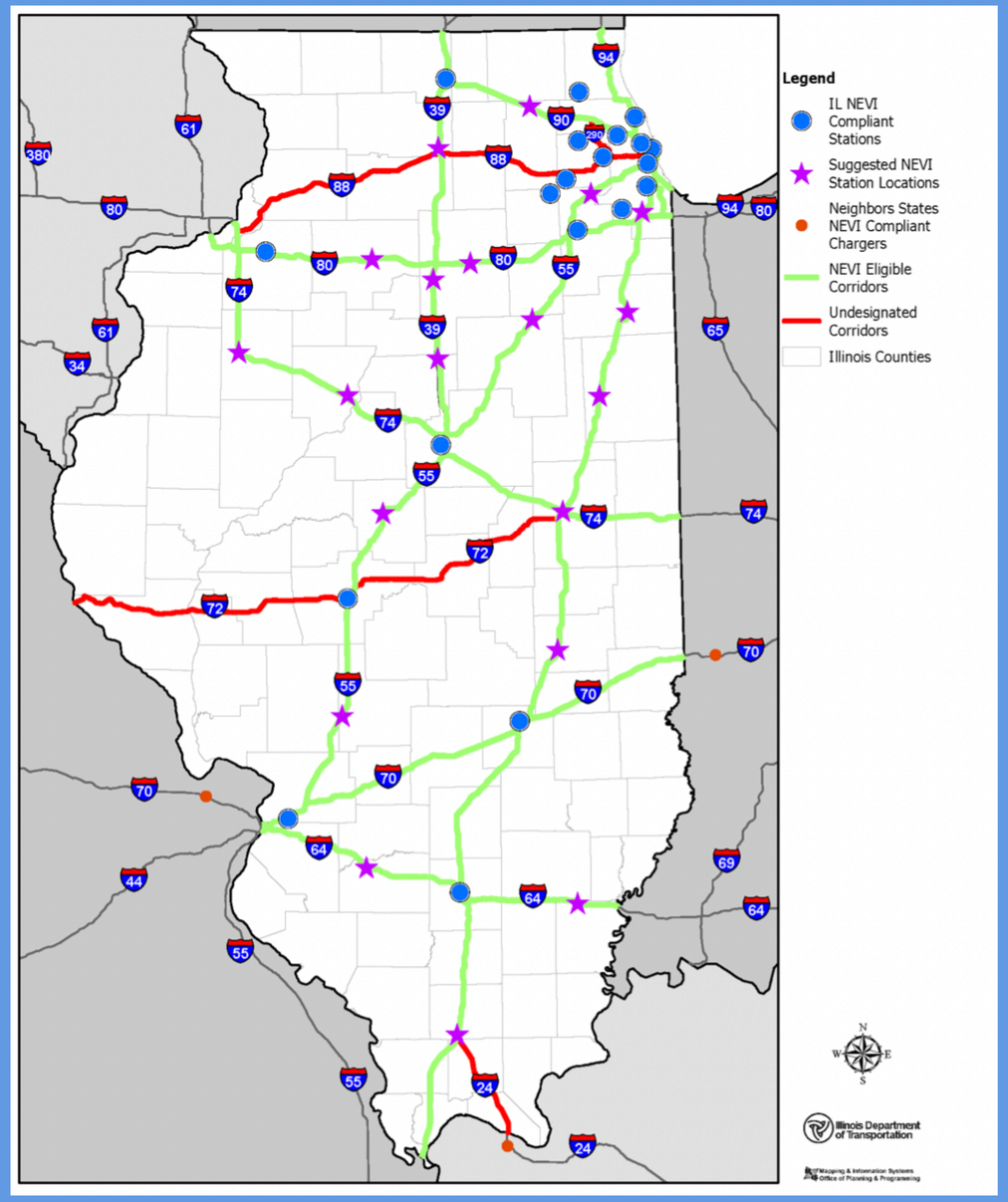
The other two ways to leave C-U by interstate. Are a little harder.
I 57 to Chicago 142 miles
I74 to lindianapolis 129 miles
Both can be reached - but speed reduction is recommended.





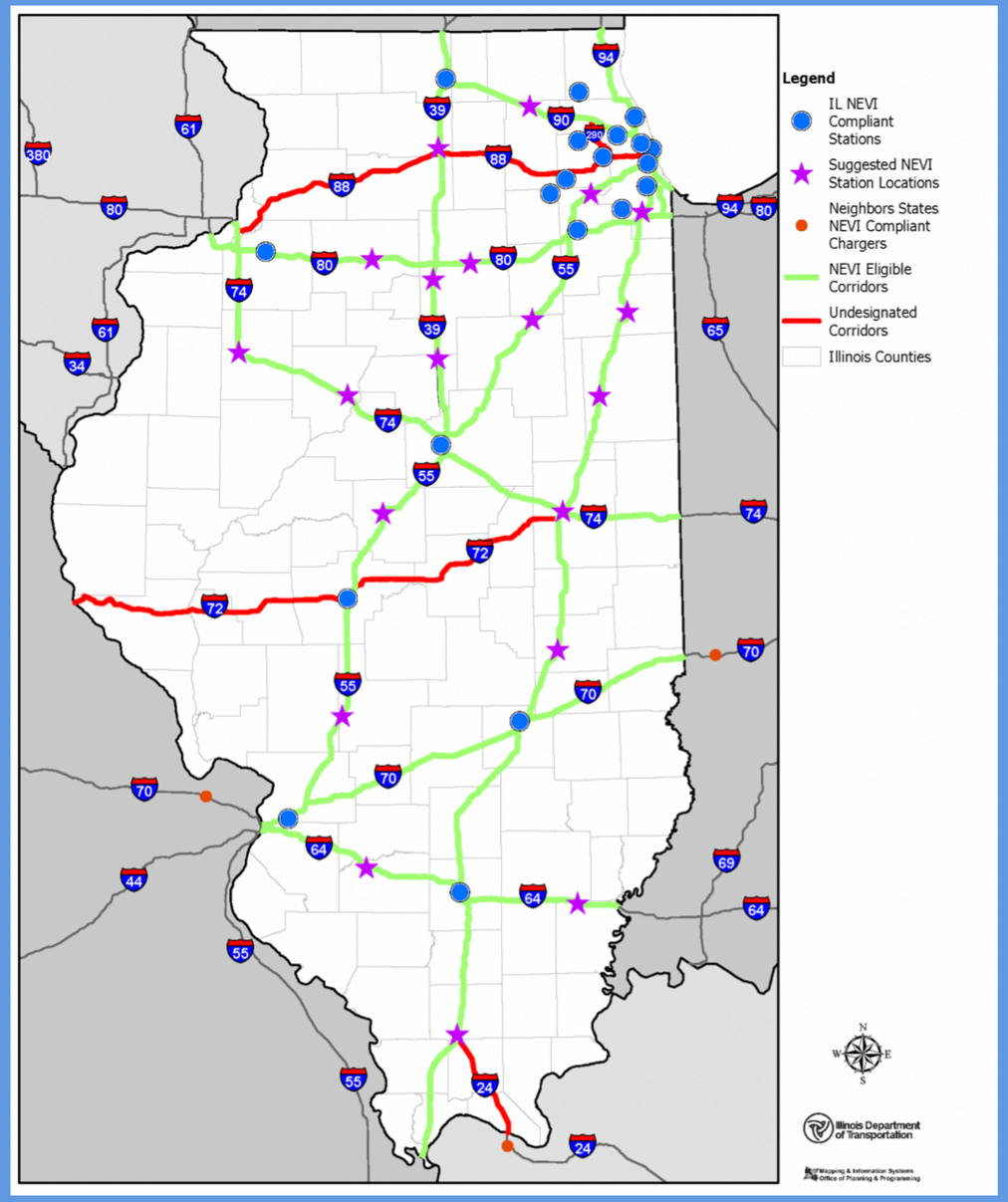
Other parts of the country have even bigger jumps – Like this one in Texas – 240 miles.
Tesla recently announced Lubbock as on the list of coming Supercharger sites. Most of Tesla chargers are about 80 miles apart.
120 miles is high for them but thats a lot of land between towns.

Session 4 : Range



IDOT choices for the NEVI program include Kankakee, Onarga and Mattoon on I57. Nothing on I74 between Champaign and the Indiana border. That would shorten ALL travel in our area to easily driven distances. There are a lot of hoops for NEVI to jump through and still more work to be done before construction can begin.

Session 4 : Range



Most of range anxiety is “Will I get to the next charger” When the NEVI chargers are fully deployed, most of range anxiety will go away. What to do until then.

Session 4 : Range

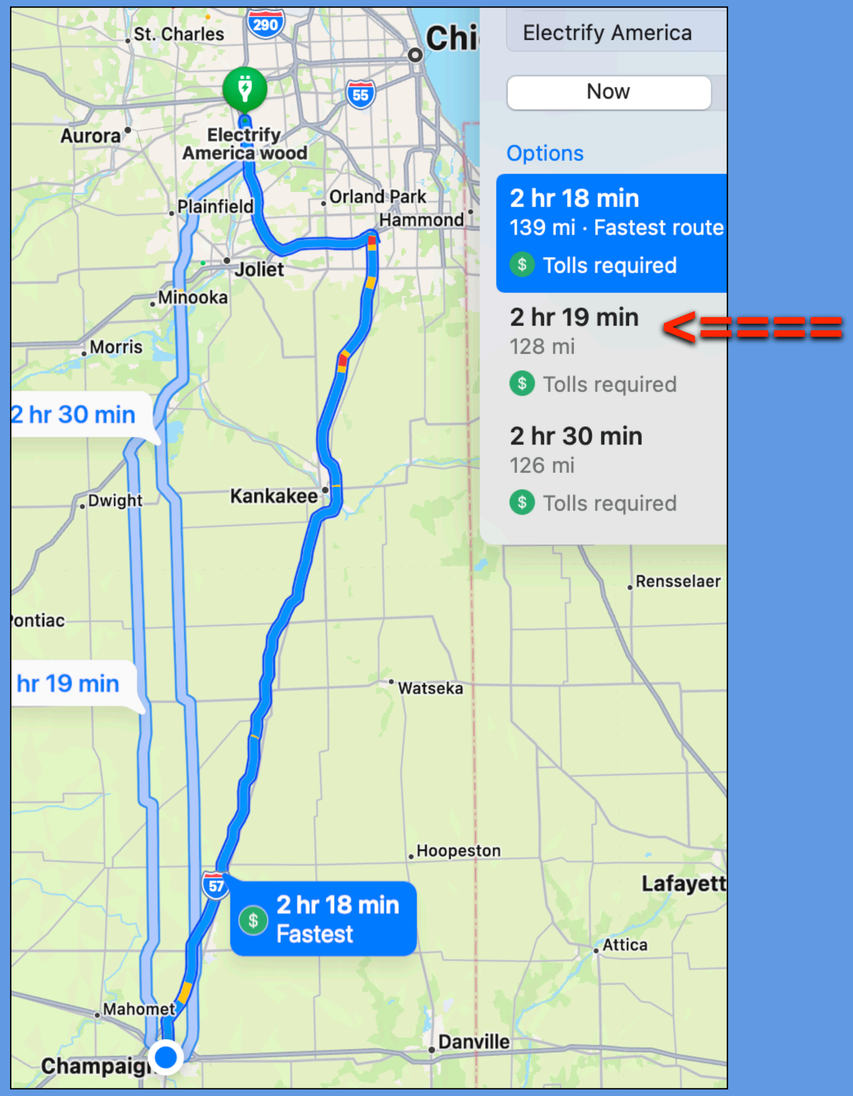
Date	temp/time	car dir speed	wind dir / speed	Mi/kwh	Mi range total calc
03/15/22	61	S -75	w@6	2.80	215.38
03/15/22	65	n-75	w@3	2.80	215.38
03/15/22	66	s-70	w@5	2.80	215.38
03/15/22	65	n-70	sw@4	2.80	215.38
03/15/22	66	s-65	sw@7	3.31	254.55
03/15/22	66	n-65	w@8	3.31	254.55

The numbers previously shown so far are in “bad” weather. These are good weather numbers and again are theoretical. On a nice day with low windspeed. The range is quite nice. I like to stop about every hour and a half. If you’re more gung ho, two and a half hours is very doable.

Please note that when the vehicle slows down there is a 20% increase in range.

Session 4 : Range

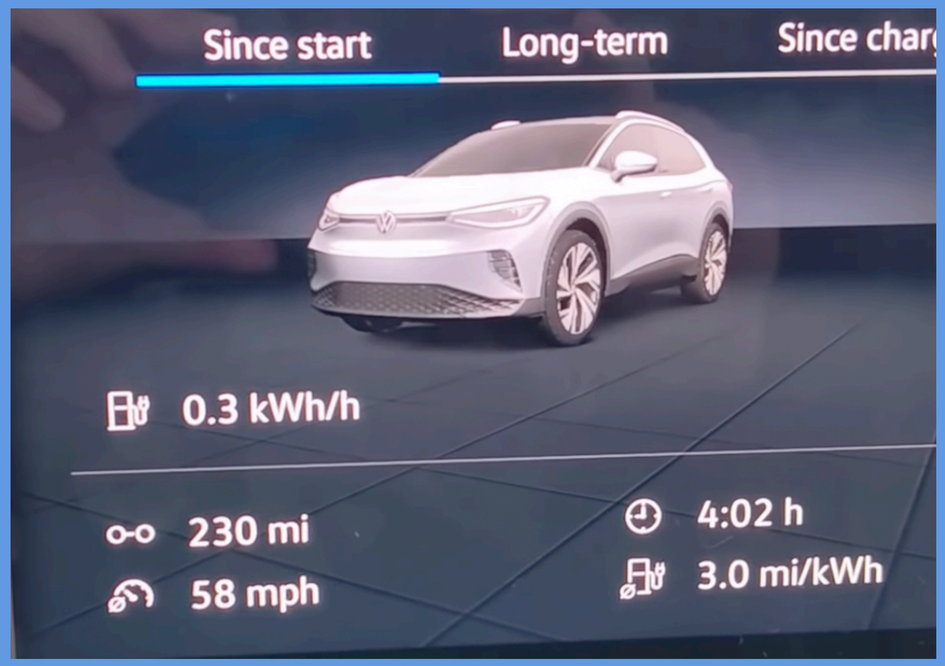
Past Performance vs Future Results



That 20% increase in range can be taken advantage of. Note the travel time using I55 and US47 in only 1 minute longer Than the usual I57 route. Planning to use that route could cut charging time 10 minutes. A bigger gain on some days since the prevailing winds here are typically from the south. With cold temps and winter winds – I will use this route a lot Dec through early Feb.

And why do I keep saying these numbers are “theoretical”.
Two things are true:
The numbers shown are for very specific conditions and cannot be duplicated on a real trip. Real trips have traffic.

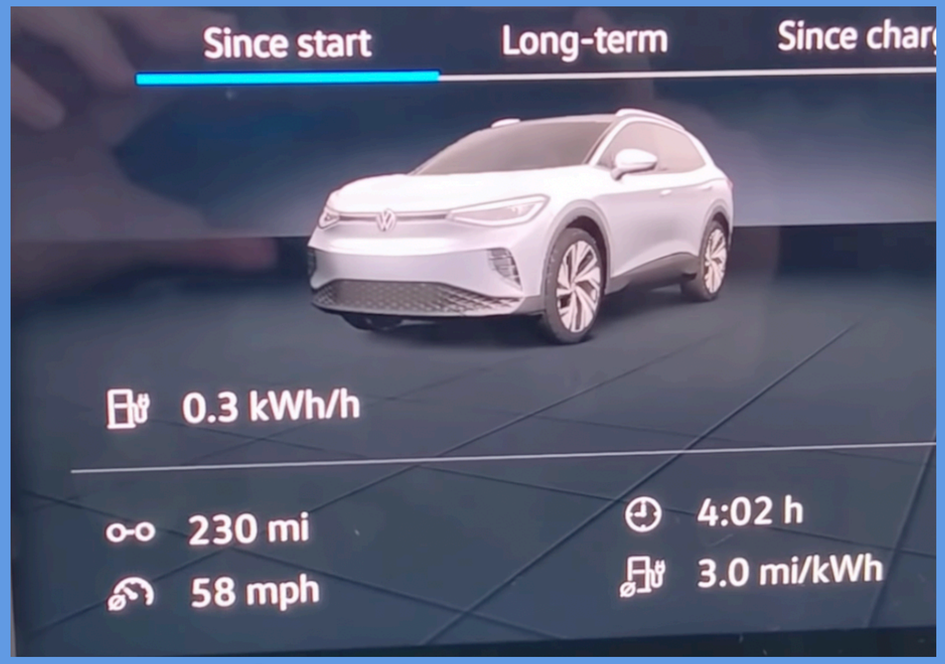
Session 4 : Range



State of charge 70mph range test

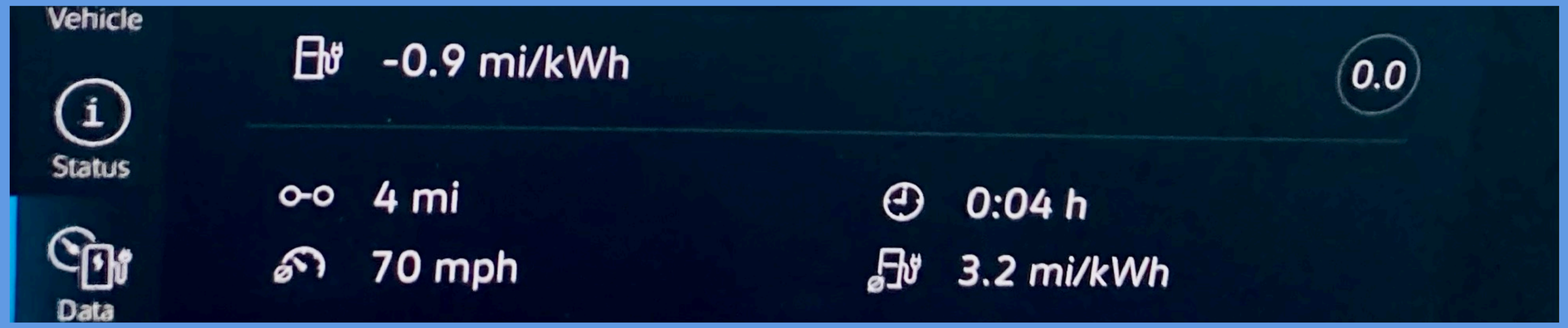
There are several people on the web that make their living by making videos and posting on the web. They get loaner cars from manufacturers and test range, charging speeds and other things. Screenshots from two of those. One a “75mph range test” (top) got 203 miles of range and a “70mph range test” (bottom) came in at 230.

Session 4 : Range



State of charge 70mph range test

Look close - The “75mph range test” (top) averaged 70mph, not 75. and the “70mph range test” (bottom) averaged 58 mph. When you start from your driveway, the speed on the way to the interstate is a lot slower than 70 mph and changes the average a lot. On your trips , it is the averge that counts. Range is easier in real life.



Momentary Efficiency: -0.9 is regeneration

0.0 is reset button

Miles driven in this period

Elapsed time for this data

Average speed

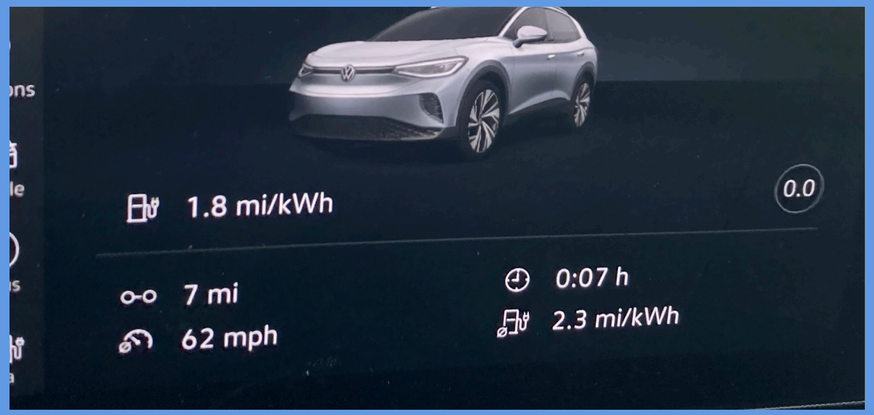
Efficiency for this time period

What these numbers mean.

Session 4 : Range

Past Performance vs Future Results

I prefer a 2.9 to 3.0 Efficiency with 80% charge for that Chicago trip & only get that with mild temps and light wind.



Session 4 : Range

Downhill SB

I use the term uphill and downhill for the harder and easier directions of a roundtrip. And sometimes for headwind and tail wind. In this case there are two distinct parts to the trip. One part is the Chicago area with slower Interstate speed limits, often slowed by traffic. The other is the open highway on I57 with 70mph speed limit (and often slowed by construction)

Past Performance vs Future Results

Slow Interstate

Fast Interstate

Trip average

Session 4 : Range

Downhill SB

Heading back to Champaign, the first part is the “slow” part with higher EV efficiency numbers. Second is the “fast” part of the trip where the efficiency number is lower.

In this case 3.7 m/kwh slow, 2.9 m/kWh fast, 3.0 m/kWh average.

Slow Interstate

Fast Interstate

Trip average

Session 4 : Range

Downhill SB

The “slow” part can leave a few extra kWhs to be used on the “fast” part of the trip where the efficiency number is lower.

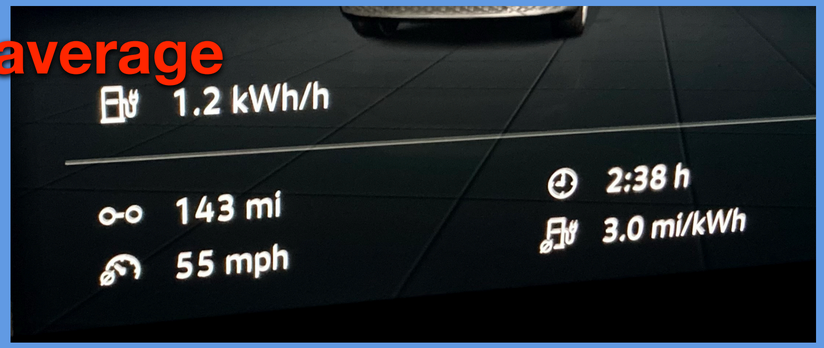
It can be used to drive a little faster or just leave a bigger safety buffer at the end the trip.

Past Performance vs Future Results

Slow Interstate

Fast Interstate

Trip average



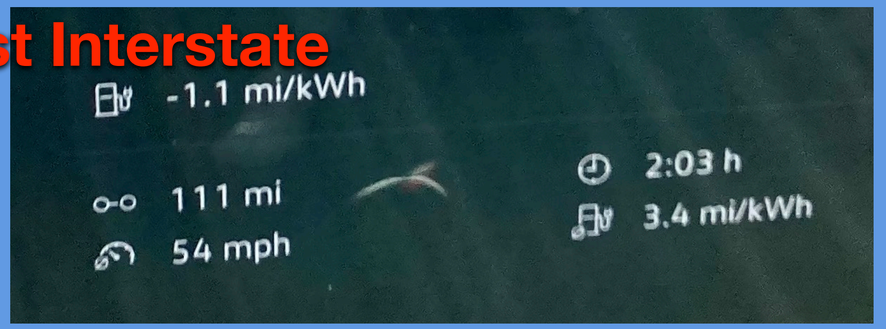
Session 4 : Range

Uphill NB

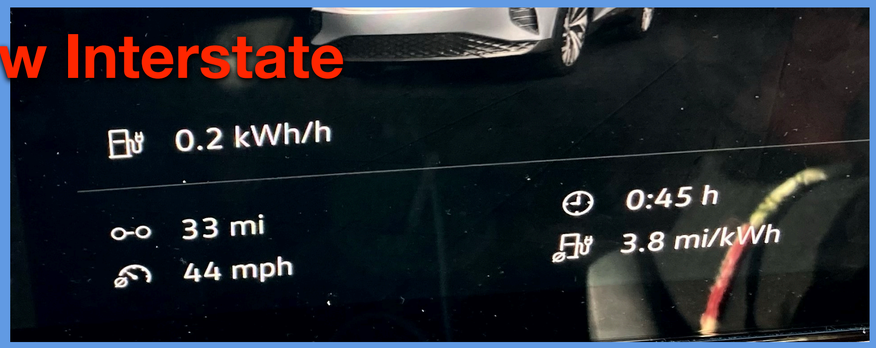
Going the other way requires a different strategy. Driving the fast part first without knowing how much the slow part will boost the average. I didn't get a good example on the trip due to a 10 mph tailwind.

Past Performance vs Future Results

Fast Interstate



Slow Interstate



Trip average

Session 4 : Range

Uphill NB

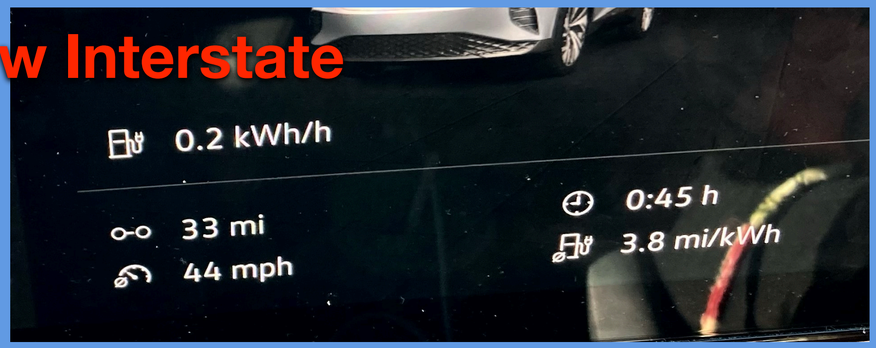
With the 10 mph tailwind the target efficiency of 2.9 m/k was overshot by close to 20%. On a different day driving slower would be recommended (if necessary) to get a minimum of 2.8 m/k. On days like this EVs that aren't trying to get a good example for a study group would drive faster (since wind is free).

Past Performance vs Future Results

Fast Interstate

Target efficiency ===>

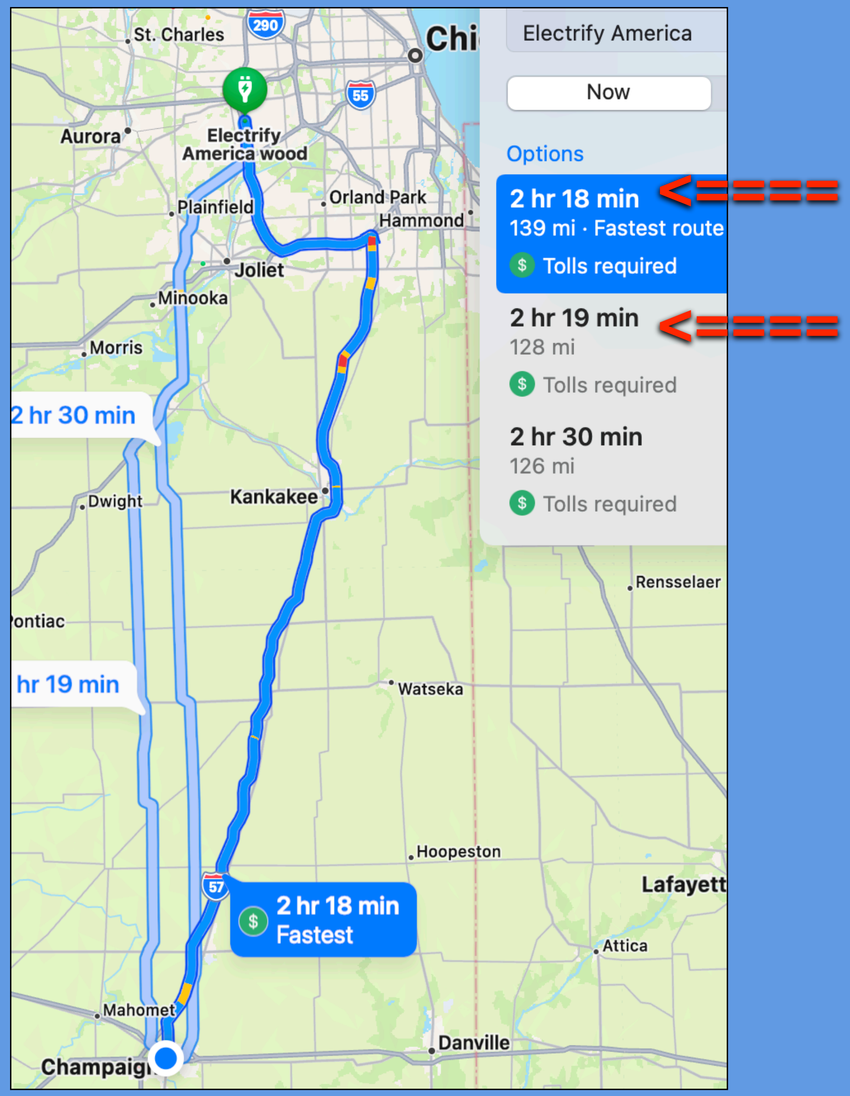
Slow Interstate



Trip average

Session 4 : Range

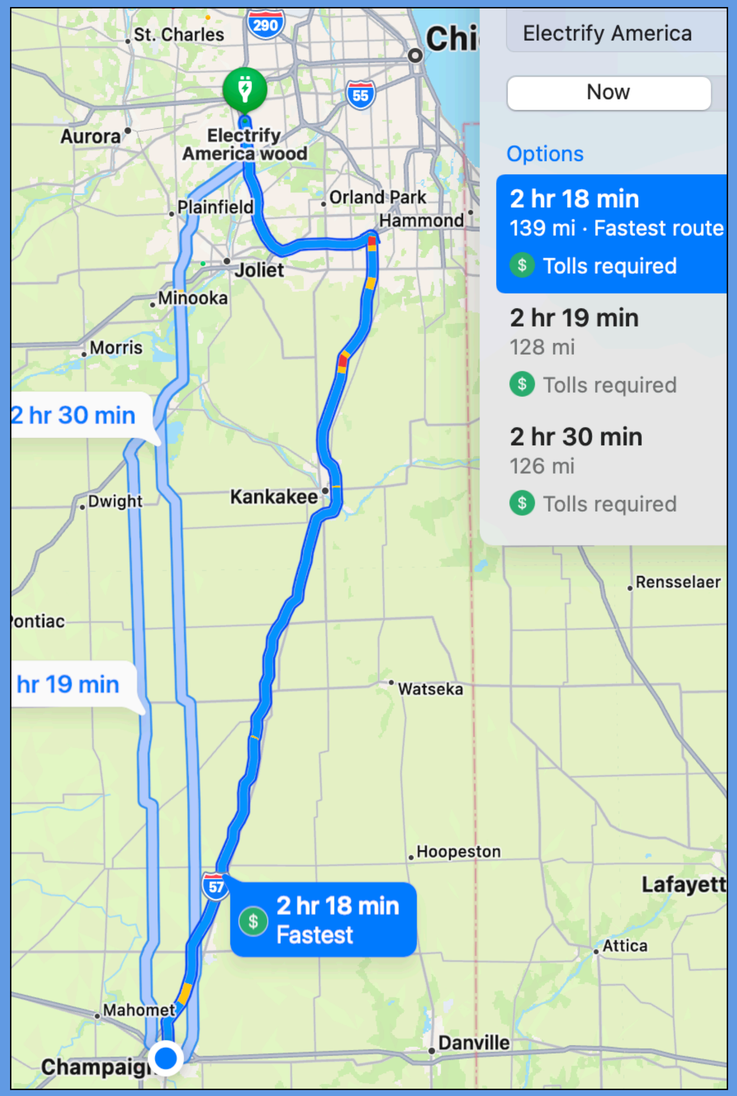
Past Performance vs Future Results



On those bad days remember there is often an alternate route that has a similar drive time. And at a slower speed with a much higher efficiency . Staying on the Interstate with a very low number might make it impossible to make up the difference on the slower Interstates.

Session 4 : Range

Past Performance vs Future Results



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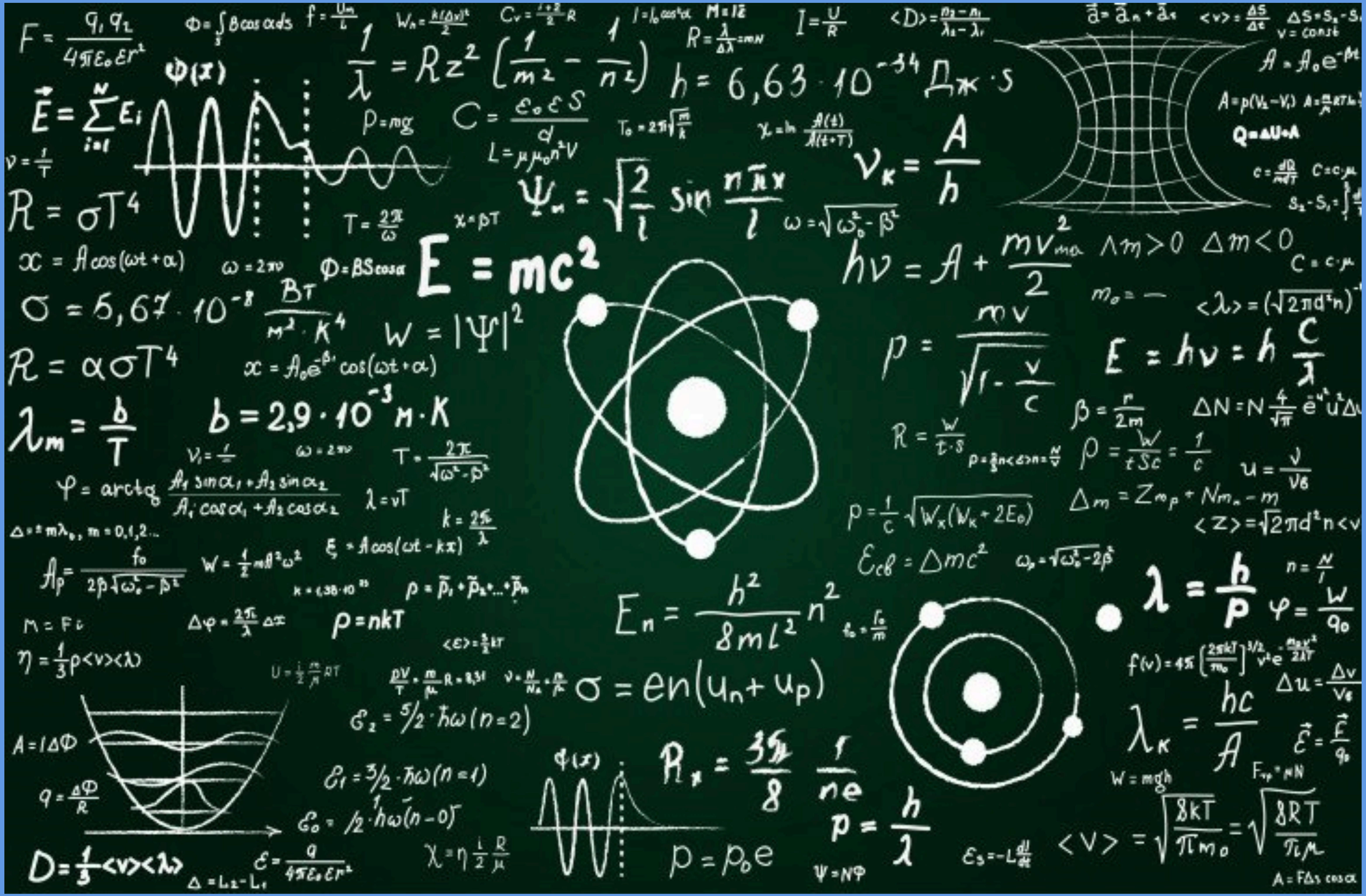
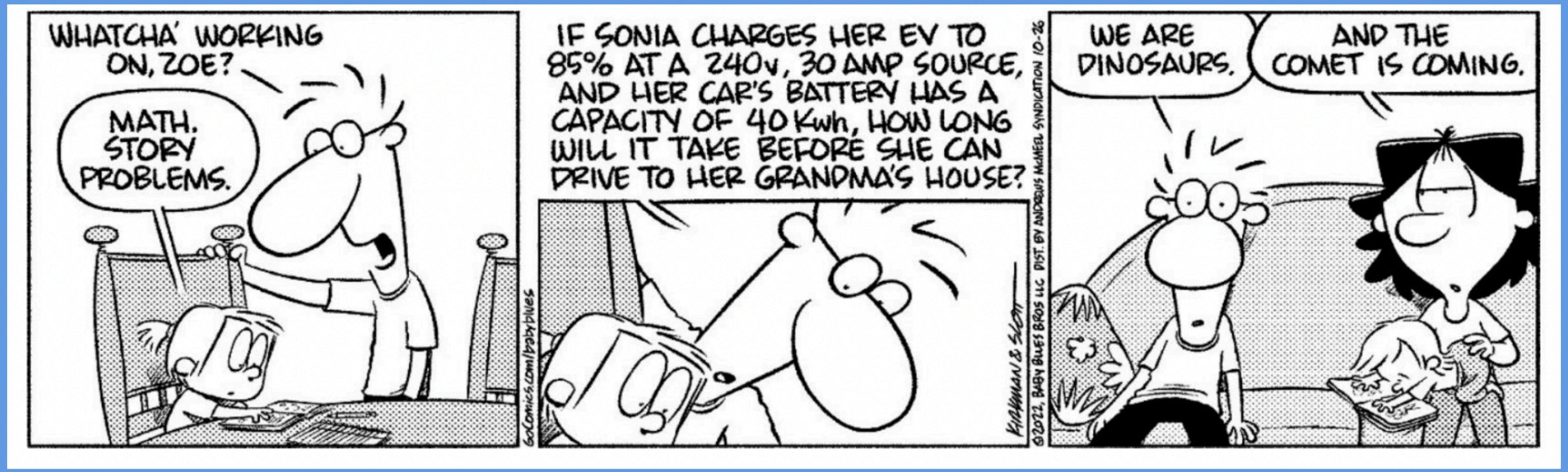
03/15/22	65	n-70	sw@4	2.80	215.38
03/15/22	66	s-65	sw@7	3.31	254.55
03/15/22	66	n-65	w@8	3.31	254.55

Remember - NONE of this needs to be done on a route with NEVI stations. For those days with those destinations take the alternate route and enjoy watching the America you don't see from the Interstate.

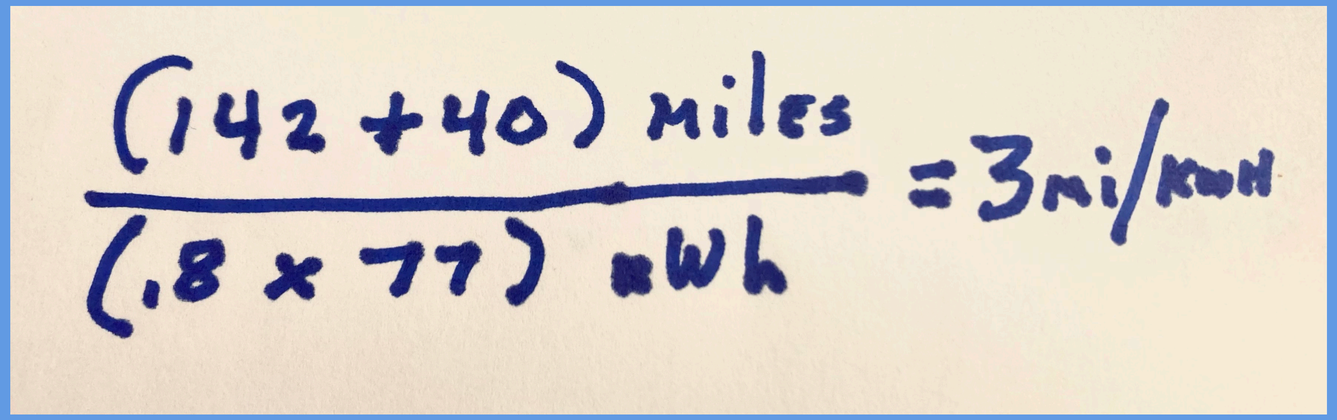

E = mc²
h = 6,63 · 10⁻³⁴ Дж · s
σ = 5,67 · 10⁻⁸
b = 2,9 · 10⁻³ м · K
W = |Ψ|²
σ = en(uₙ + uₚ)
p = p₀e
p = nkT
E = hν = h c/λ
λ = h/p

OMG - it's MATH



Not that math – this math.

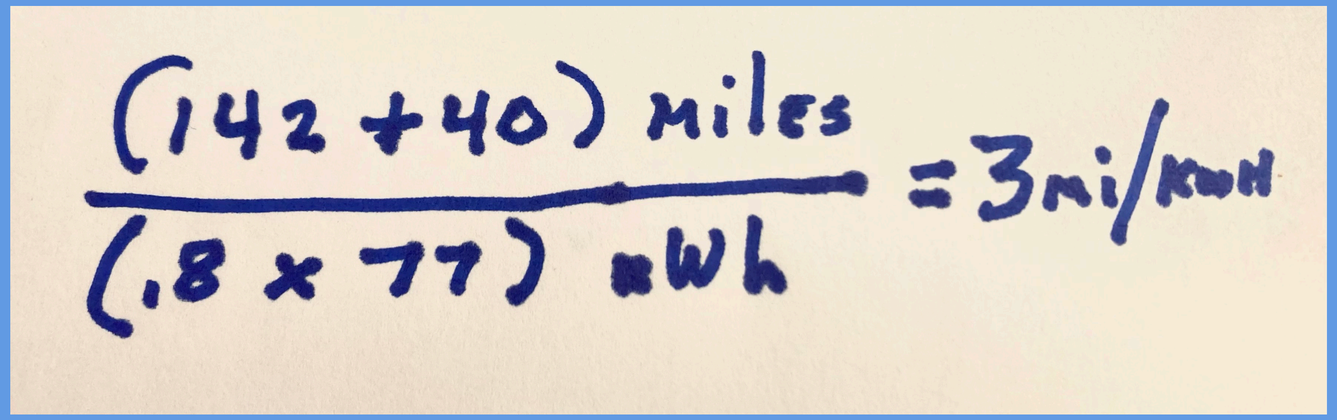
Not that math – this math. And its fairly simple. Pick a trip, get the miles. Add a few miles for a cushion. (this depends on your bravery) . Pick the starting level of charge. e.g. 80%. Multiply the 80% times the size of the battery. Divide miles by the kilowatts. (kWh) . And you get your number.



For my West Chicago trip - 142 miles to the CHARGER
add 40 miles – 184.
(the 40 miles = not run to 0%)
80% of the VW 77kWh battery – 62

182 / 62 = 3.0

Session 4 : Range



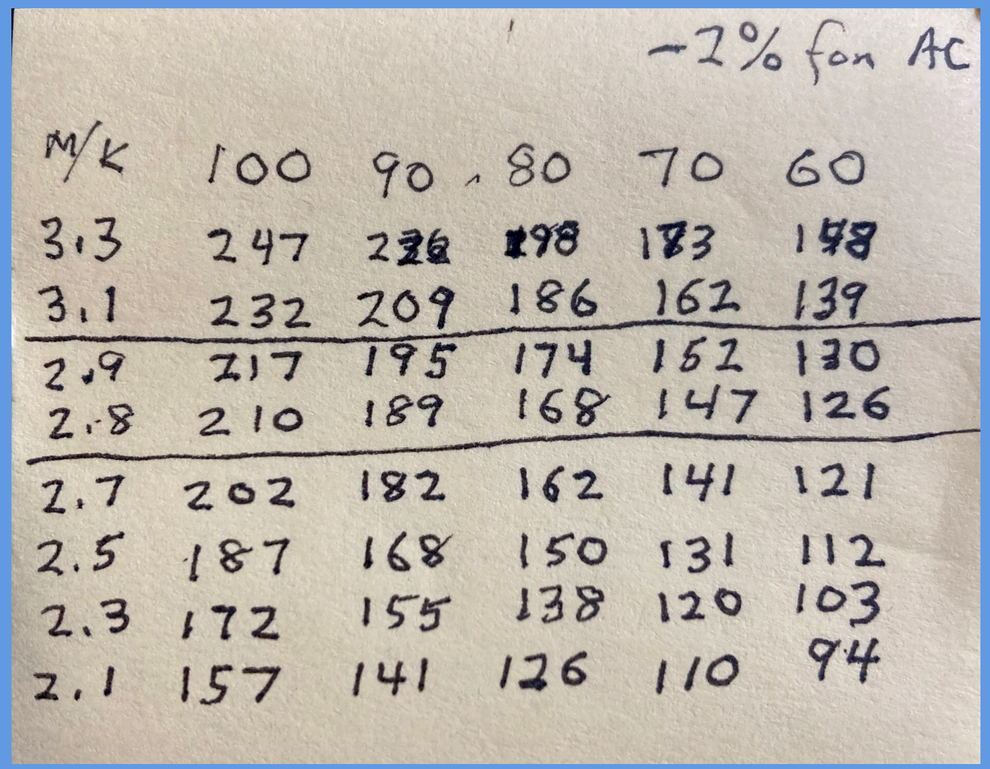
For my West Chicago trip -
142 miles to the CHARGER
add 40 miles (as a cushion) – 182.
80% of the VW 77kWh battery – 62

182 / 62 = 3.0

Since I'm not that brave, and a slow overnight charge is kind to my battery, I charge higher and can drive at 2.8.

Session 4 : Range

Past Performance vs Future Results



-2% fan AC

M/K	100	90	80	70	60
3.3	247	226	198	183	148
3.1	232	209	186	162	139
2.9	217	195	174	152	130
2.8	210	189	168	147	126
2.7	202	182	162	141	121
2.5	187	168	150	131	112
2.3	172	155	138	120	103
2.1	157	141	126	110	94

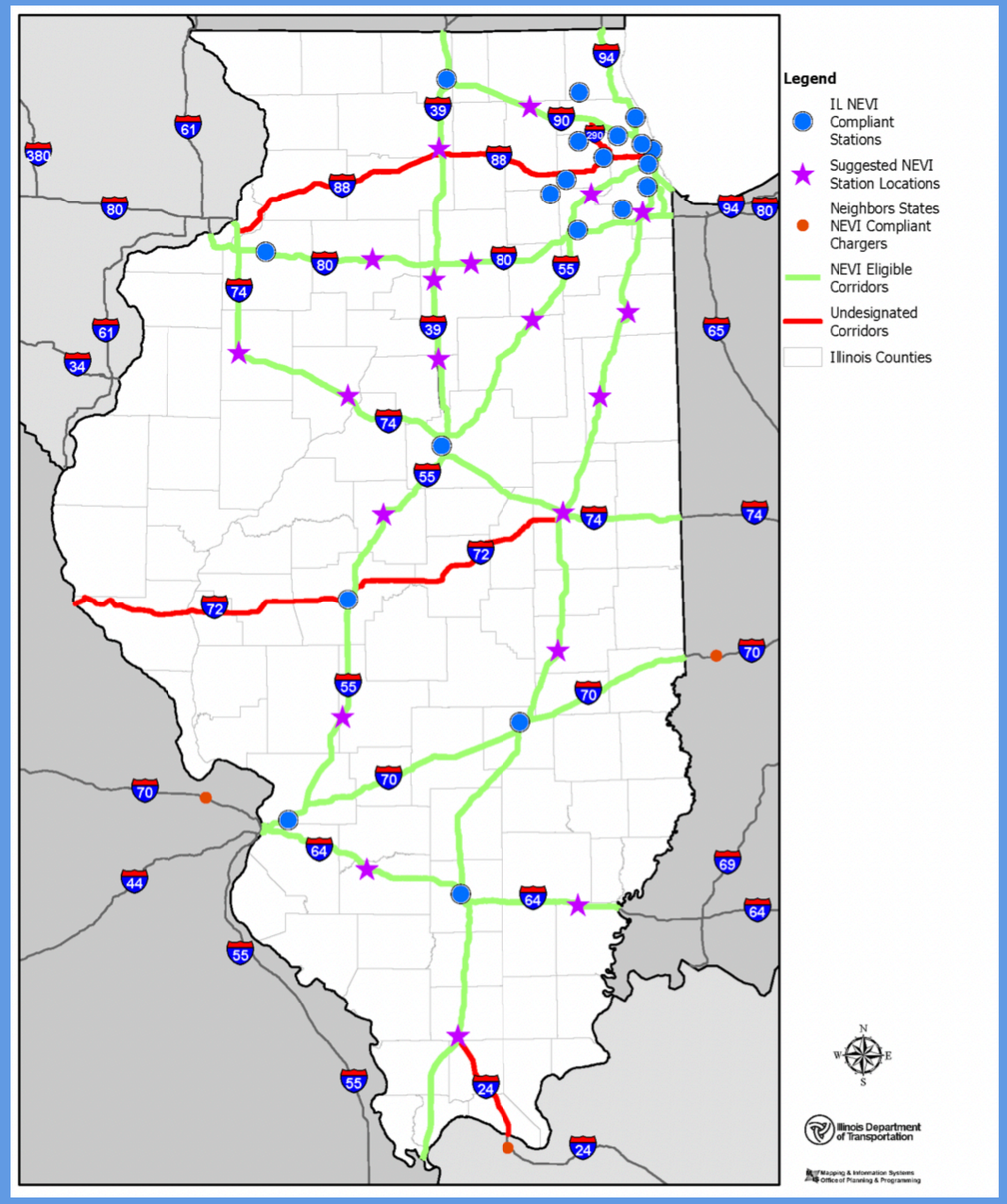
My Cheat Sheet

I know how far I need to go

I have an Idea what efficiency I can get.

I read off the charge level needed to begin the trip.

Session 4 : Range



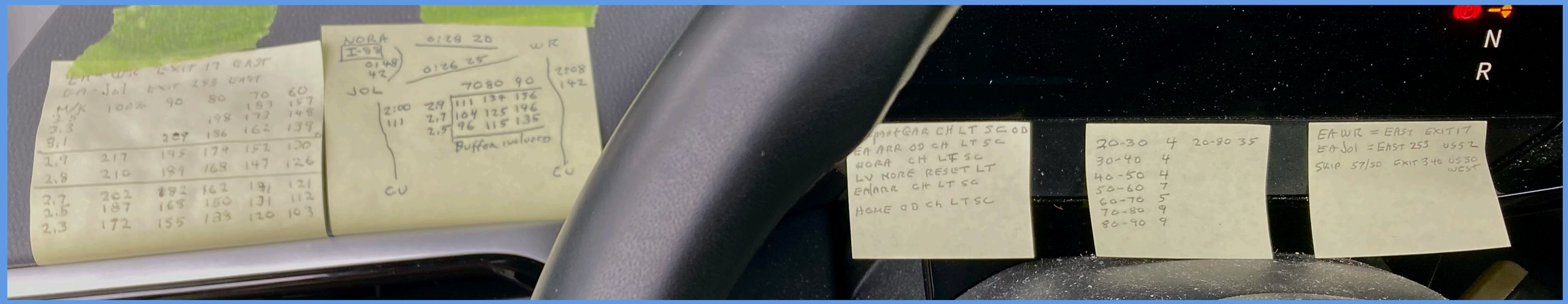
Post Script - - - Early this year we arrived at the Electrify America in Bloomington. We needed a charge and (Rivian factory) there were lots of cars there. Didn't have enough charge to drive home on I74 – but did have enough to drive 40 mph on route 150. We made it and probably got home faster than waiting and then charging.

I spent a lot of time this session with strategies for a trip of 140 miles with no good DC chargers along the way. And it is likely that distracted from how easy and comfortable road trips can be. Driving to St Louis is very simple NOW. The trip to Chicago will be easier than St Louis with the addition of one DC location between here and I-80. These road trips can be made. I hope no one is denying themselves these ease of daily EV driving and the very real cost benefits of EVs because a few trips out of town a year can be slightly inconvenient.

This is the end

Session 4 : Range

Past Performance vs Future Results



Don’t need the extra notes anymore

- but keeping the map and the cheat sheet.

This is the end

Looking back

Looking back

Cost increases and cost savings with Electric.

Looking back

Except for the US postal service. At one time the largest private fleet of vehicles (now second) The federal Government is offering money to cover the cost of buying EVs to convert fleet to as close to 100% electric as possible. The little trucks that drive past my house are estimated to save $8000 per year per vehicle.

Looking back

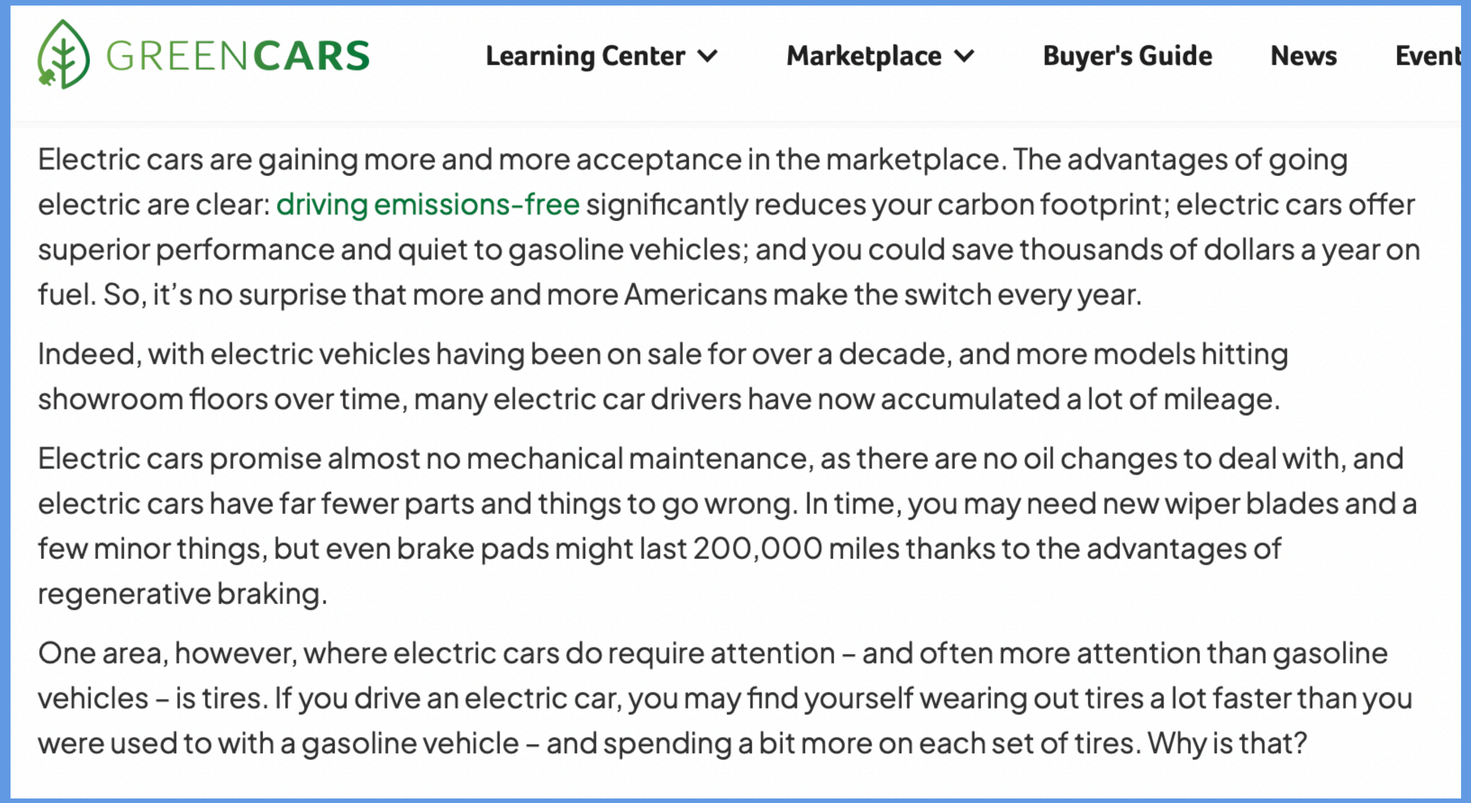
Energy

Hard to give a dollar amount on this. Each post office vehicle will save more than a vehicle for personal use. Maybe if someone drives very far everyday for work.

I will guess a good ballpark estimate is that every mile driven will save 10 cents. To get a total for the year, a number for yearly mileage is needed. For the last year of my gasoline Subaru - 6000 miles or $600. But I've driven my VW ID4 twice that far this year.

Looking back

Maintenance



GREENCARS Learning Center Marketplace Buyer's Guide News Event

Electric cars are gaining more and more acceptance in the marketplace. The advantages of going electric are clear: driving emissions-free significantly reduces your carbon footprint; electric cars offer superior performance and quiet to gasoline vehicles; and you could save thousands of dollars a year on fuel. So, it's no surprise that more and more Americans make the switch every year.

Indeed, with electric vehicles having been on sale for over a decade, and more models hitting showroom floors over time, many electric car drivers have now accumulated a lot of mileage.

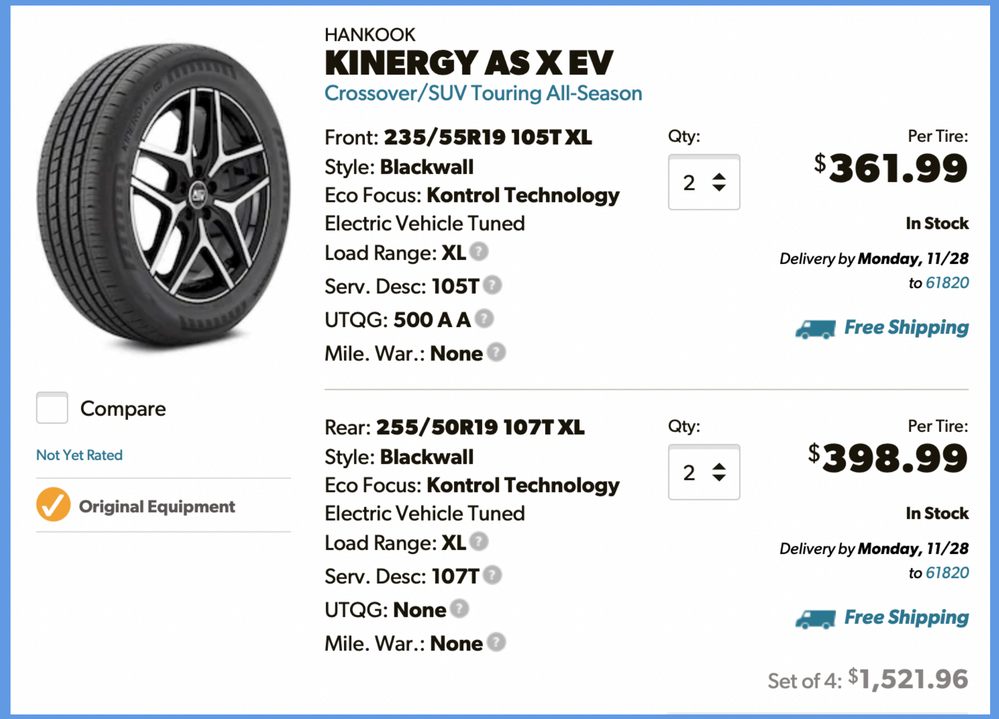
Electric cars promise almost no mechanical maintenance, as there are no oil changes to deal with, and electric cars have far fewer parts and things to go wrong. In time, you may need new wiper blades and a few minor things, but even brake pads might last 200,000 miles thanks to the advantages of regenerative braking.

One area, however, where electric cars do require attention – and often more attention than gasoline vehicles – is tires. If you drive an electric car, you may find yourself wearing out tires a lot faster than you were used to with a gasoline vehicle – and spending a bit more on each set of tires. Why is that?

Few people want to go out on a limb and say no maintenance. But I have never taken my 30 year old electric drill in for maintenance. There will be some things that need it.

First up will be fluid changes in the mechanical brakes every 3 years. After that I can't remember anything I needed for the Subaru that the EV will need.

Looking back



TireRack website - (I buy all my tires there)

Its possible that a lot of EVs will be like mine and not have tire rotation. The illustration is for my tires and note different sizes, front and back.

Tires

OUCH ! ! !

Tires are the big one. I haven't purchased tires in a while, but it looks like twice as much. Remember - These are TRUCK tires. With the EV battery the gross vehicle weight of the cars are high and need almost truck sturdy tires. Also non-EV tires are available cost less upfront. EV tires will get better range and cost less over time.

Looking back

MICHELIN
ENERGY SAVER A/S
Passenger All-Season

Size: **215/50R17 91H**
Selfseal, TPC Spec, Chevy Bolt
Style: **Blackwall**
Eco Focus: **Green X**
Electric Vehicle Tuned
Serv. Desc: **91H**
UTQG: **480 B B**
Mile. War.: **65,000 Miles**

Qty: 4

Per Tire: $**244.77**

Out of Stock
Additional inventory due 12/01/22
Delivery by ***Wednesday, 01/18***
to 61820

Free Shipping

TOYO
PROXES A40
Passenger All-Season

Size: **215/45R18 89V**
Serv. Desc: **89V**
UTQG: **300 B A**
Mile. War.: **None**

Qty: 4

Per Tire: $**174.20**

Out of Stock - On Backorder
The manufacturer does not have an expected due date at this time

Free Shipping

Set of 4: $**696.80**

Tires

Less OUCH ! ! !

The top tire is OEM for Chevy Bolt. The other is for a Mazda 3 considered a very similar car. The Bolt tires are designed for better range and are for a heavier vehicle. Note the Chevy tires carry a fairly high mileage warranty. The Mazda tires has none.

Looking back

Registration

Affirmation for Electric Vehicle

Definition (625 ILCS 5/12-805): Beginning on January 1, 2020, the registration fee for Electric vehicles shall be equal to the fee set forth in Section 3-806 for motor vehicles of the first division, other than Autocycles, Motorcycles, Motor Driven Cycles, and Pedacycles. In addition to the registration fees, the Secretary shall assess an additional $100 per year in lieu of the payment of motor fuel taxes. $1 of the additional fees shall be deposited into the Secretary of State Special Services Fund and the remainder of the additional fees shall be deposited into the Road Fund. (Source: P.A. 101-32, eff. 6-28-19.)

Fees

Random-Number Electric Vehicle License Plates

- Newly acquired vehicle/first-time issuance - $406 ($155 title fee + $251 registration fee)
- Currently titled vehicle/first-time issuance - $251 ($251 registration fee)
- Current plates expire within 90 days - $280 ($251 registration fee + $29 replacement fee)
- Current plates do not expire within 90 days - $280 ($251 registration fee + $29 replacement fee)
- Annual renewal - $251

Passenger	$151
Passenger Personalized	$158
Passenger Vanity	$164
Persons with Disabilities	$151
Persons with Disabilities Personalized	$158

Illinois Sec. Of State website

Passenger vehicle plates in Illinois cost $100 more to offset the motor vehicle fuel tax that they do not pay.

Looking back

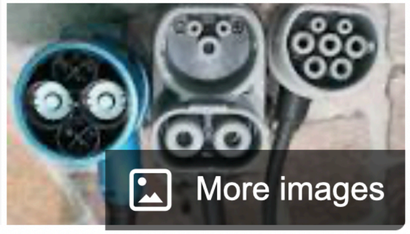
Insurance

Expect car insurance to start a little higher. For a lot of insurance companies, the actual payouts for losses is an unknown, I expect that to go down as more EV drivers are cautious and the percentage of Tesla (Plaid version) street racers diminishes.

The end for now.

CHAdeMO

CHAdeMO



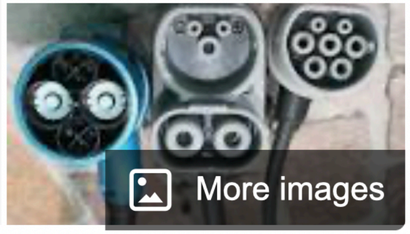
CHAdeMO is a fast-charging system for battery electric vehicles, developed starting in 2010 by the CHAdeMO Association, formed by the Tokyo Electric Power Company and five major Japanese

Wikipedia

I neglected the CHAdeMO connector last week. Still in use, very few cars, future support uncertain.

CHAdeMO

CHAdeMO



CHAdeMO is a fast-charging system for battery electric vehicles, developed starting in 2010 by the CHAdeMO Association, formed by the Tokyo Electric Power Company and five major Japanese

Wikipedia

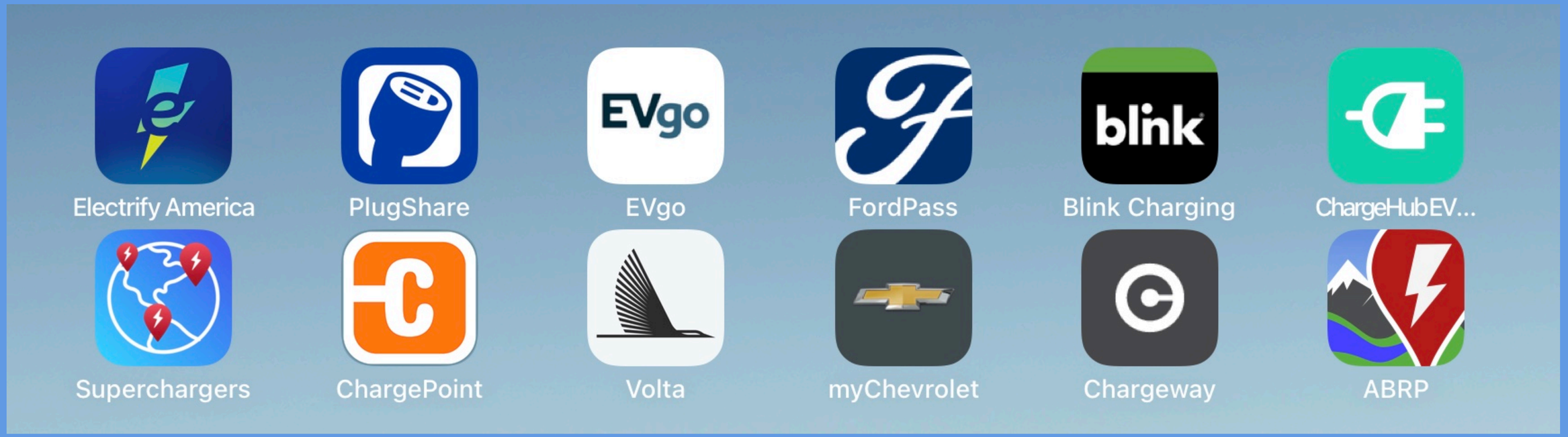
Electrify America will phase out at end of this year.

Nissan : Newer Leaf models will continue with CHAdeMO but the new Ariya will be Tesla and not CHAdeMO.

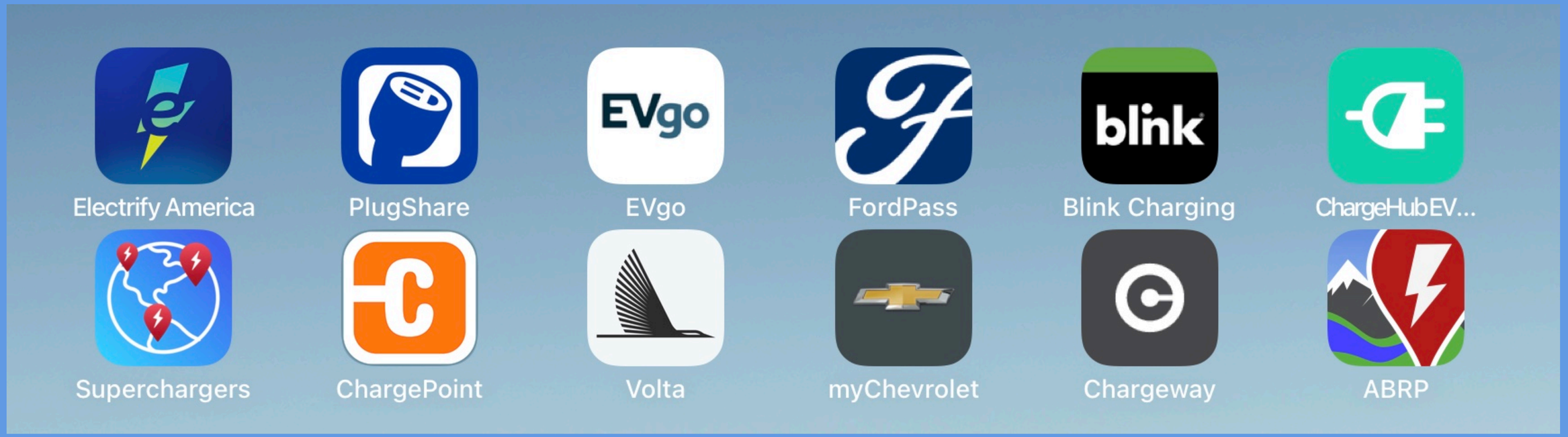
There a couple other EVs around that have CHAdeMO, mostly older models with short range and rarely use DC charging.

The end for now.

Session ??: Charger Apps



Session ??: Charger Apps



There are a lot of apps for charging networks - some actually are charging networks - one in particular - is pretty good at finding chargers regardless of network. Some even claim to be a networks but are really just a list of chargers.

Session ??: Charger Apps

Starting with the ones that I find most useful.

Electrify America

Superchargers

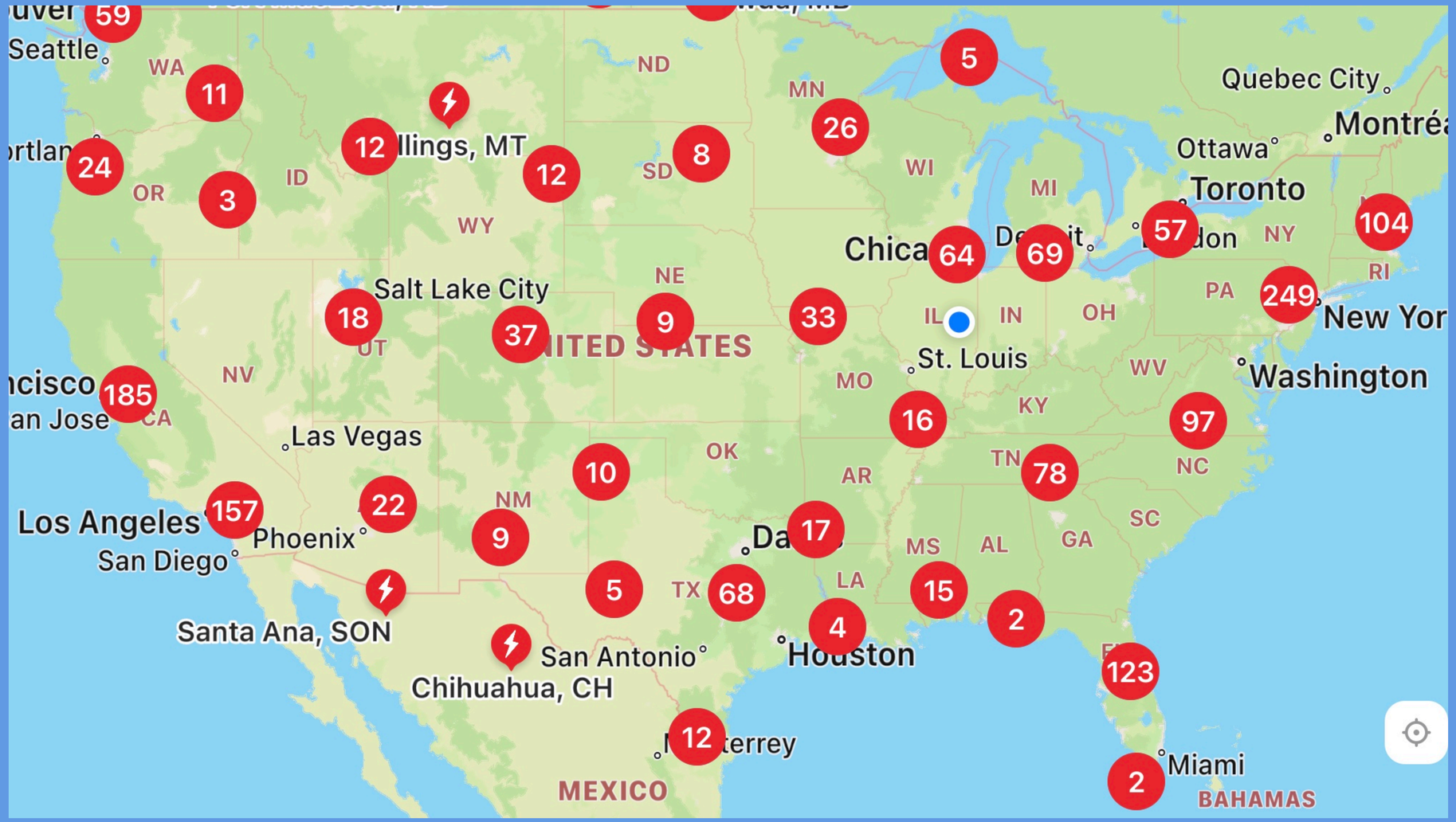
PlugShare

ChargPoint

Session ??: Charger Apps

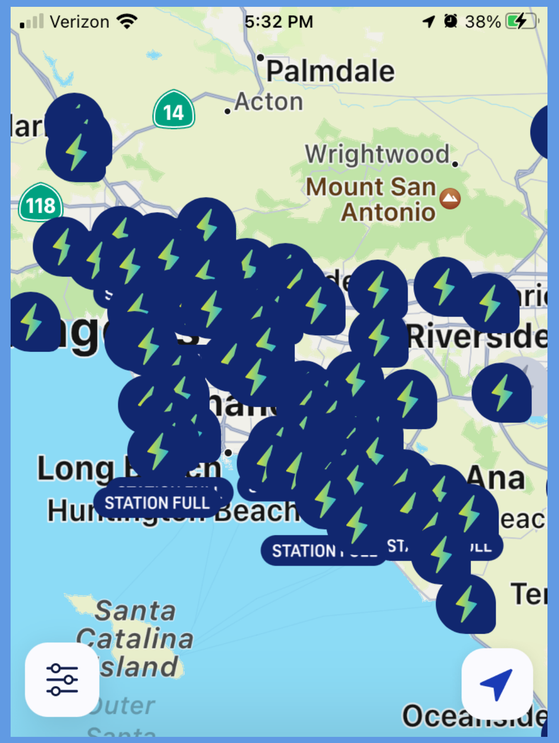
The Electrify America charging network.
Showing every location - looks pretty.

Session ??: Charger Apps

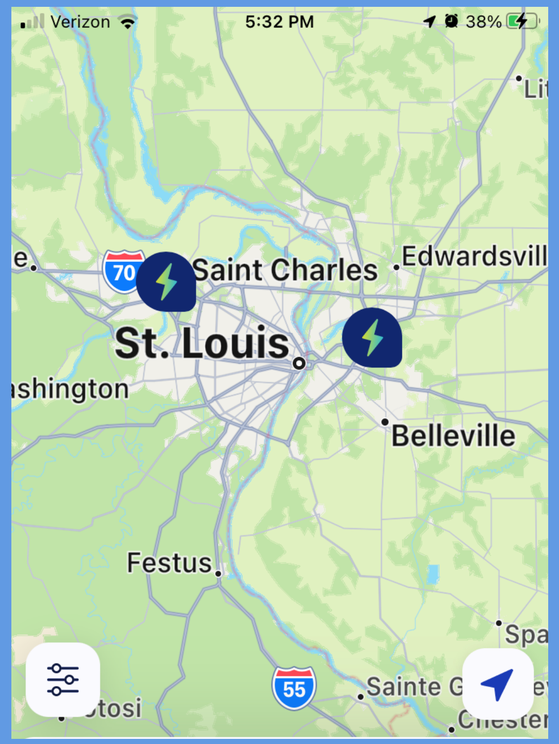


The Tesla Supercharger charging network.
It shows the number of locations in an area, while EA shows every location.

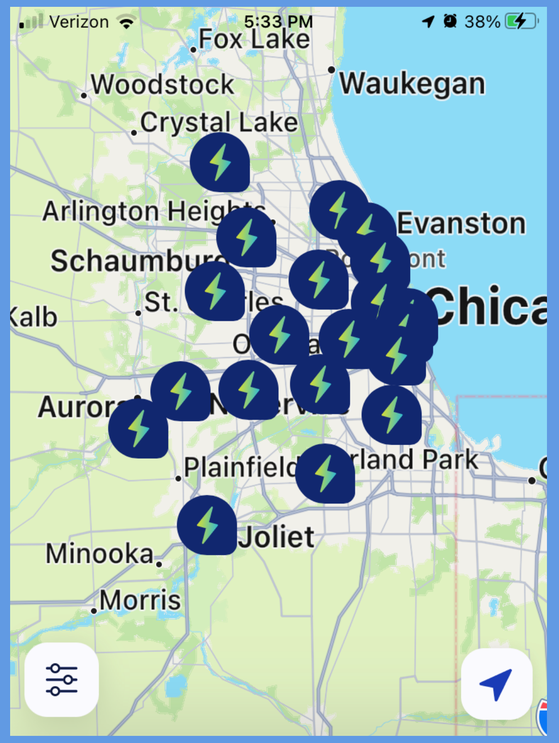
Session ??: Charger Apps



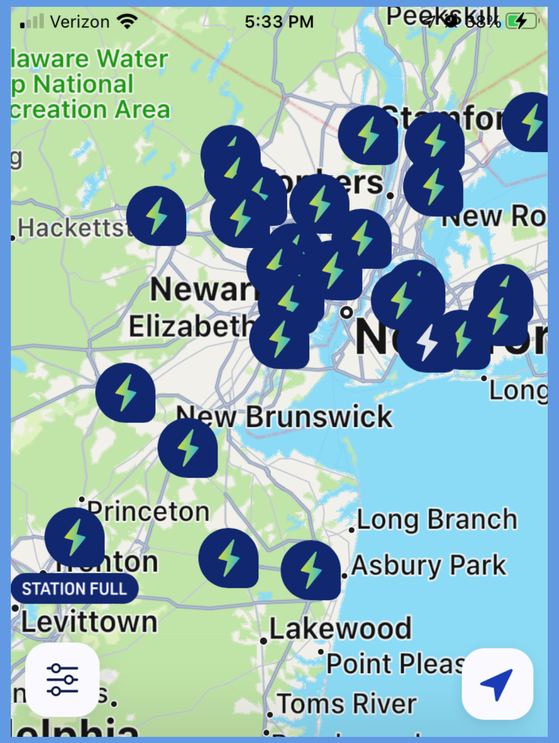
Los Angeles



St Louis



Chicago

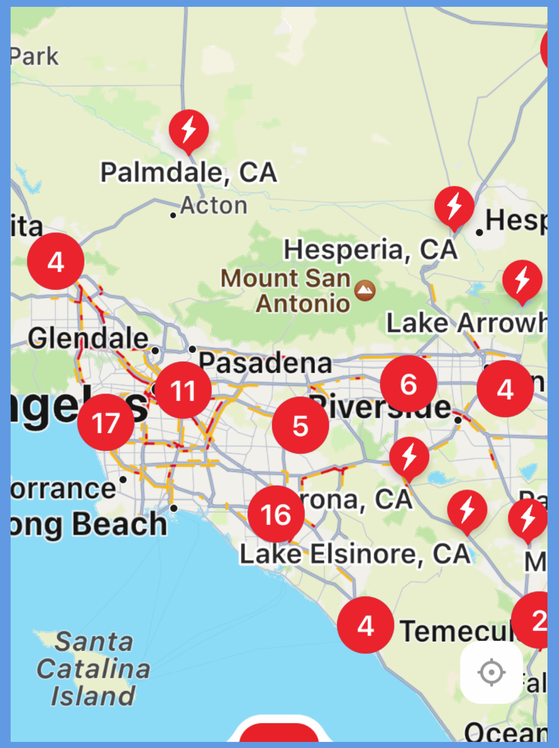


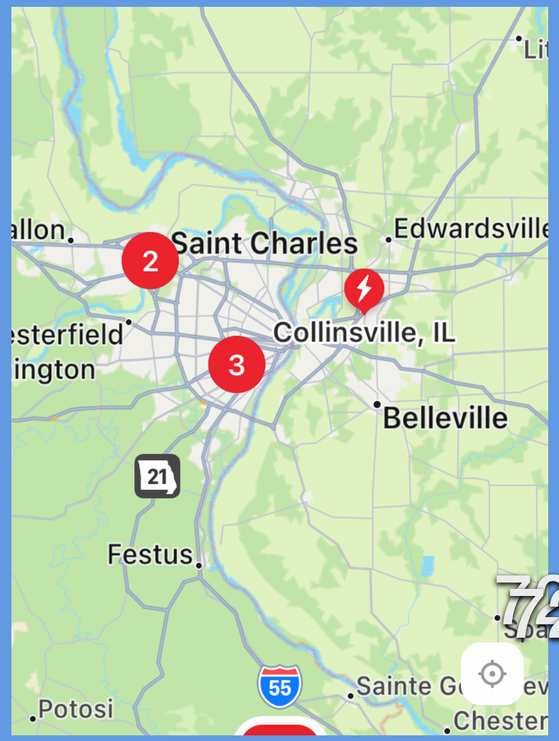
New York

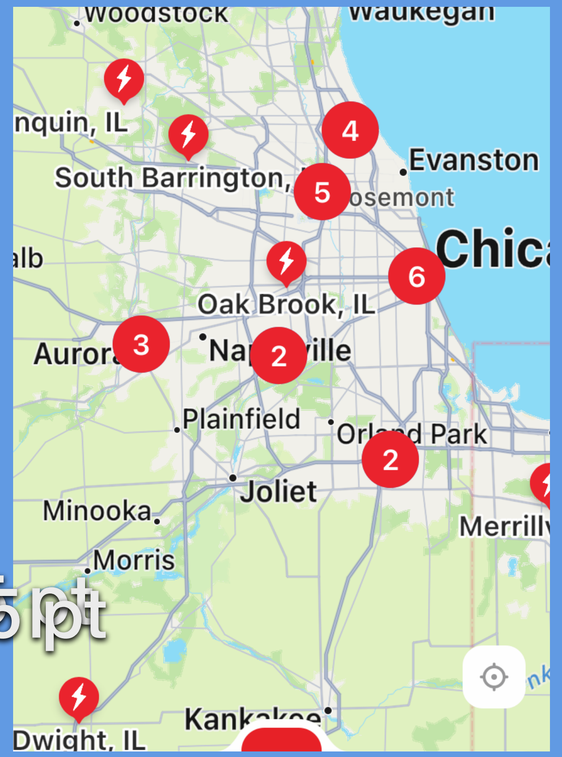
Electrify America
Individual locations

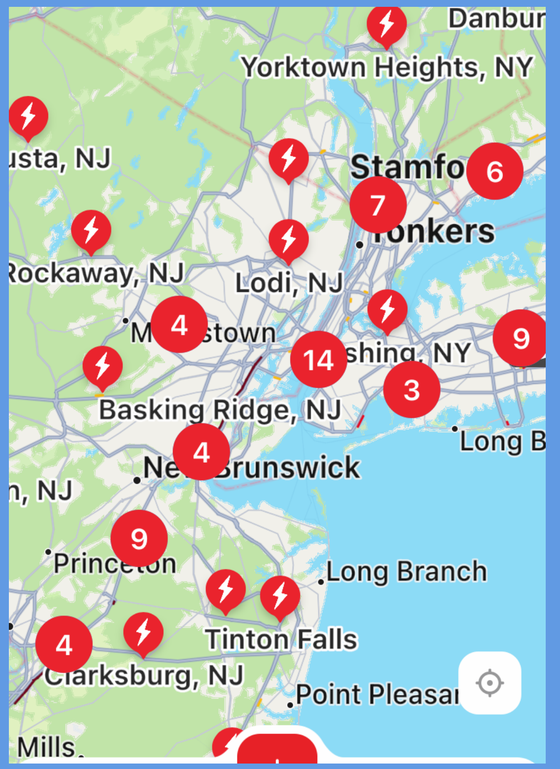
Each map section is the same scale and shows how well each city is served by public charging.
Note: it shows which locations are full.

Session ??: Charger Apps









725 pt

Los Angeles

St Louis

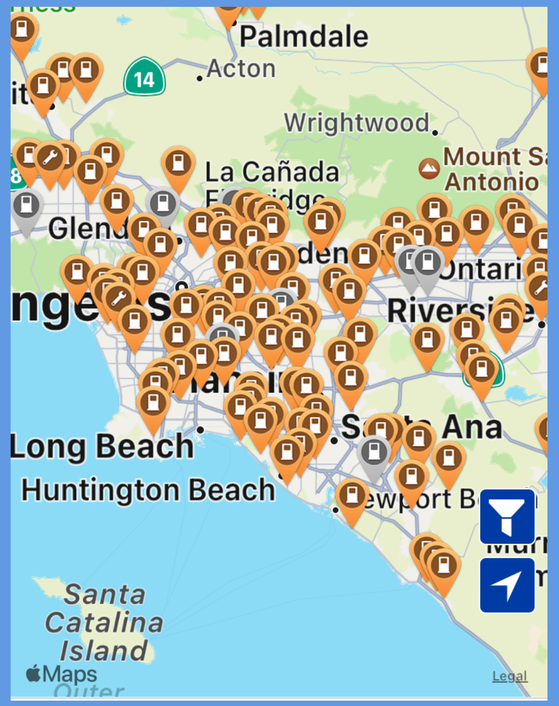
Chicago

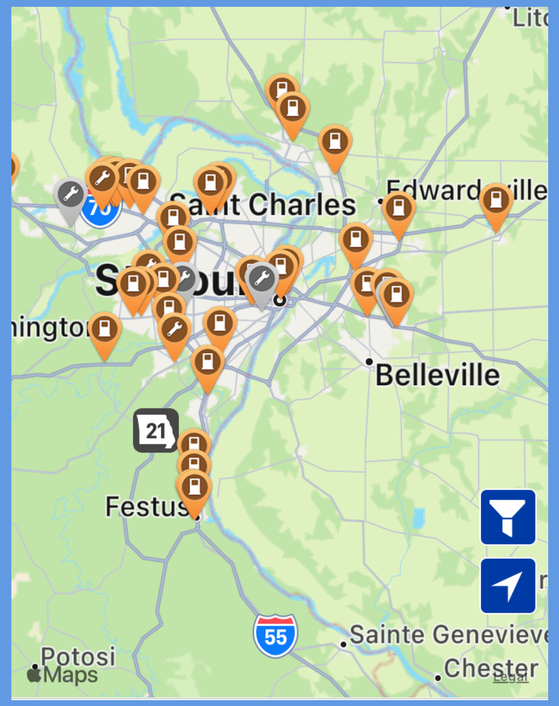
New York

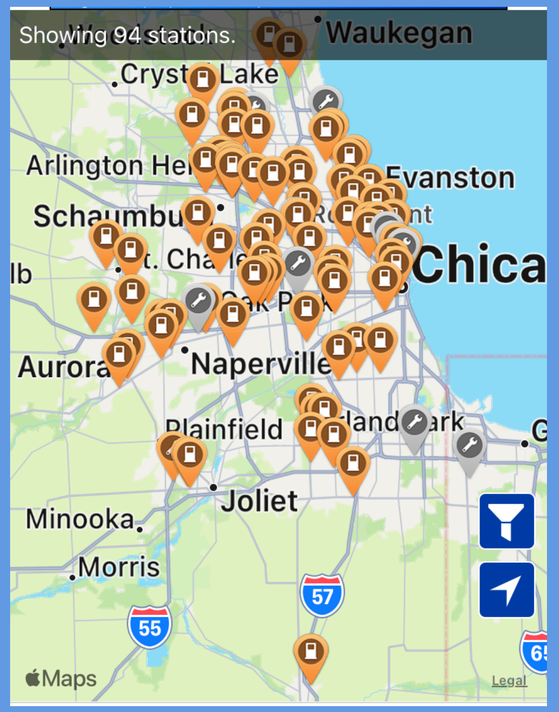
Tesla Superchargers
Groups of locations

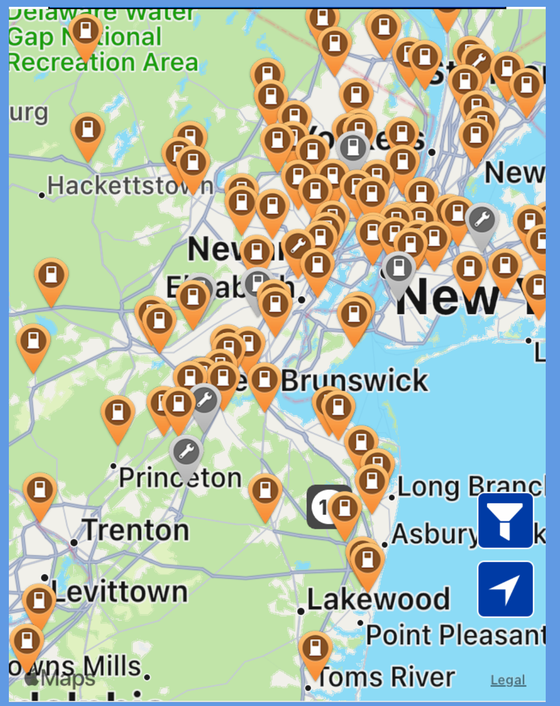
Each map section is the same scale and shows how well each city is served by public charging

Session ??: Charger Apps









Los Angeles

St Louis

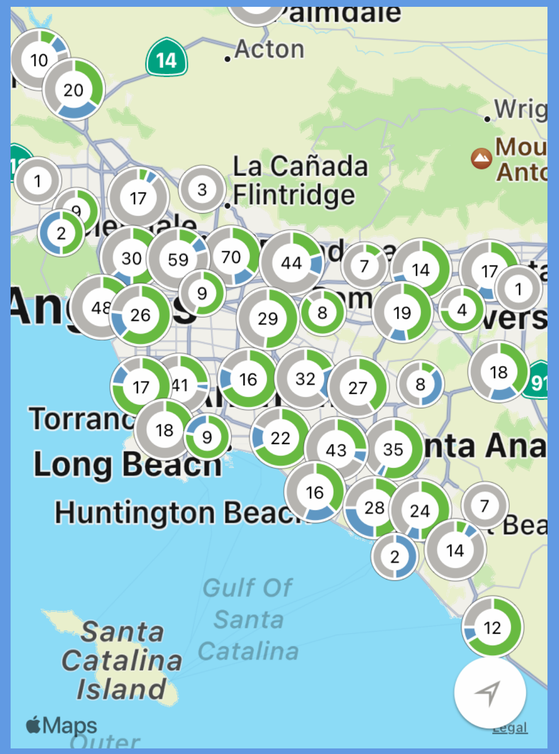
Chicago

New York

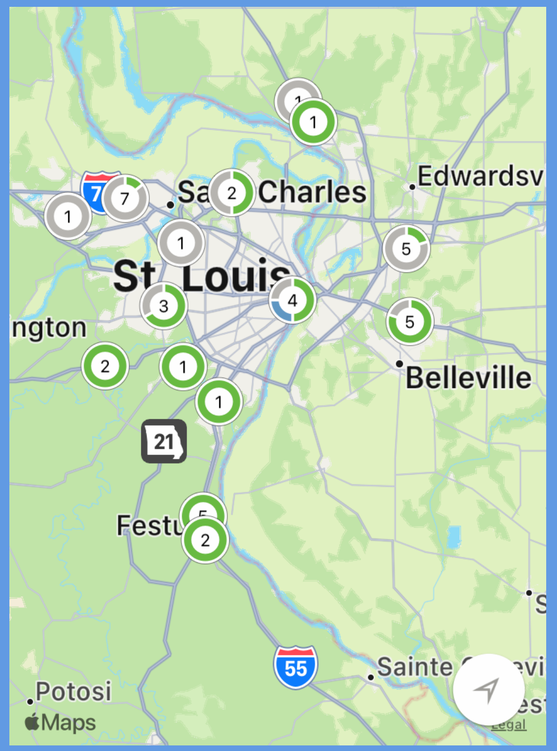
PlugShare
Individual locations

Each map section is the same scale and shows how well each city is served by public charging

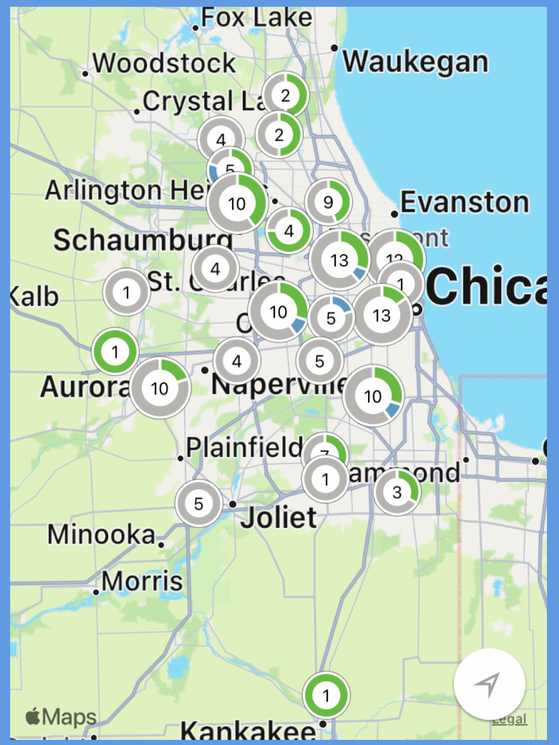
Session ??: Charger Apps



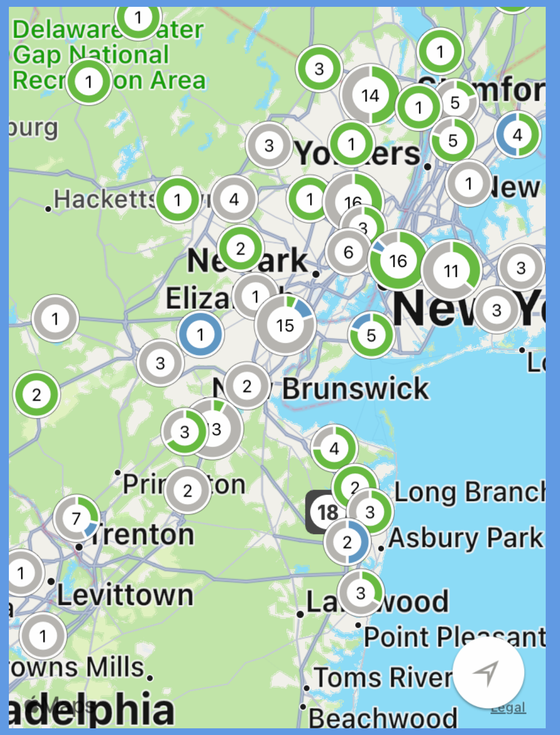
Los Angeles



St Louis



Chicago

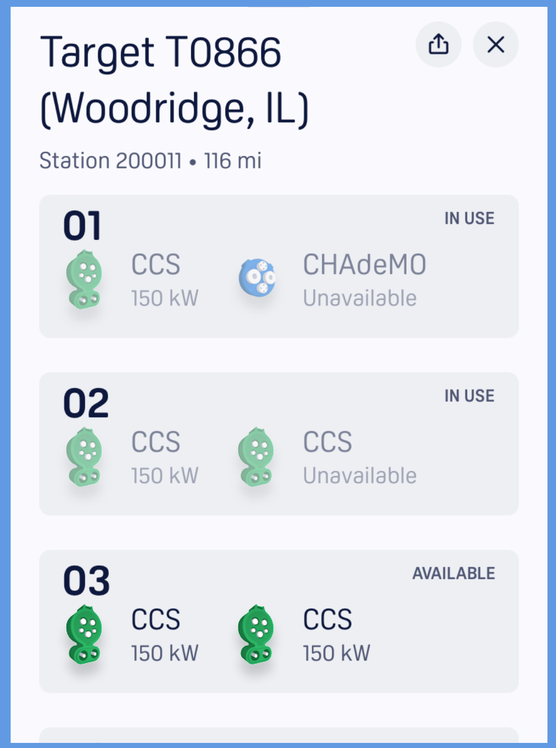


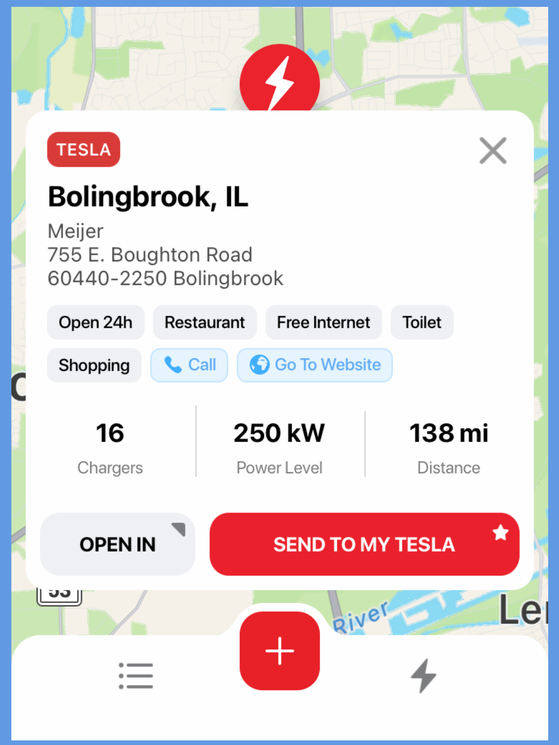
New York

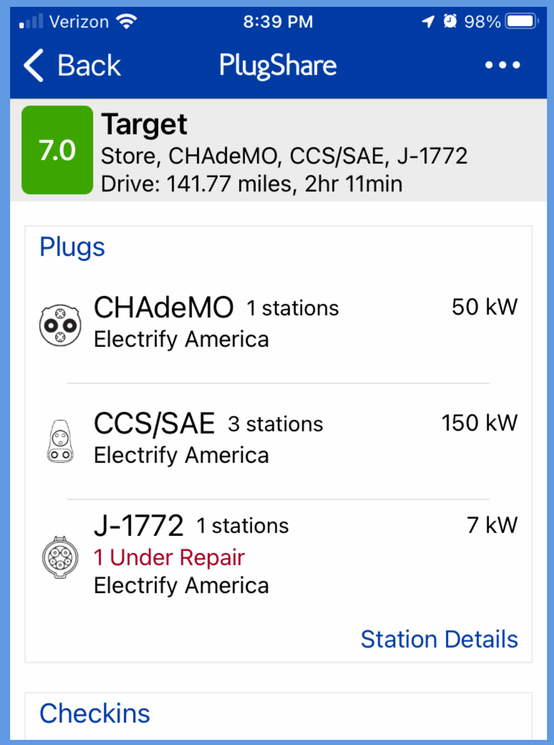
ChargePoint
Grouped locations and current usage.

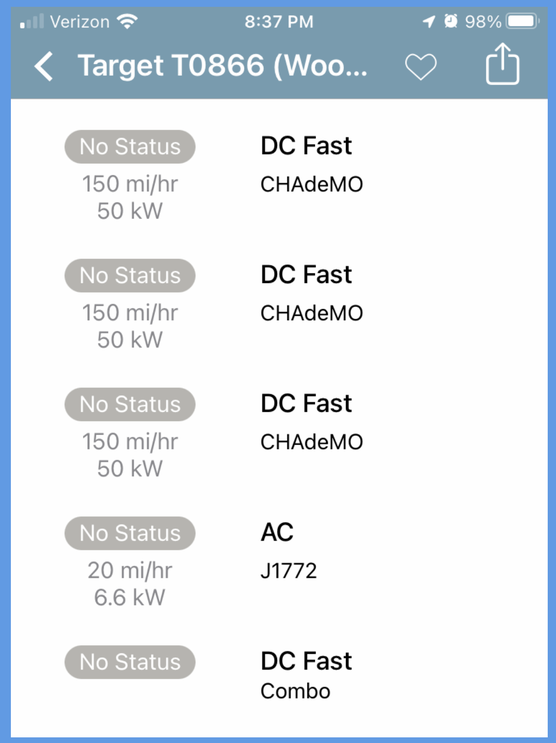
Each map section is the same scale and shows how well each city is served by public charging

Session ??: Charger Apps





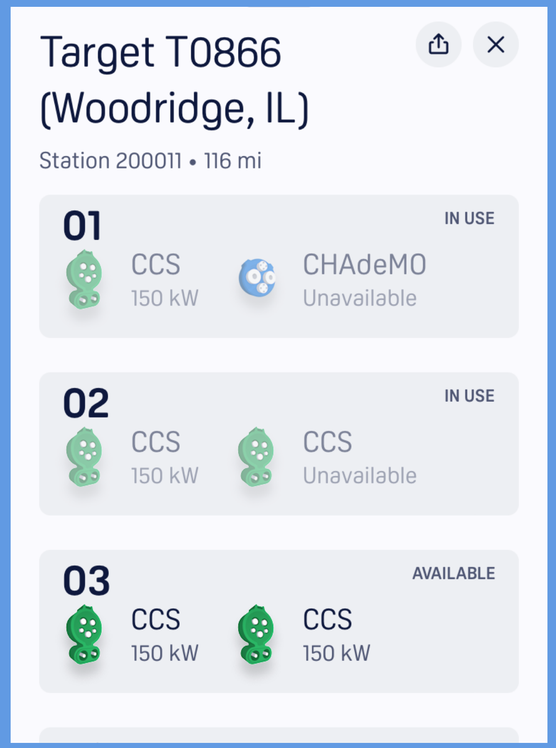


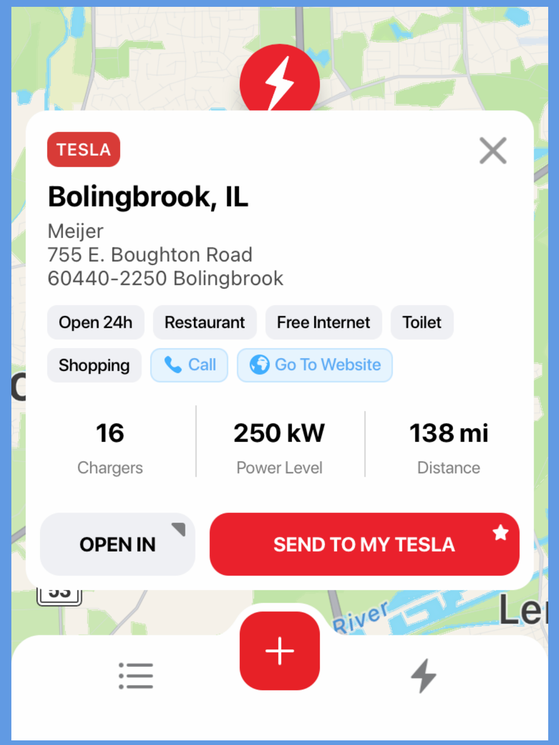


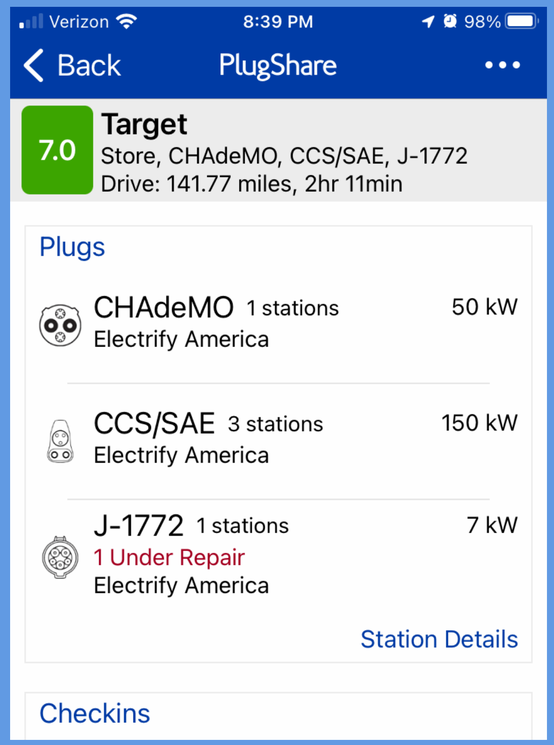
Electrify America | Tesla | Plugshare | ChargePoint

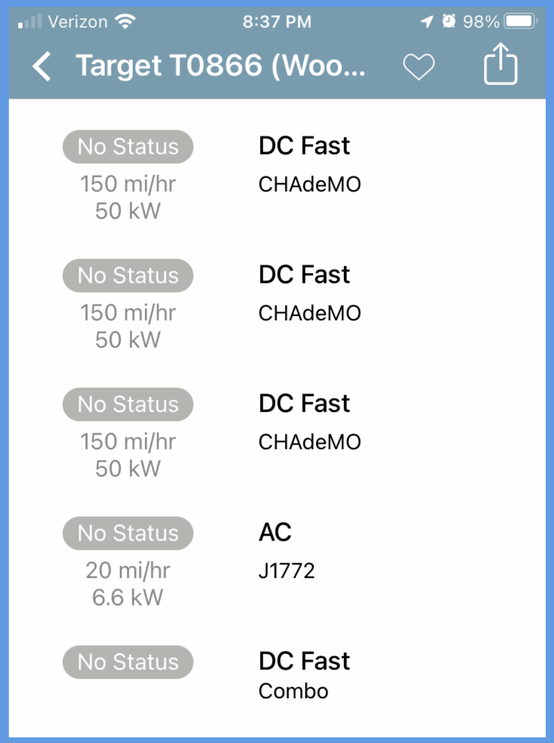
How the four apps display what is available at a location. Electrify America shows charger status and uses a GPS distance (off by 26 miles). Tesla, correct distance and amenities. PlugShare has distance correct, lists correct connectors, shows details with additional tap. (but not status). ChargePoint also does GPS distance, does list the chargers correctly.

Session ??: Charger Apps





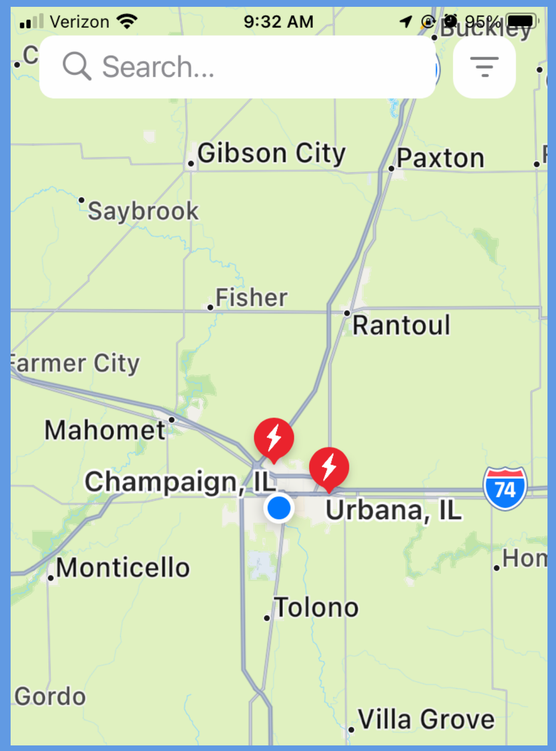


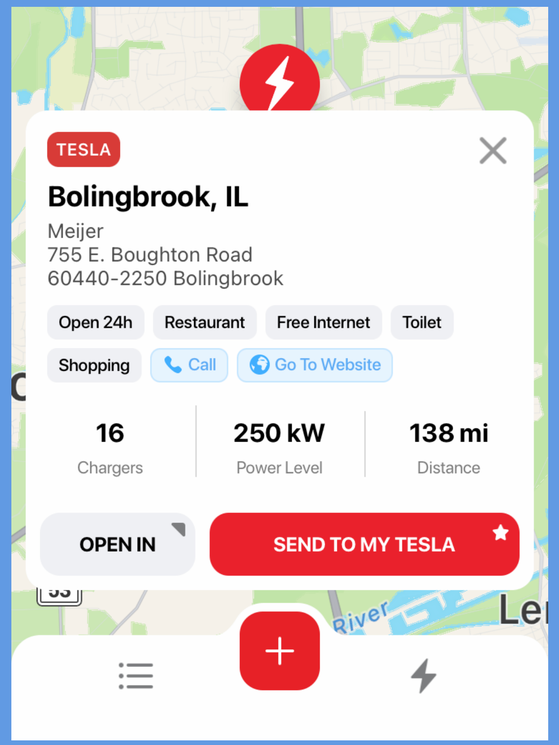


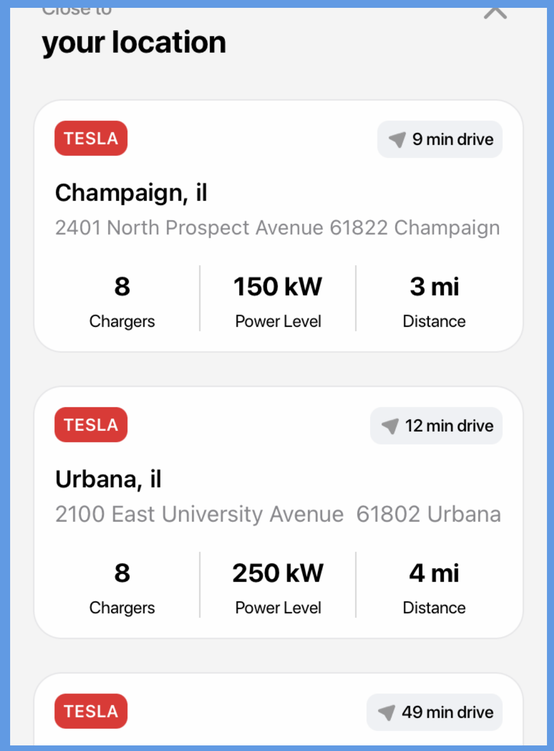
Electrify America | Tesla | Plugshare | ChargePoint

PlugShare is one of the few apps with comments and reviews. Tesla, Electrify America, ChargePoint and others generally will post if a charger is “unavailable” but will not have comments. PlugShare does not have access to network information and will not have information if a charger is currently in use.

Session ??: Charger Apps





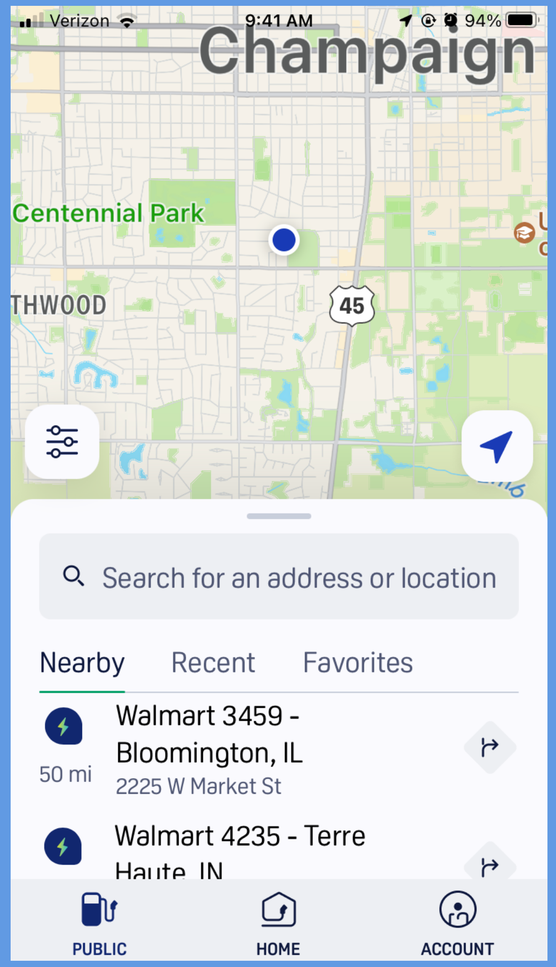


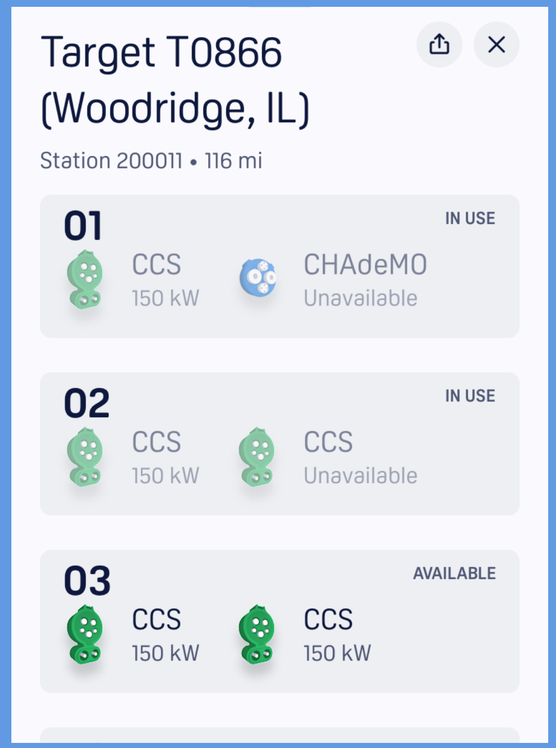
Tesla

Tesla is its own world - you only need it if you own one.

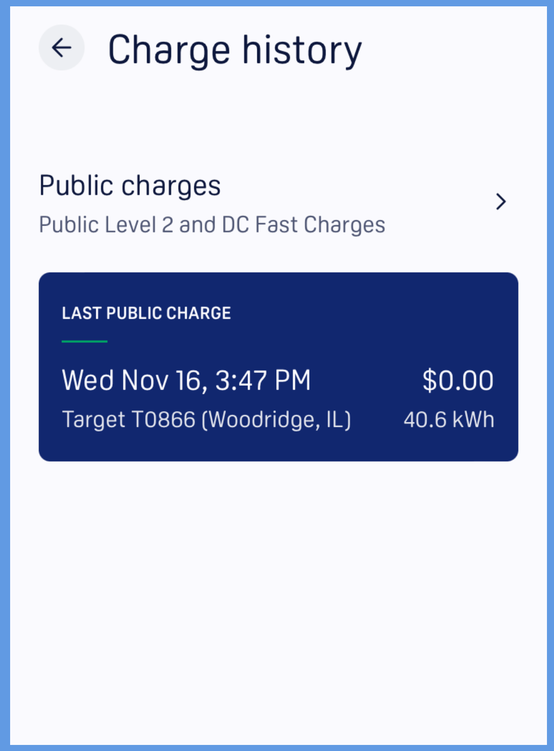
Left image the start screen if you're in Champaign, center -the location on I355, right - details of current location.

Session ??: Charger Apps



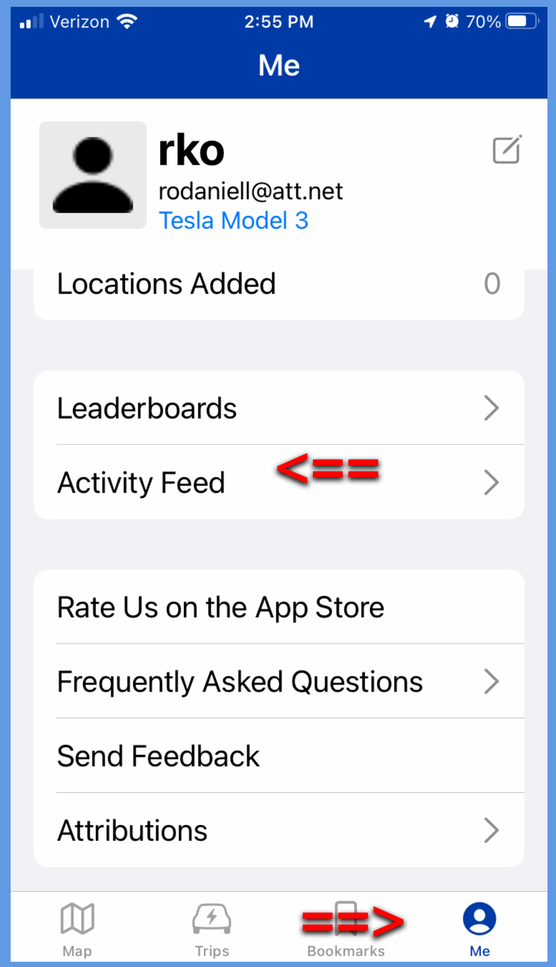


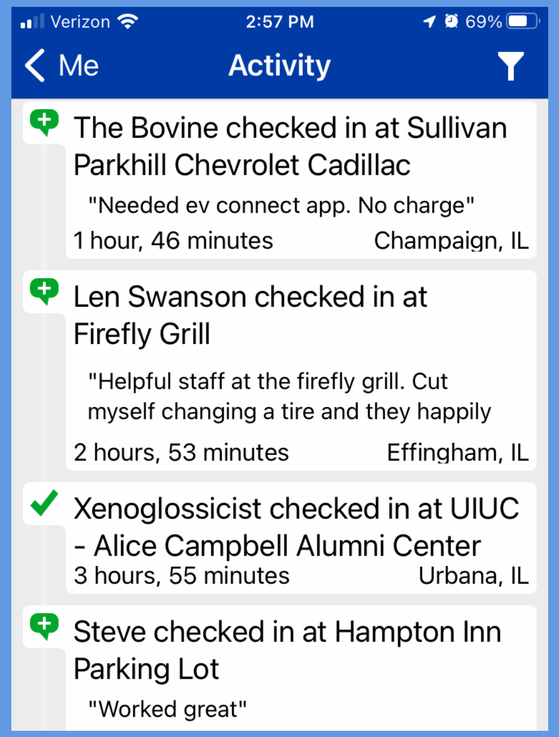
Electrify America

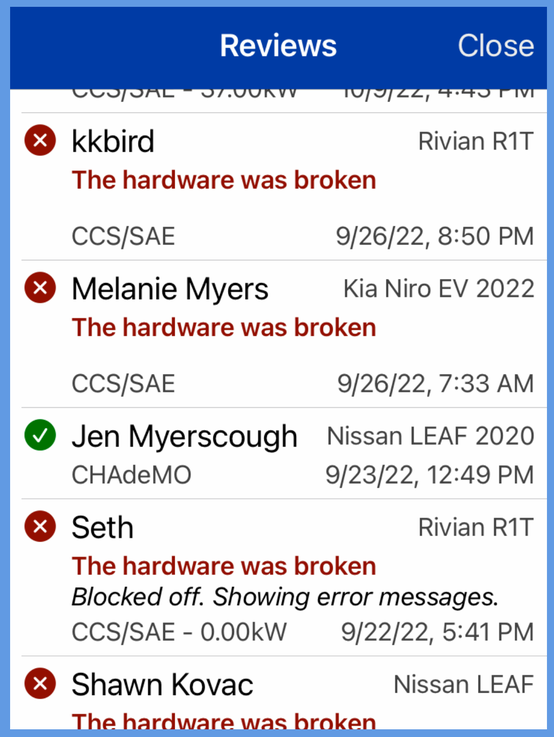


EA- I find very useful because its the best high speed charging network. Left image the start screen if you're in Champaign, center -My go to location in the Chicago area, right - I like the charging history .

Session ??: Charger Apps







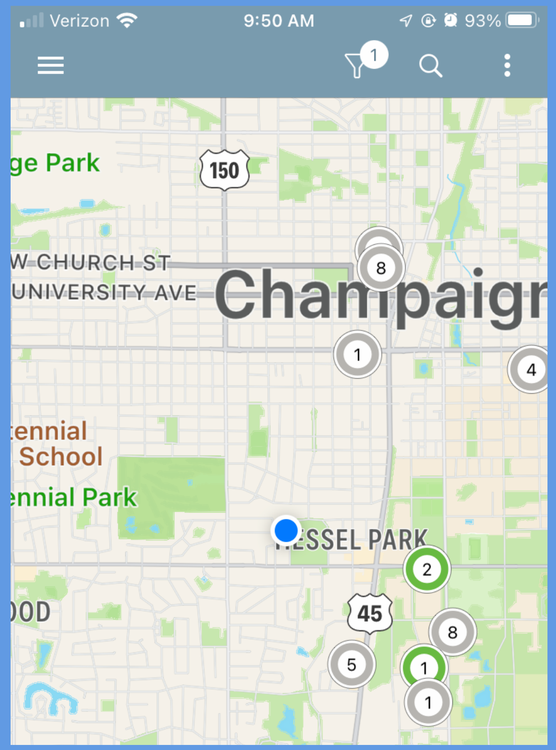
The "reviews" are checkins posted directly to a specific charger location, in this case the Wally's in Pontiac, still having charger problems.

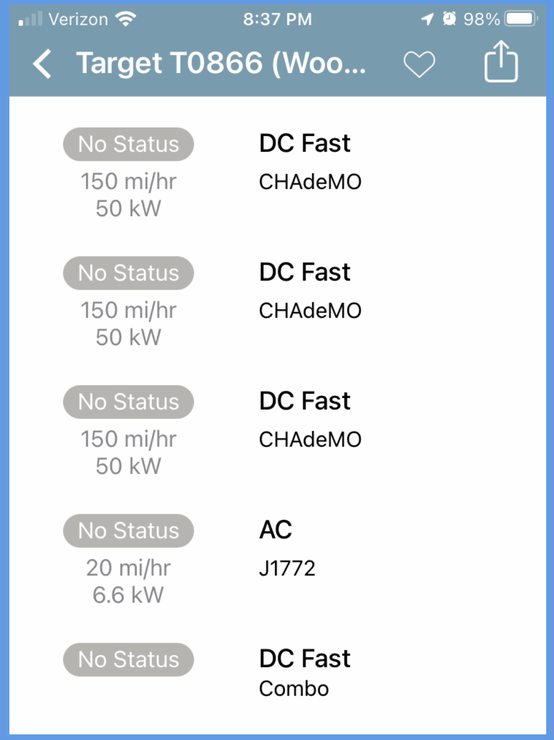
Plugshare

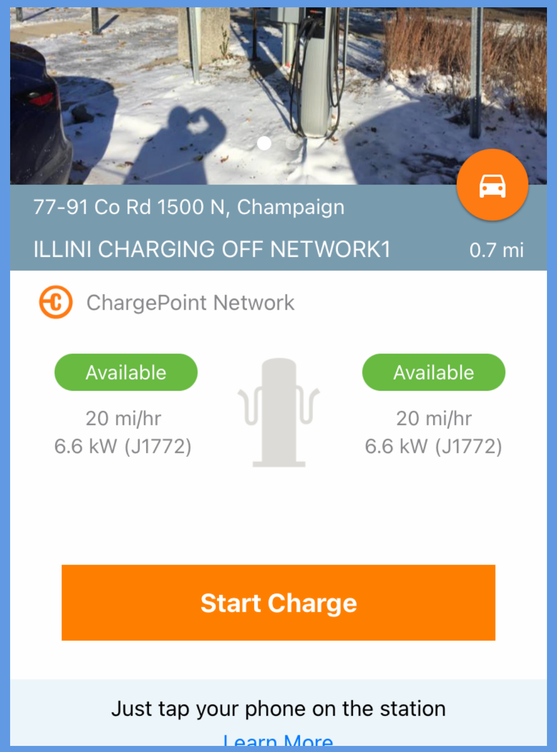
Plugshare is a crowd source App

EV users locate, comment on, describe, add photos and review public chargers. Click on the "me" at the bottom, then "activity feed" (red arrows) and you will get the most recent checkins from an area within 50 miles or so from your current location.

Session ??: Charger Apps



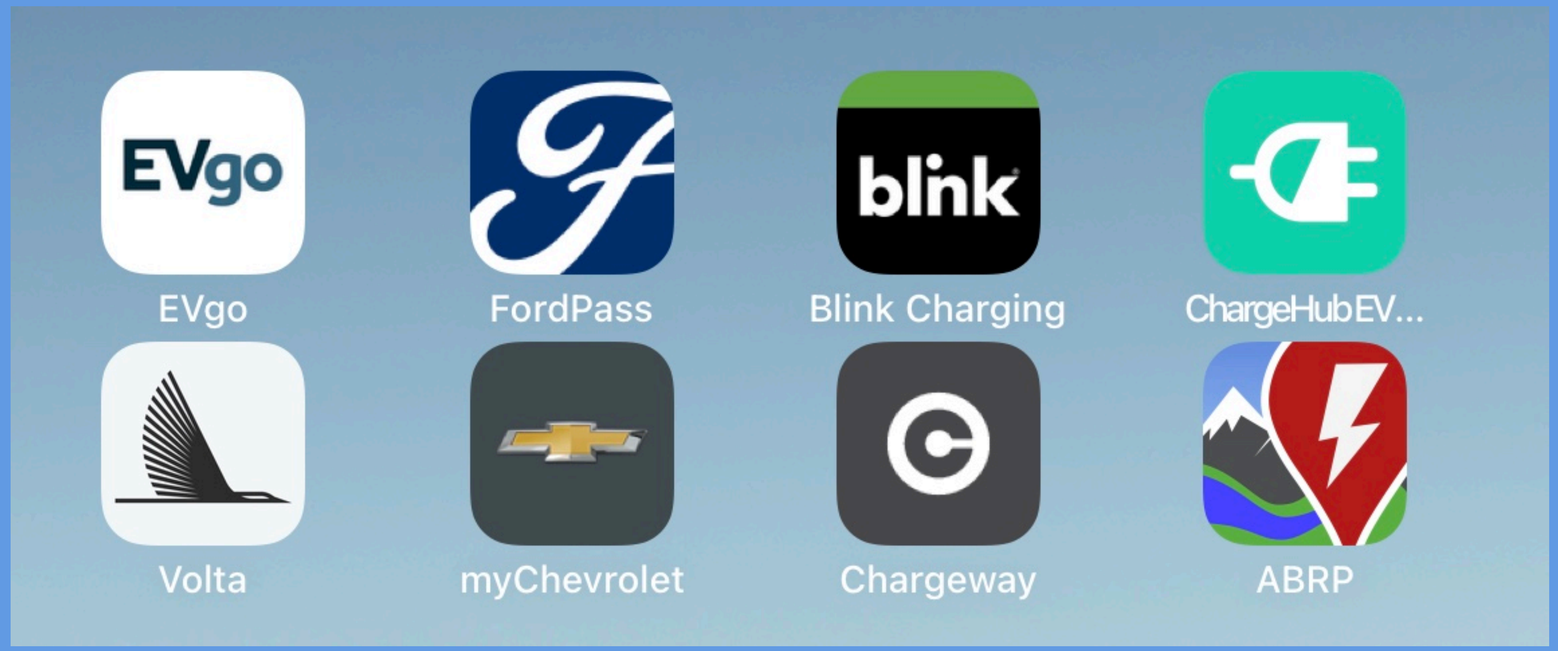




ChargePoint

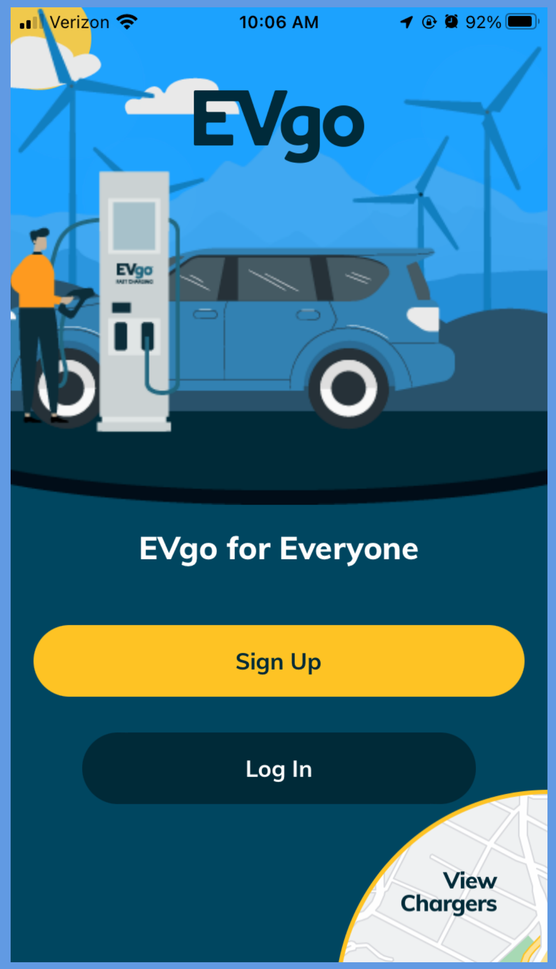
I don't find very useful except for using the app to when using a charge station (right screen) Left image the "home" screen if you're in Champaign, center - a description of an Electrify America location. I prefer to find Level2 stations with PlugShare , then switch to Chargepoint app if its one of theirs.

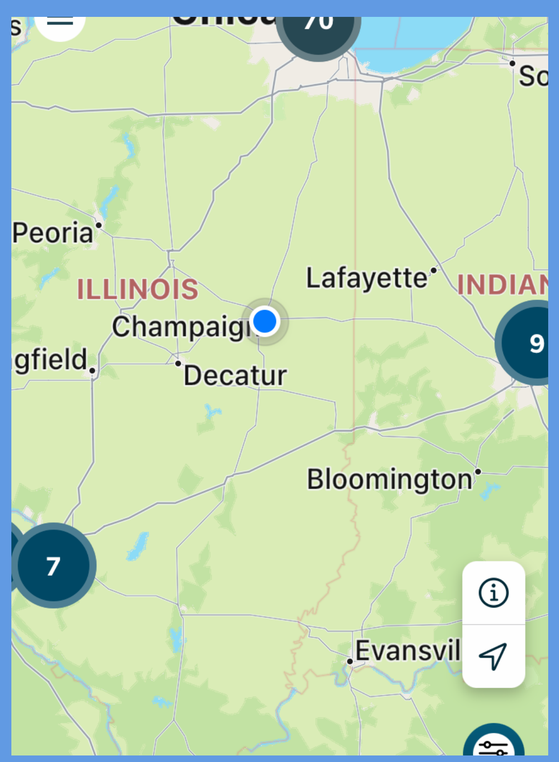
Session ??: Charger Apps

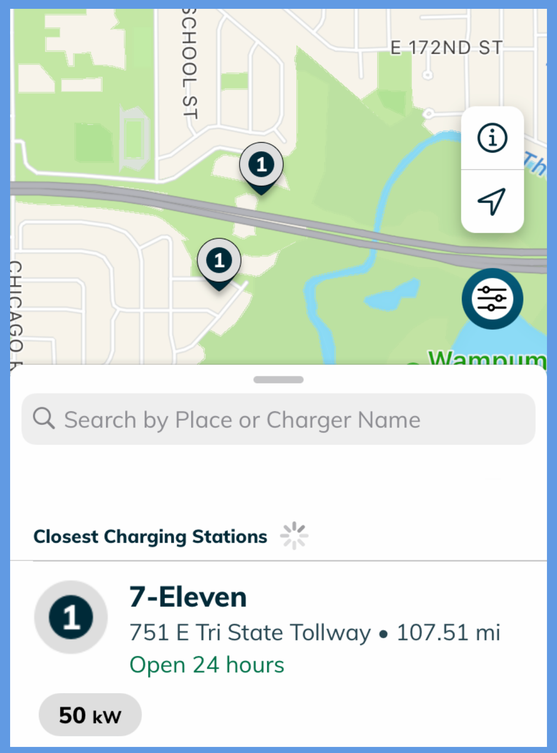


A quick run-through of the others.

Session ??: Charger Apps





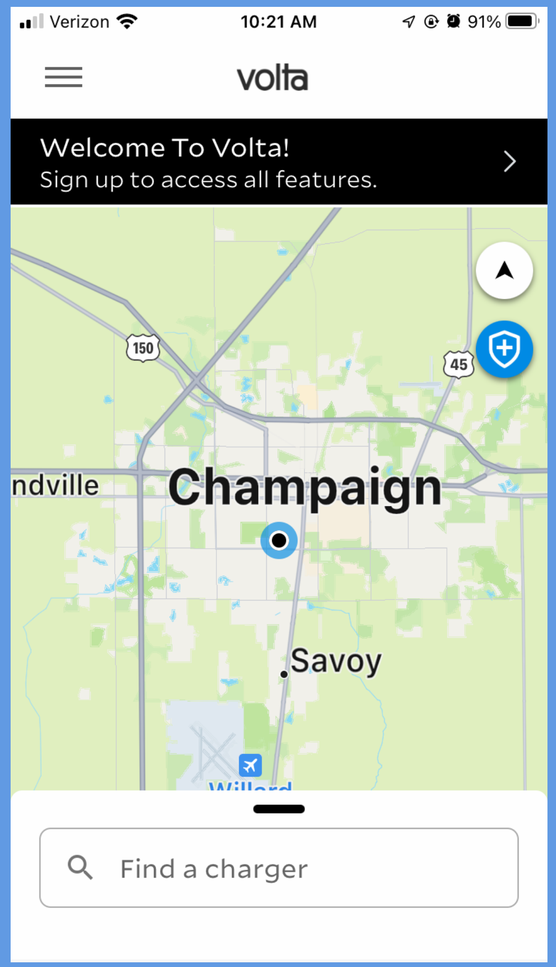


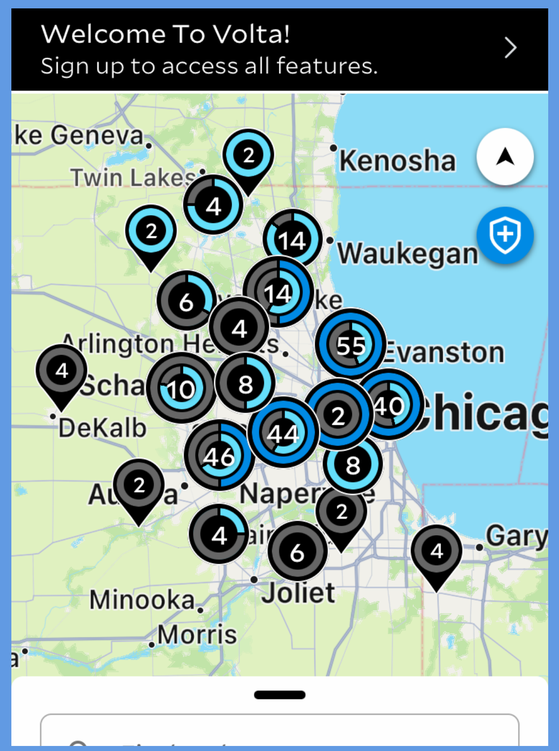
Left image the start screen, center -very few locations in Illinois, right - details of a typical location with only one 50 kw charger.

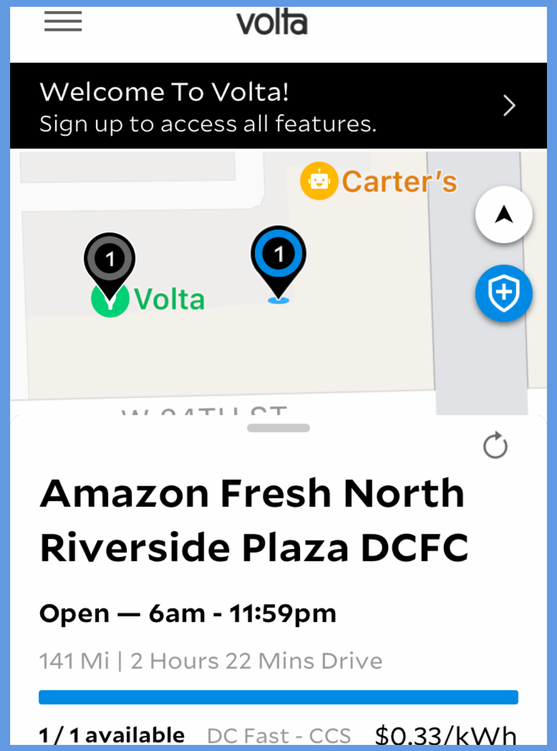
EVgo

EVgo used to be somebody - until 2020. Their growth stalled and Electrify America was started with $2 billion dollars of VW “Dieselgate money”. EA rapidly outpaced them with locations with a minimum of 4 150kw chargers. EVgo is just beginning to grow again, adding locations with multiple chargers of 150 and 350 kw.

Session ??: Charger Apps



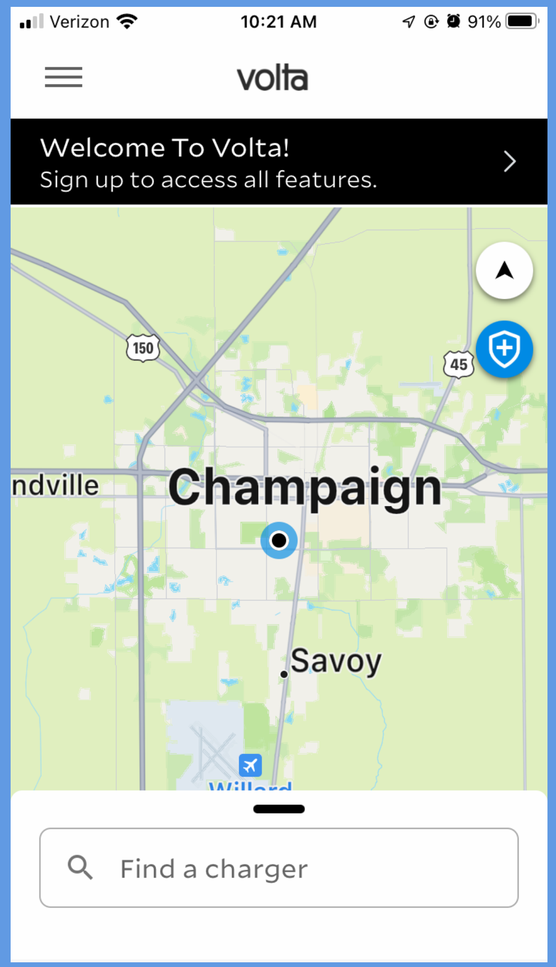


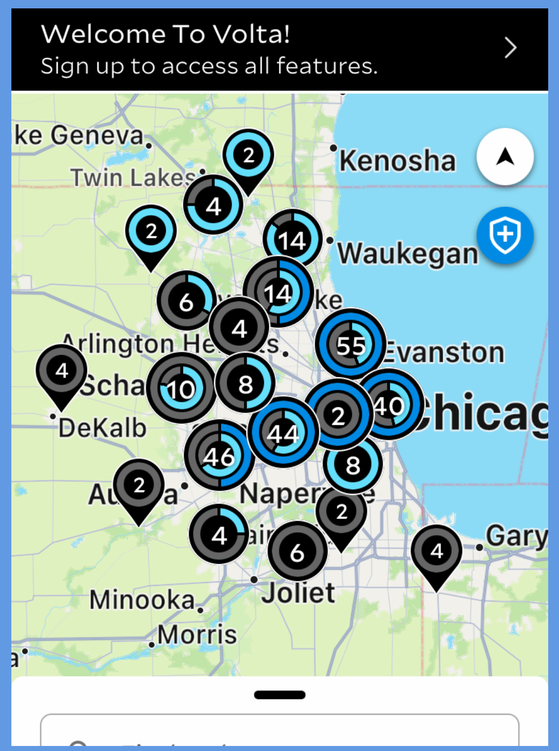


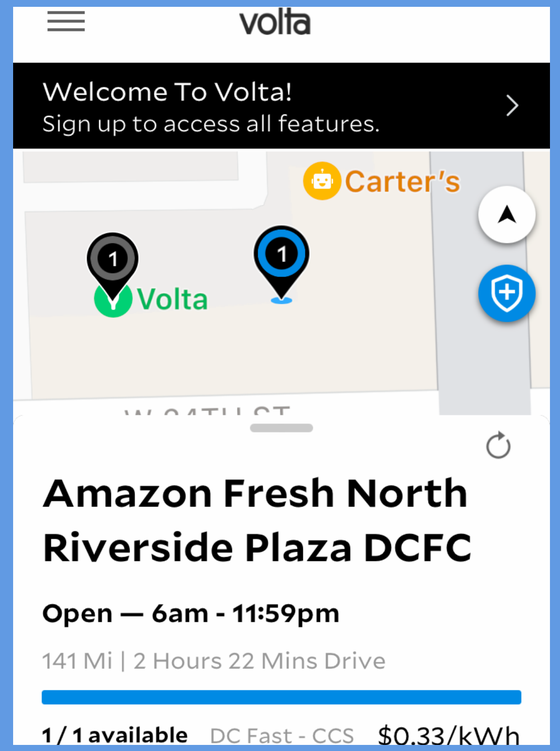
Volta

Mostly level 2 chargers that are FREE. They approach shopping sites, install chargers free to the stores, let EV drivers charge for free and make all of their money advertising on the Charger cabinet. Branching into DCFC, but those have a fee.

Session ??: Charger Apps







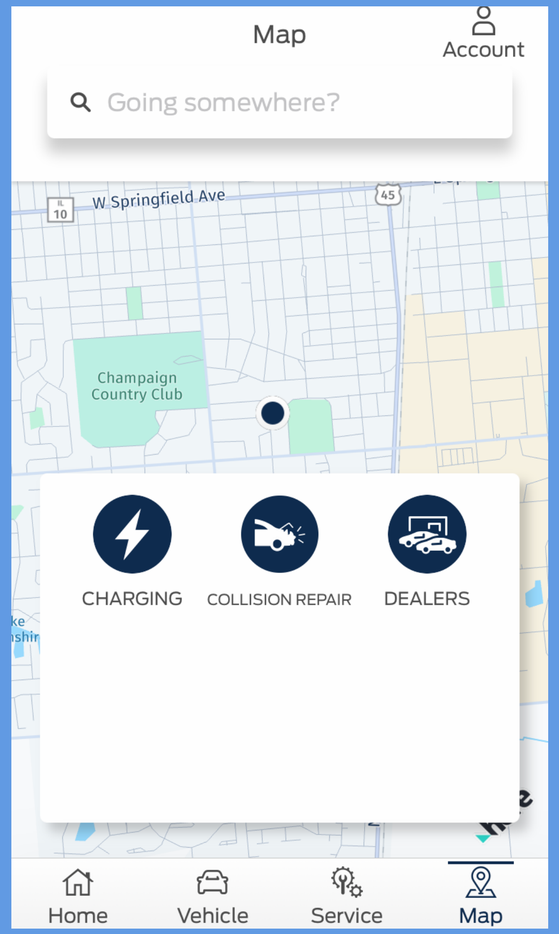
Left image the start screen, , center -Chicago locations, right - details of a location with DCFC charger. Volta DCFC are usually between 50-100 kw.

Volta

I LOVE Volta - I bought some stock, lost 90% of my money. Excellent charging experience, excellent business plan. Made every prudent long term move and the stock market hammered them. They deliberately slowed growth to wait for Jan 1st federal money.

Session ??: Charger Apps

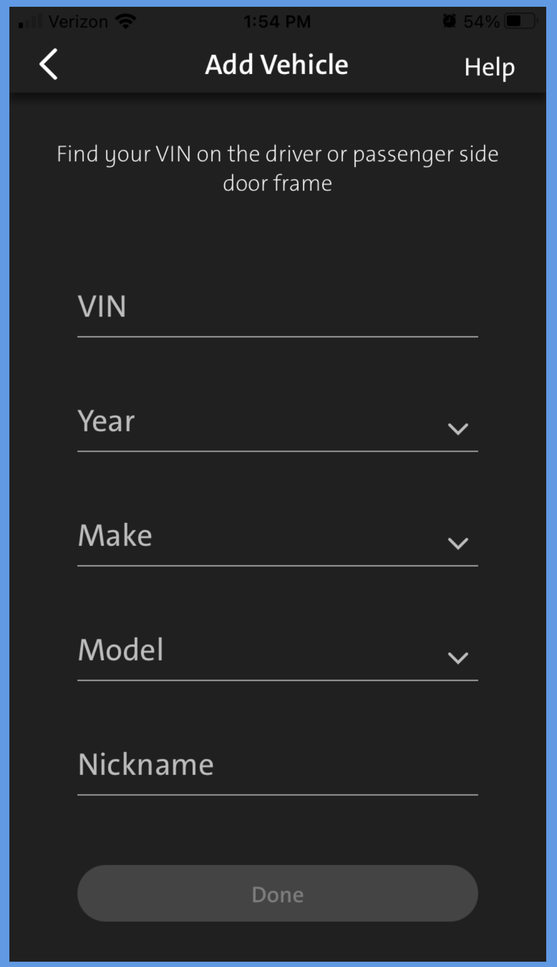
Electrify America

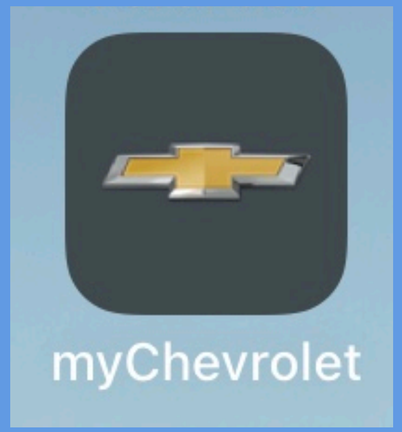


FordPass

Its an app aimed at Ford owners. It has links to services other than charging. Ford does not have a network. When companies like them claim and name a network, almost always it is a partnership with actual charging networks.

Session ??: Charger Apps





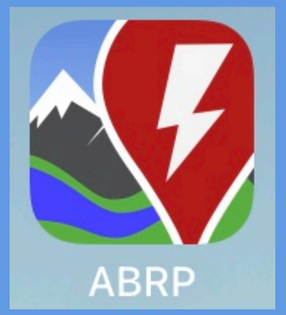
Chevy an app is so aimed at Chevy owners you need a VIN to sign up.

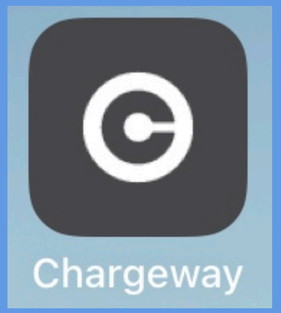
Ford and Chevy apps are likely mediocre at finding chargers. Dedicated apps do a better job of giving information about the chargers and allow better decisions to be made.

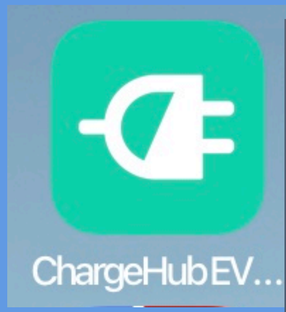
Session ??: Charger Apps

I mentioned before that Blink charger fees are high. Blink would be my last choice for a charger. But sometime it might be the only charger. If so consider signing up on the app to get discounted fees.

Shell is starting a program to install DCFC at gas stations. App call ShellReCharge. Charging network is Greenlots renamed. Planning installation of 500,000 chargers by 2025. Currently this app has little use (IMO)





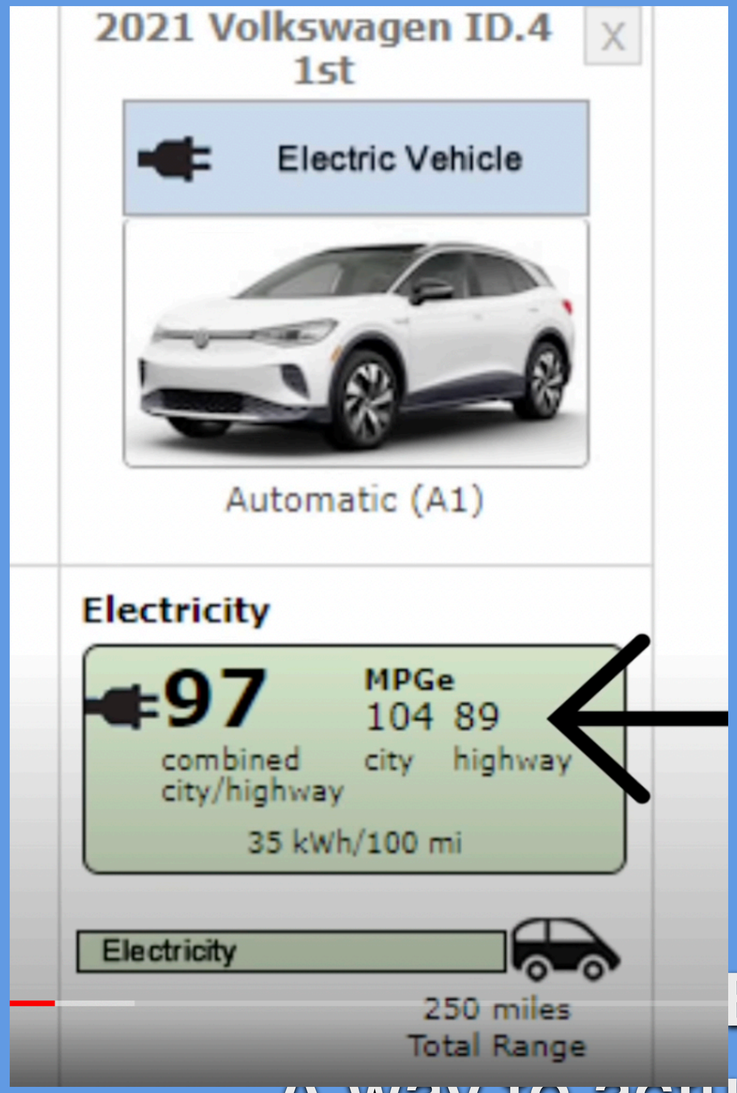


ABRP (a better route planner) ; Chargeway; EVConnect; and ChargeHubEV. Primarily early attempt to make route planning easier. Interesting concept - try them. I personally will do most of my planning with Electrify America and use PlugShare to fill in the gaps. Both work quite well on the dining room table with a cup of coffee. (Or at a coffee shop)

This is the end

This is the end

This is the end



EVI minimizes distance

A way to actually know distance is always good.

Use slide f .

Range anxiety is not kn drive
And is that enough r.
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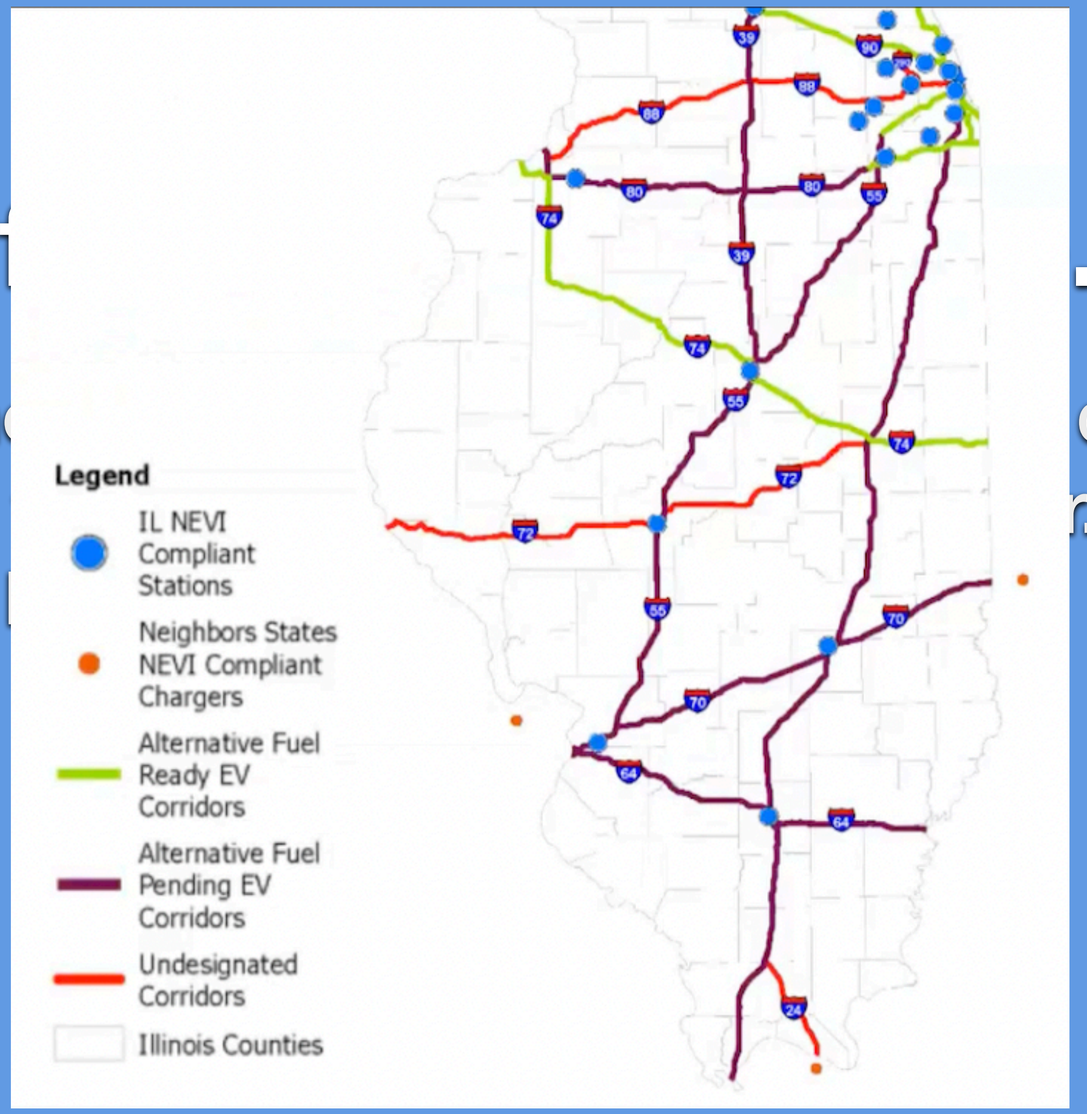
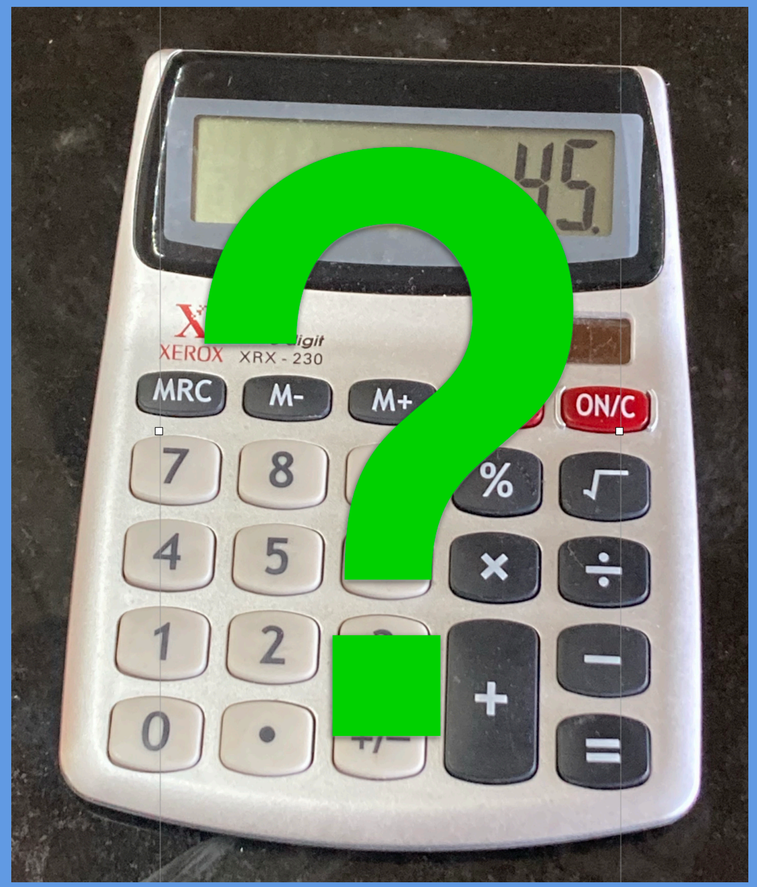
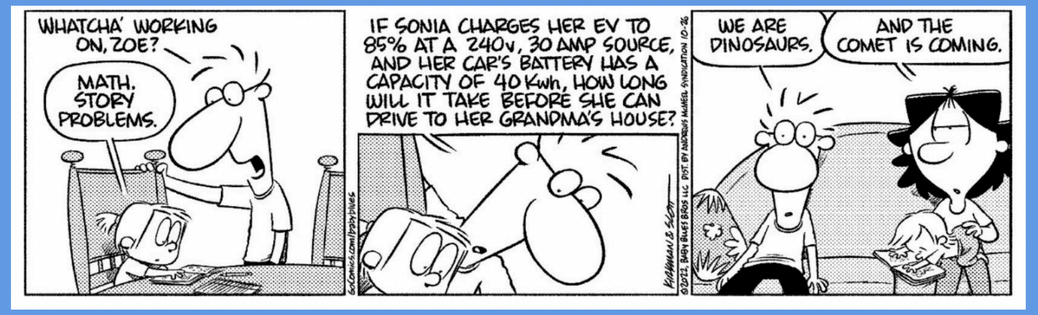


Session 4 : Range

Past Performance vs Future Results



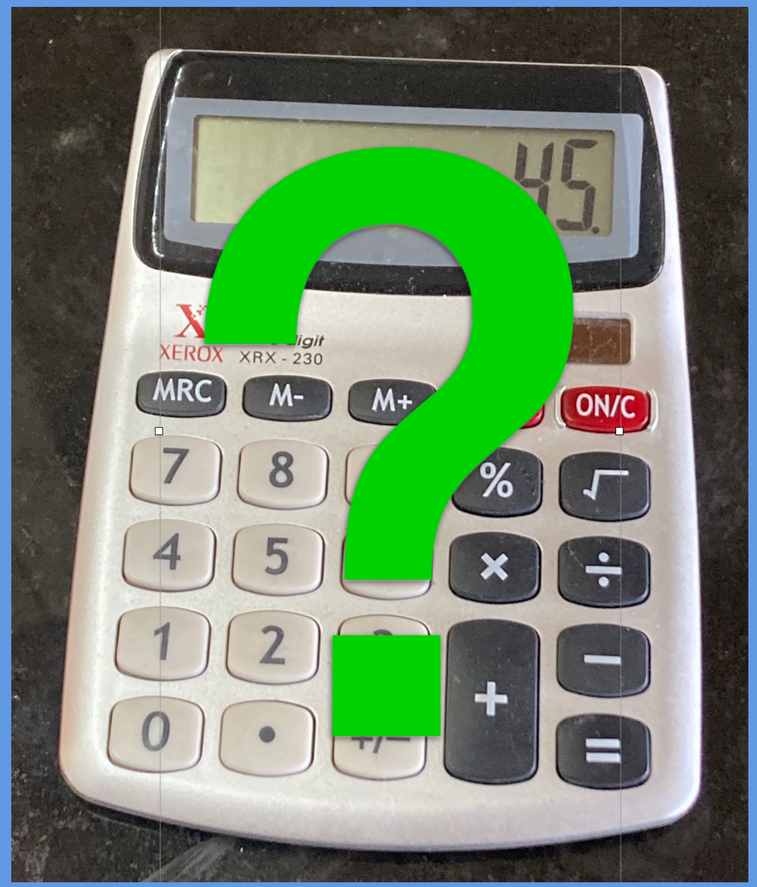


NEVI minimizes distance

A way to actually know distance is always good.

Session 4 : Range

Past Performance vs Future Results



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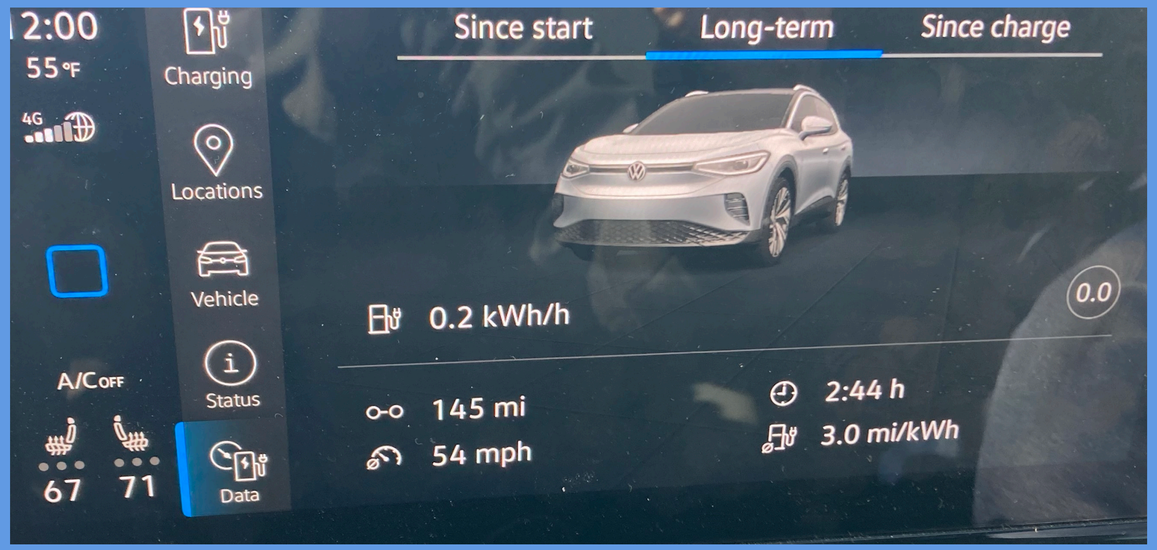
Session 4 : Range

Past Performance vs Future Results



Downhill

NEVI minimizes

A way to actually know distance is always good.

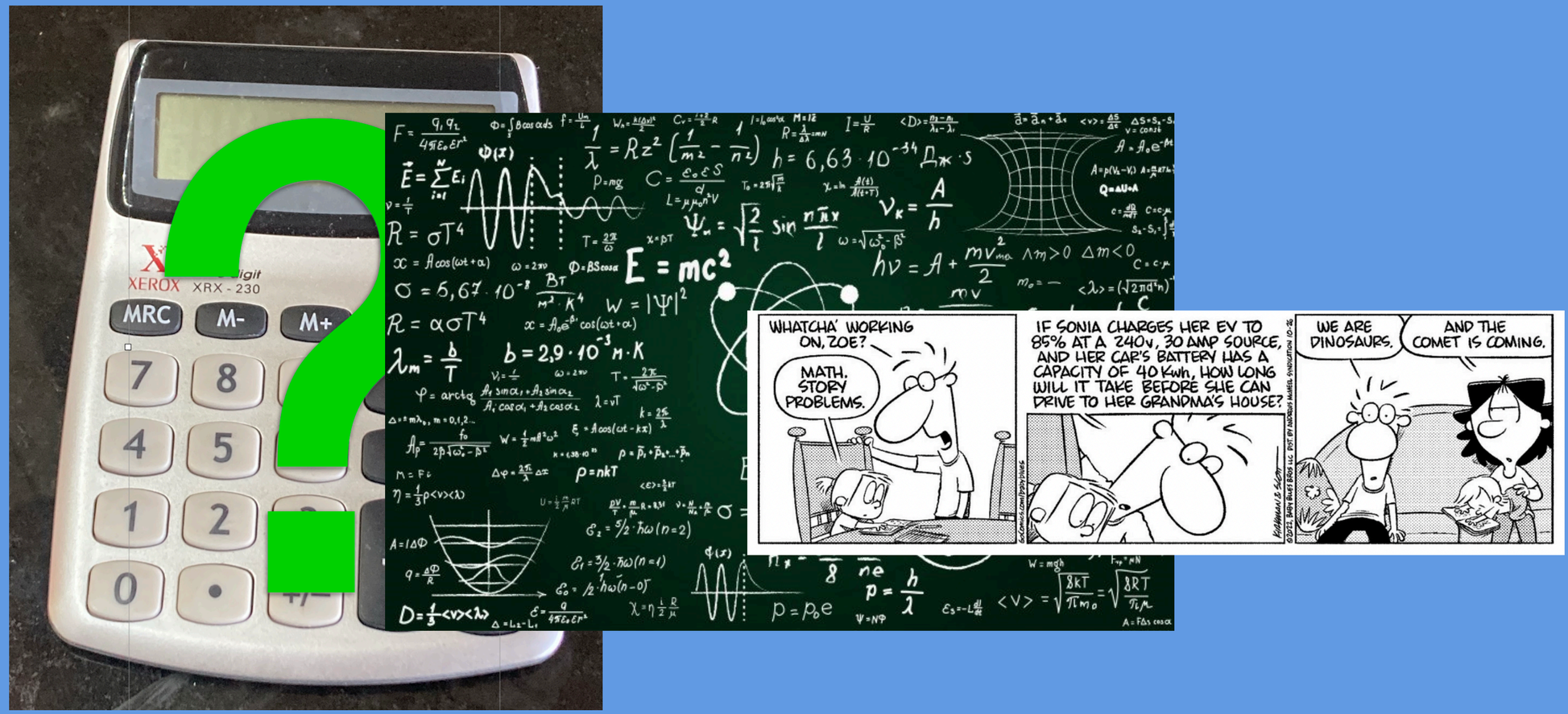
Session 4 : Range

How to get a good average from low numbers

2.6

Session 4 : Range

Past Performance vs Future Results



NEVI minimizes distance

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