

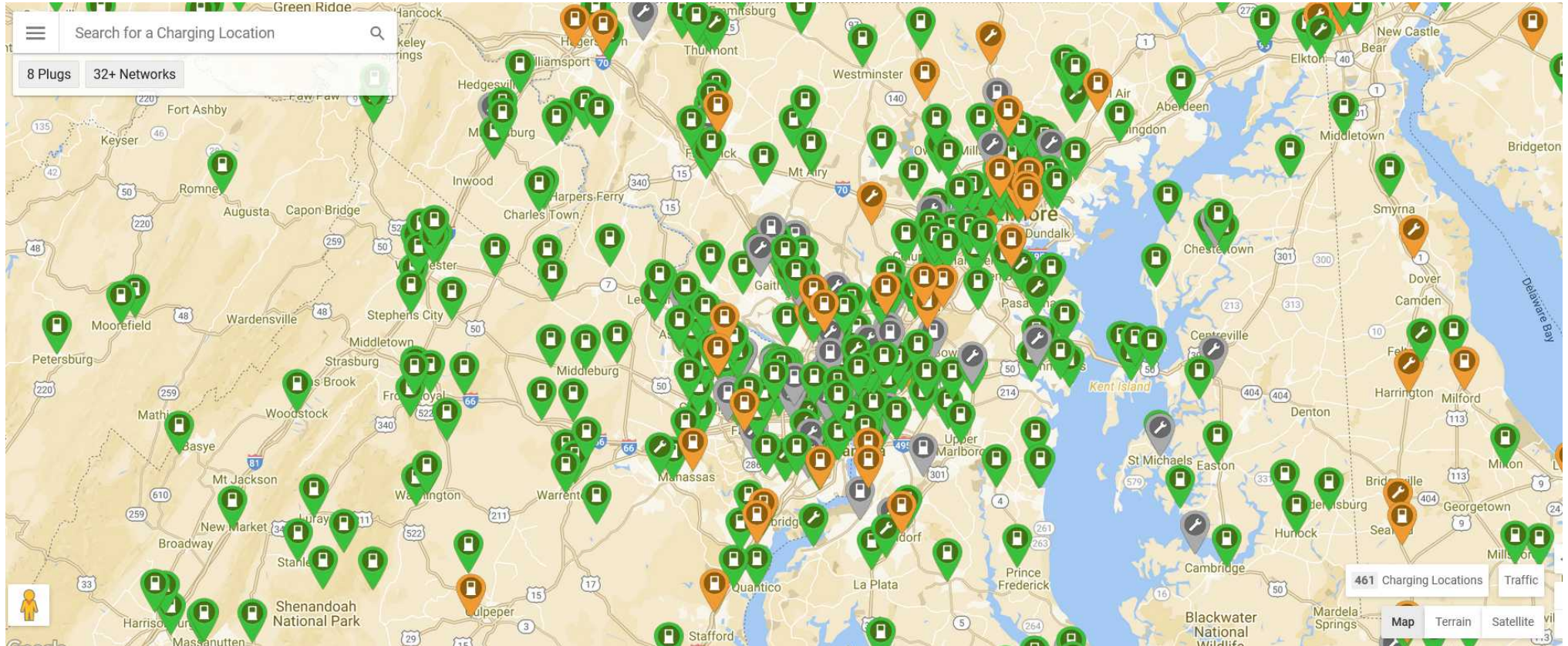
**Find Zero-cost
Charging Stations
for your PHEV or EV**

Presented by John Krout

For PATACS+OPCUG

April 20, 2024

Zero-cost car charging stations are not difficult to find



Map provided by Plugshare.com

Agenda

- Car charging tech language refresher.
- My 2023 PHEV Road Trips.
- Car charging systems are not perfect.
- How to use three free apps for finding zero-cost charging stations.
- How to obtain the free apps for Apple and Android smart phones.

**CAR CHARGING
TECH LANGUAGE
REFRESHER**

Car charging power level ranges

- A **Level 1 charger** plugs into an ordinary AC socket and usually provides less than 1 kilowatt of power, Charging is slow. I use mine overnight at home and vacation rentals.
- A **Level 2 charger** provides anywhere from 1 kilowatt to 50 kilowatts of power. Charging is much faster. Used by PHEVs, and sometimes by EVs.
- For EVs, a **DC Fast charger** can provide 50+ kilowatts of power. Many provide 100+ kilowatts.
- Charging station power greater than the maximum power your car can accept will not hurt your car or the charging station.











Car charging networks

- Many car charging stations belong to a charging **network**, meaning a brand.
- Network charging stations usually provide a **free smart phone app** to:
 - * **find charging stations on a map**,
 - * **unlock and activate** a charging station,
 - * **pay the fee** (if any) for charging station use, and
 - * contact **customer service**.
- Some car charging stations are **non-network** and require only that you connect the charging cable to your car, and possibly push a **START** button on the charger.

Car charging sockets and plugs

- Each EV or PHEV provides one or two sockets for charging.
- There many such sockets: J-1772, CCS1, CHAdeMO, Tesla NACS
- Each charging station has one or at most two types of charging plugs on its charging cables.
- Tesla Model 3 EV uses NACS but includes a socket adapter for using J-1772 to “top off” slowly.

Pictures of the four types

Current type	Region			Tesla	
	Japan	North America	Europe, rest of world inc. Tesla 3 & Y	Tesla: Models S & X Rest of world	Tesla: (plug) N. America
AC					
Plug name:	Type 1 (J1772)	Type 1 (J1772)	Type 2 (Mennekes)	Modified* Type 2	NACS
DC					
Plug name:	CHAdeMO	CCS1	CCS2	Modified* Type 2	NACS

Language in this presentation

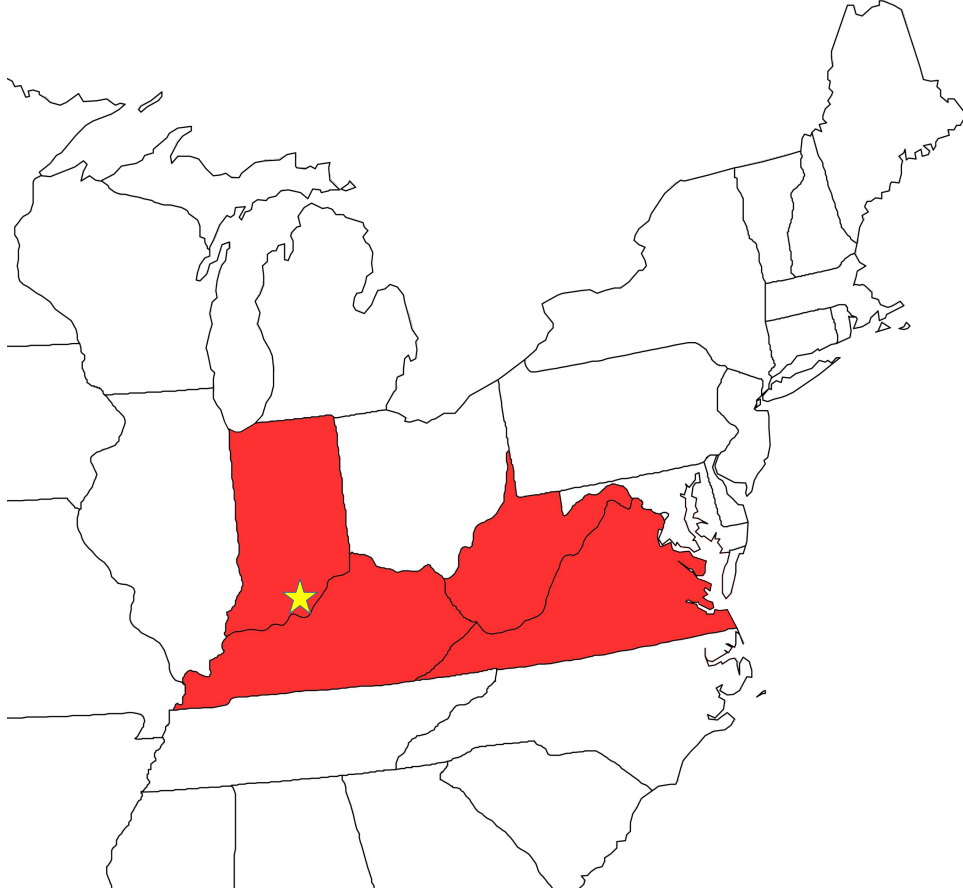
- In this presentation, a Level 2 charging station cable with a J-1772 plug at the end is called a **J-1772 cable**.
- A DC Fast charging station cable with a CCS1 plug at the end is called a **CCS cable**.
- A DC Fast charging station cable with a CHAdeMO plug at the end is called a **CHAdeMO cable**.
- ** Some zero-cost charging stations for Tesla have NACS plugs but nonetheless are Level 2, not DC Fast.

**My 2023 Road Trips
and my
2020 Prius Prime PHEV**

Owensboro Kentucky

- Site of annual Geowoodstock event for geocachers, Memorial Day weekend 2023.
- A small city on the Ohio River
- Only a week or two earlier, I decided to attend. I found affordable lodging in nearby Evansville Indiana.
- Evansville has many charging stations, and car dealers selling PHEVs and EVs. Owensboro has very few charging stations.
- I located zero-cost car charging stations there using the PlugShare app already installed on my phone.

The Road Trip part 1



From Arlington to
Evansville:

I-66 west to I-81,

I-81 south to I-64

I-64 west

through VA, WV, KY,
IN

to Evansville IN

~ 13 hours

All in Hybrid mode

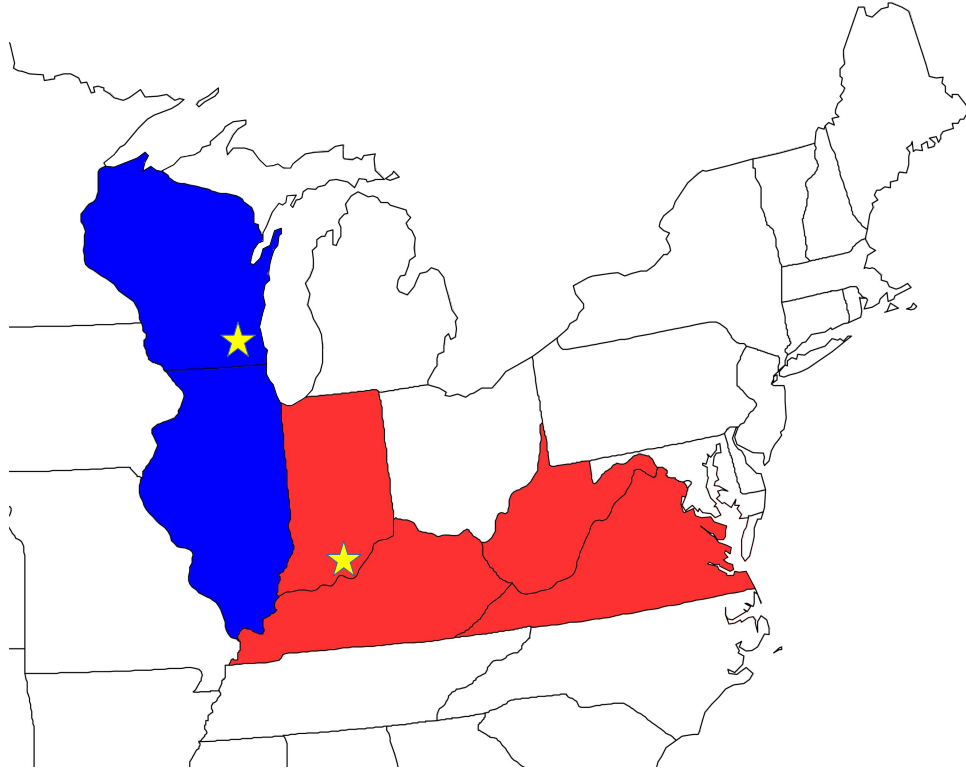
No recharging

Orthopaedic Associates Building, Evansville Indiana

- Near I-69 exit in southeast Evansville.
- Zero-cost Level 2 ChargePoint network car charging station in the parking lot.
- Roof bearing solar panels covers the entire parking lot (1+ acres), and perhaps the building roof.
- When the sun shines, the solar panels provide **zero-carbon electricity** to the charging station and the building.



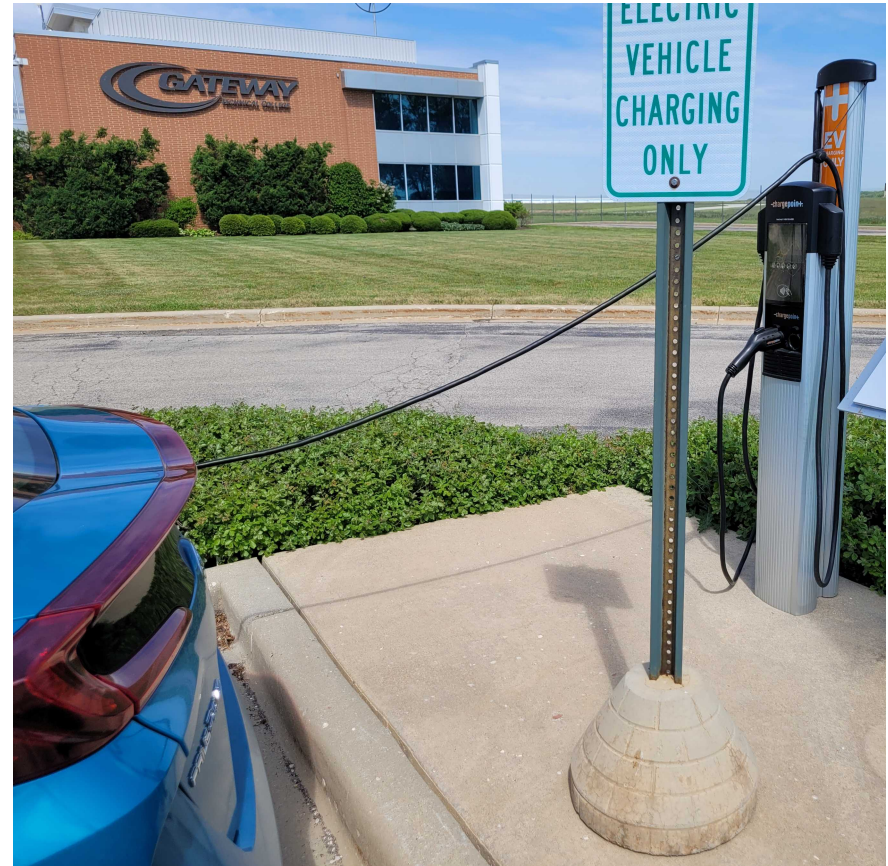
The Road Trip part 2



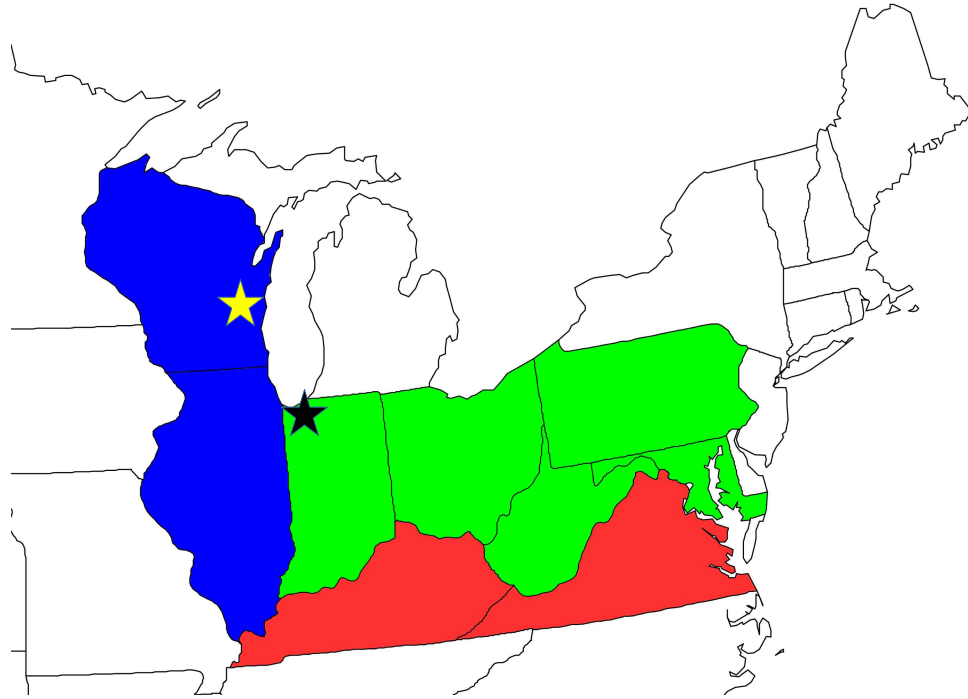
Memorial Day
From Evansville to
Chicago and Kenosha:
I-64 west to Illinois
I-55 north to Chicago for
dinner with friends.
After dinner:
I-94 north to
Kenosha WI
(I had never before set
foot in Wisconsin)

Gateway Technical College in Kenosha Wisconsin

- Zero-cost Level 2 ChargePoint car charging station, with two J-1772 cables. Used it for 40 minutes.
- A zero-cost Level 2 Blink network charging station is at **Chesapeake Community College** on the Eastern Shore, corner of US 50 and MD Route 404.



The Road Trip part 3 (Day 1 of 2)



Tuesday May 30

from Kenosha to Dayton:

I-94 south to Chicago

I-94/90 east to **Indiana**

Dunes National Park

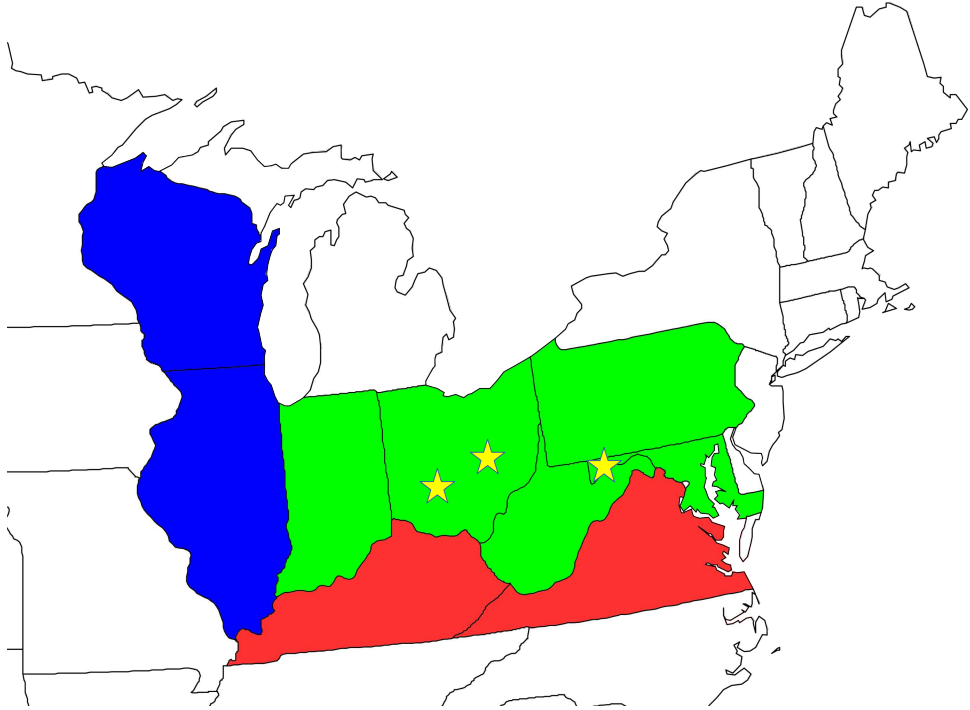
(zero-cost ChargePoint charging station there was down, *and still is*)

I-65 south to Indianapolis,

I-70 east to Dayton.

Stayed at a hotel in Dayton.

The Road Trip part 3 (Day 2)



Wednesday May 31:
Zero-cost recharge at Dayton Public Library.
I-70 east through Ohio to Columbus: ***Zero-cost recharge at AEP Ohio HQ;***
I-70 to Wheeling and PA,
I-79 south to Morgantown,
I-68 east to tiny Friendsville
MD: ***recharge 1.5 kWh, costing 34 cents, and then home.***

AEP Ohio HQ zero-cost car charging stations, Columbus

- AEP is an Electric utility.
- Southeast side of Columbus
- One zero-cost ChargePoint DC Fast charging station
- Six zero-cost ChargePoint Level 2 dual-cable charging stations. One was out of service.



Summer Road trips to Delaware

- The **Delaware Electric Cooperative HQ**, on US 13 south of Greenwood Delaware, offers zero-cost ChargePoint Level 2 dual-cable chargers for public use.



Summer Road trips to Delaware

- The **Royal Farms** store at the corner of US 13 and Delaware 404 near Bridgeville offers two non-network zero-cost Level 2 chargers, each 18 kW and with one J-1772 cable per station.



Summer Road trips to Delaware

- The **Delaware Technical Community College** campus at the intersection of US 113 and Delaware 404 includes an Automotive Tech Center with a zero-cost Level 2 ChargePoint car charging station with two J-1772 cables.
- Note the station is anchored at parking lot level. Easy to hit by accident.



Vacation in Canaan Valley WV

- The WV Eastern Tech Community College slightly east of Moorefield WV on US 48 offers zero-cost non-network Level 2 chargers.
- During the day, a solar cell roof provides **zero-carbon electricity**.



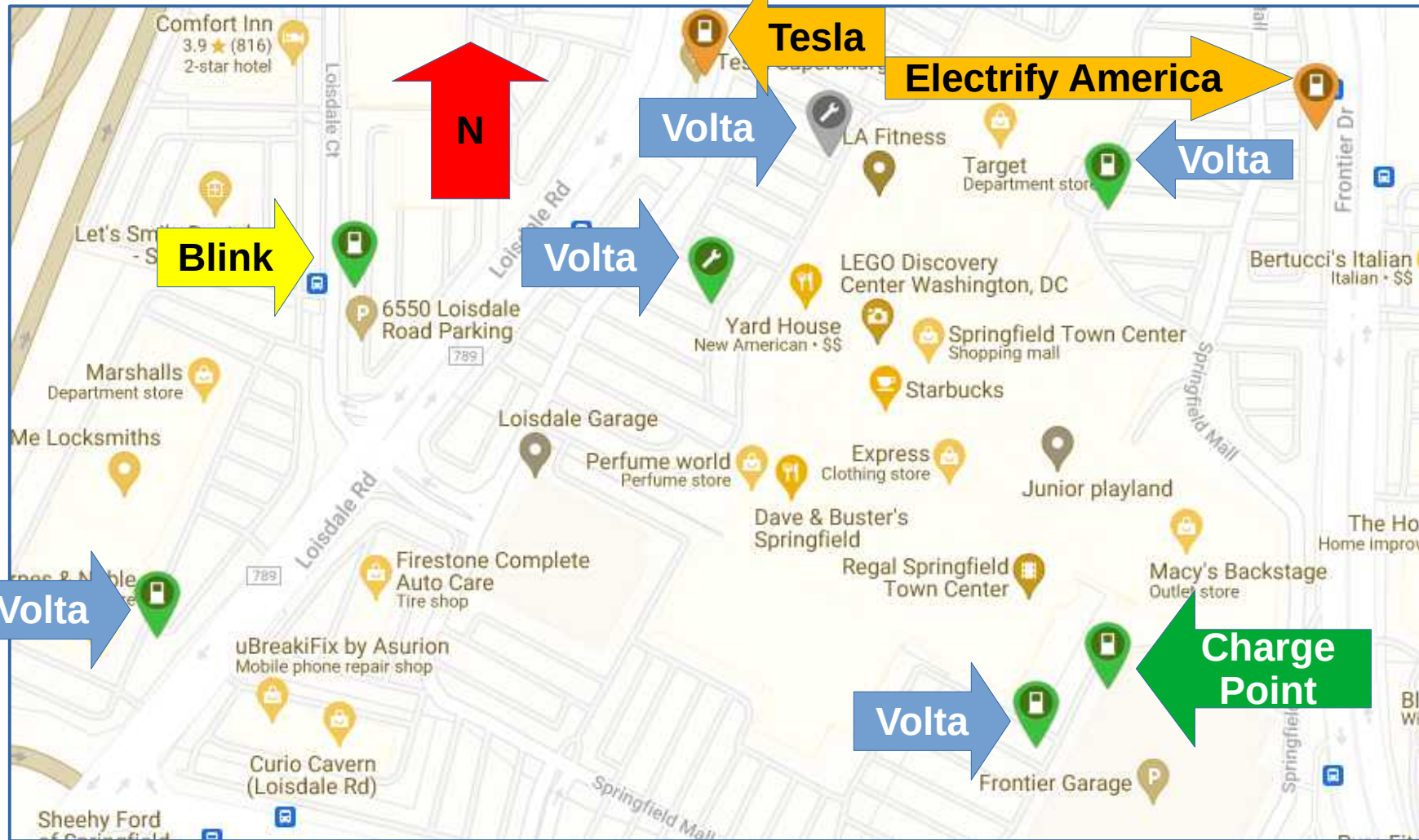
Vacation in Canaan Valley WV

- The **Canaan Valley National Wildlife Refuge HQ** offers zero-cost Level 2 chargers in its parking lot on WV Route 32 in Canaan Valley.
- Many **WV State Parks** have zero-cost *non-network* Level 2 charging stations with NACS and J-1772 cables.
 - Cacapon Resort State Park on US 522 south of Berkeley Springs.
 - Blackwater Falls State Park near Davis WV.
 - Canaan Valley Resort State Park on WV Route 32 in Canaan Valley

Zero-cost car chargers at Casinos

- Delaware: **Harrington Raceway and Casino**, in Harrington on US 13. Six Level 2 J-1772 cables. Not available during the annual Delaware State Fair.
- Maryland: **MGM National Harbor**, Oxon Hill. Twenty Level 2 charging stations with J-1772 plugs. Free parking. Four stations per parking level. Five parking levels. Levels P1 and P2 may not be open 24/7.

Springfield Mall Charging Stations



Map provided by PlugShare .com.

Springfield Mall charging stations

- Car charging stations of four networks are scattered around the parking lot of Springfield Mall.
- Electrify America (4), ChargePoint (3x2), Volta (8), and Tesla Supercharger (20). Total of 38 car charging station cables.
- Electrify America and Tesla are **NOT** zero-cost stations.
- All charging stations there operate between 6 AM and 11:59 PM.

Springfield Mall charging stations

- **Volta/Shell Recharge** has a total of eight single-cable zero-cost Level 2 J-1772 charging stations, each with a pylon showing big screen advertising on two sides.
- All are located in the open and close to Town Center entrances. There are **two stations per entrance**.
- A parking spot by each pylon is reserved for a car using the charging station.



Southeast corner by Dick's and Macy's entrances.

Springfield Mall charging stations

- **ChargePoint** has three dual-cable Level 2 zero-cost J-1772 chargers (total of six charging cables) on the ground floor of the multi-level parking garage at the same southeast corner. The **ONLY** chargers in a Mall garage.



Springfield Mall charging stations

- **Electrify America**, in the northeast corner by Frontier Drive, far from the Mall, has three fee-based 350 kilowatt DC Fast charging stations. Each station has a CCS1 cable and a CHAdeMO cable. Use either cable, and the other is not active.
- Also includes one fee-based Level 2 J-1772 station, a smaller pylon.
- Note if the zero-cost Level 2 charging stations are unavailable, Electrify America is the **ONLY *fee-based*** Level 2 J-1772 charger in the entire parking lot.



Springfield Mall charging stations

- Twenty **Tesla Superchargers** are in the Northwest corner by Loisdale Road, far from the Mall.
- All are fee-based.
- I found one Tesla Model 3 using a zero-cost Level 2 Volta charging station instead.



Configuration of charging stations

- DC Fast stations often have two cables, CCS1 and CHAdeMO, but *only one plug can be used at a time*. **ElectrifyAmerica** is an example.
- Some Level 2 stations have two cables, both J-1772, and can charge two cars at a time. **ChargePoint** is an example.
- However, on those dual-plug Level 2 stations, the power delivered per car is cut in half when both of the two plugs are in use at the same time.
- Each Tesla Supercharger provides one NACS cable.

What we have learned so far

- Volta/Shell Recharge network Level 2 charging stations are zero-cost, with a 2-hour use limit.
- Some ChargePoint charging stations are zero-cost
- Non-network stations are usually zero-cost
- Charging stations at some community colleges are zero-cost, especially tech community colleges.
- Charging stations at some grocery stores are zero-cost.
 - Harris-Teeter in Arlington
 - Whole Foods in Reston, maybe Wegmans too

What do these have in common?

- Grocery stores
- Shopping centers
- Community college campuses
- Medical campuses
- Public Libraries
- Casinos
- **Answer: all are places where people may spend an hour or more**

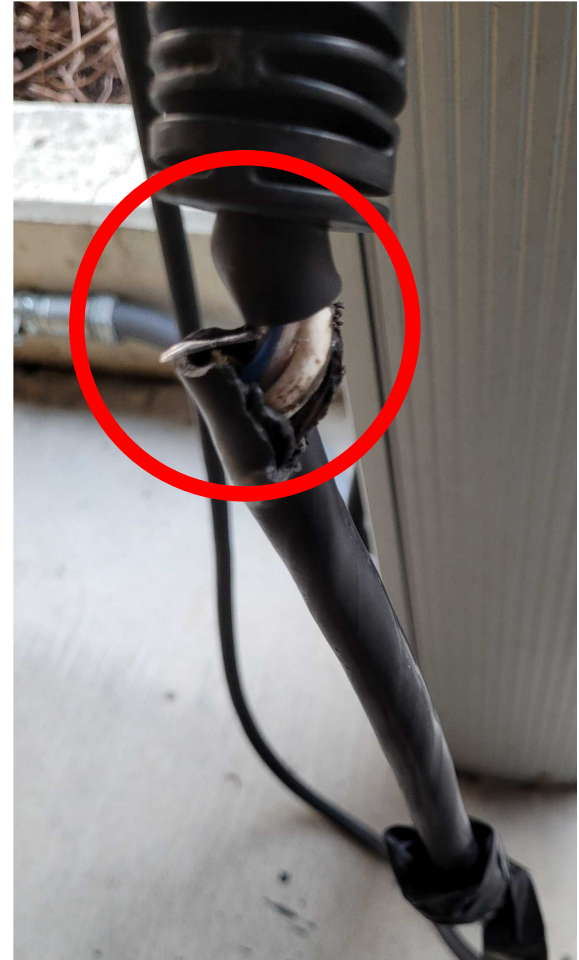
**CAR CHARGING SYSTEMS
ARE NOT PERFECT**

Network charging stations are **COMPUTERS**

- Computer software and operating system sometimes fail. Electric power can fail.
- The data network connecting a charging station to its servers can fail. Most charging stations use internal cell phone tech to communicate with servers.
- Sometimes outdoor charging stations can be flooded, or struck by lightning, or struck by vehicles or big animals.

Charging cables can fail too

- At Springfield Town Center in late March, I found this damaged charging cable on a ChargePoint car charging station.
- Maybe the cable was pulled beyond its max length too many times.
- Or somebody drove away without disconnecting the cable from the car.
- The other cable works and is unshared. So that one cable delivers the station's full power to a vehicle.



APPS TO FIND ZERO-COST CHARGING STATIONS

Each car charging network offers a free network app

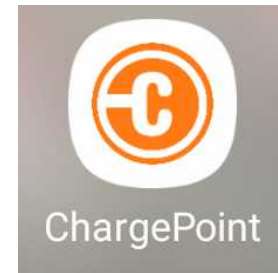
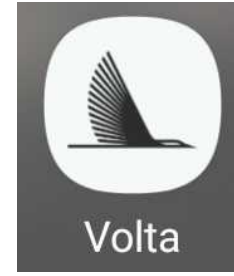
- The app shows you a **map** for locating the network car charging stations, and **details** about charging stations: price, if the station is in use, etc.
- You can add **filters** to ensure the map shows you only stations compatible with your car.
- The app may allow you to **reserve** a charging station for your use in the very near future (~20 minutes).
- When you arrive, the app **unlocks** the charging station.
- You use the app to **pay** for charging station use.

Why pay for charging?

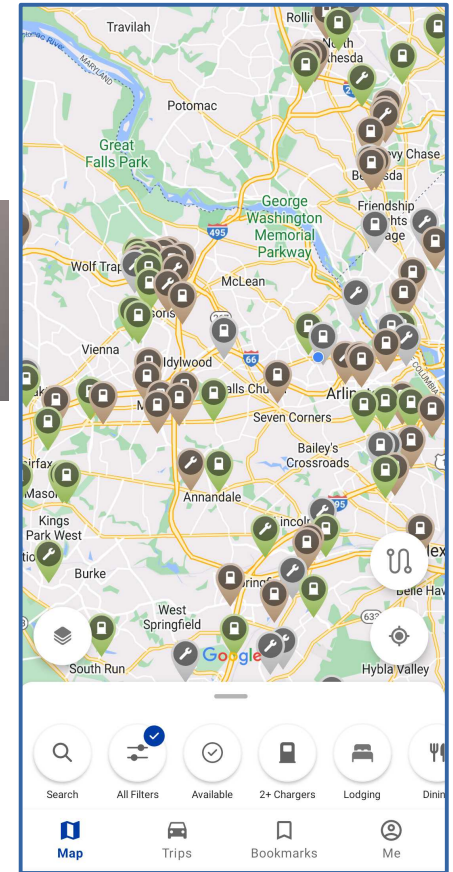
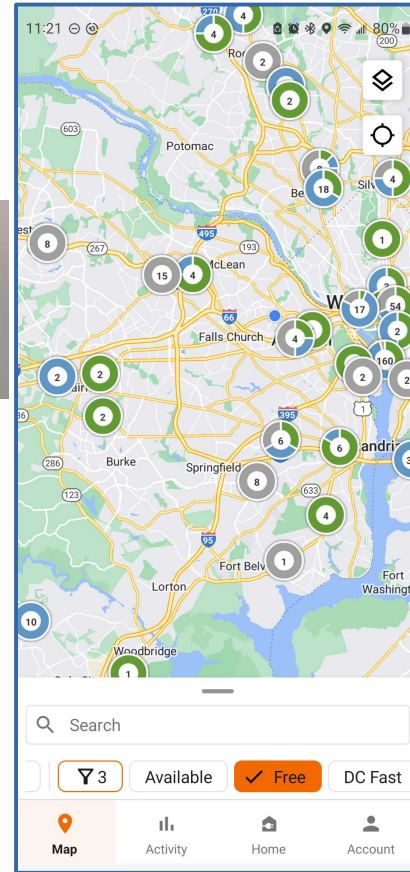
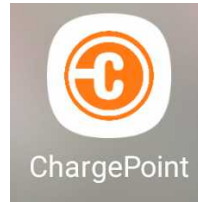
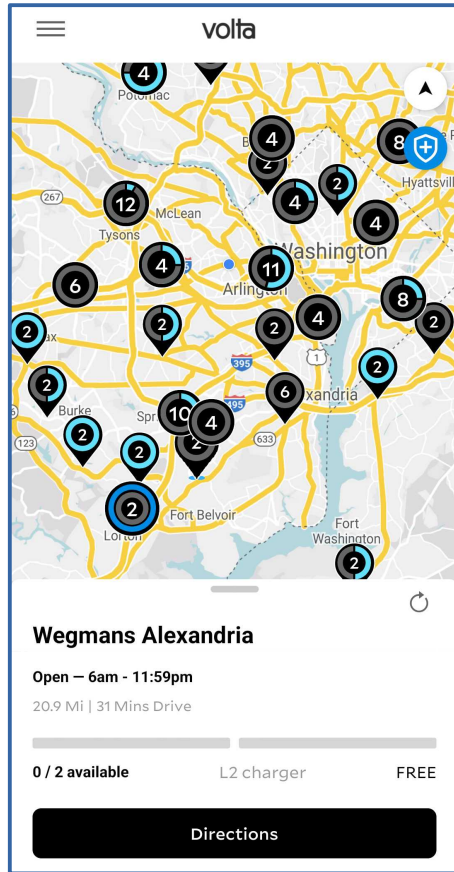
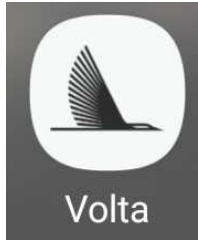
- When you need to recharge, a zero-cost station may be too far away or broken down or in use.
- If all the up-and-running zero-cost charging stations are in use, and your battery is about to die, then you are forced to find any available charging station and pay for its use.
- The cost of charging a PHEV may or may not be significant. The time required is significant.
- Some charging station fees are per minute, others per kilowatt-hour.

Three free apps that can help

- The **Volta app** for the Volta network of zero-cost Level 2 and DC Fast charging stations.
- The **ChargePoint app** for the ChargePoint network of Level 2 and DC Fast charging stations. Many are free, but not all.
- The **PlugShare app** is best for finding non-network charging stations, and is a one-stop shop for finding zero-cost charging stations.



Each app displays a Map of car charging stations



The Volta App

- On the app map, car charging stations are shown as circles, showing the number of charging station cables. Level 2 use is free for 2 hours.
- If the number is greater than 2, that denotes a *cluster* of charging stations. Tap the circle to zoom zoom in and see each individual station.
- A blue-green arc depicts the extent to which each site of charger stations is in use at the moment.
- A dark blue outer arc denotes DC Fast charging stations. Use is free for 30 minutes and, after that, the cost is \$0.47 per kWh.



Volta and Retailers

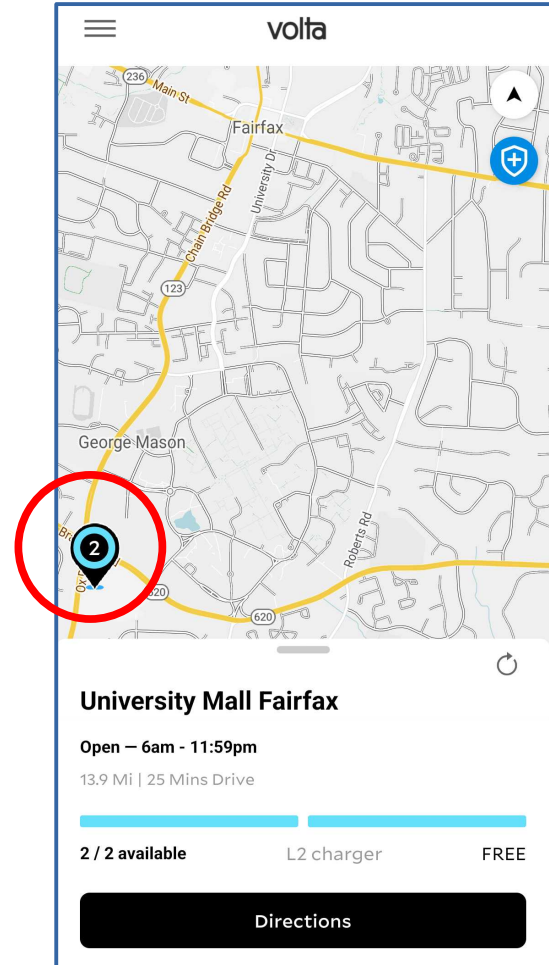
- Volta runs ads on the charging station pylon screens. Clever monetization. May risk increased maintenance.
- Volta chargers are often found at grocery stores and other places where shoppers spend an hour or more. Volta zero-cost stations are **loss leaders** for retailers.
- Volta chargers shut off on a schedule. Often at 11:59 PM, and resume operation at 6:00 AM.
- Volta does offer both Level 2 and DC Fast chargers but, for now, DC Fast seems to be rare: one each in Lorton, Manassas, and Gaithersburg.

Volta and Shell Recharge

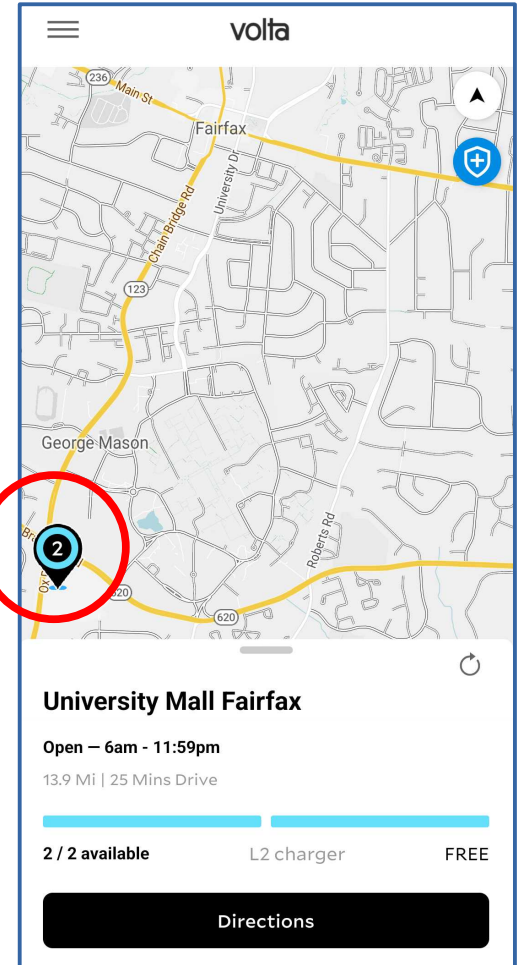
- Shell Recharge owns Volta and other charging networks.
- Volta Level 2 stations are being *rebranded* as Shell Recharge stations.
- Volta stations do not show up yet on the Shell Recharge app map of charging stations.
- Volta Level 2 stations behave like non-network stations. Plug the J-1772 cable into your car, and charging starts. **No app needed** to unlock the station.
- The Volta app map indicators of charging station availability are not reliable.

Two Volta stations close to Tallwood

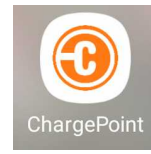
- University Mall Shopping Center, outside of Giant Food.
- Two Level 2 pylons, each with one J-1772 cable.
- Easy to visit before or after a PATACS+OPCUG meeting. McDonalds is nearby for a snack while charging.



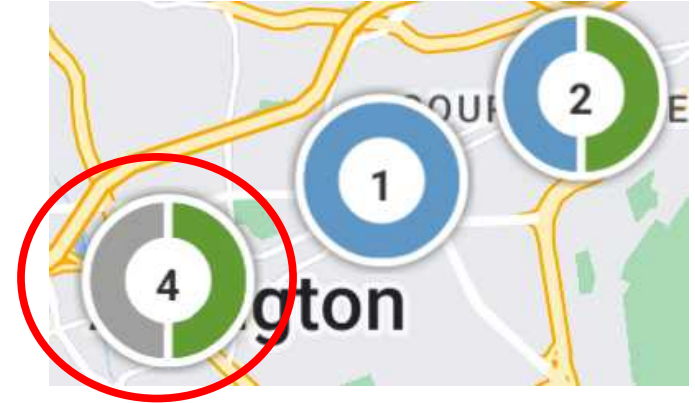
Two Volta stations close to Tallwood




The ChargePoint App

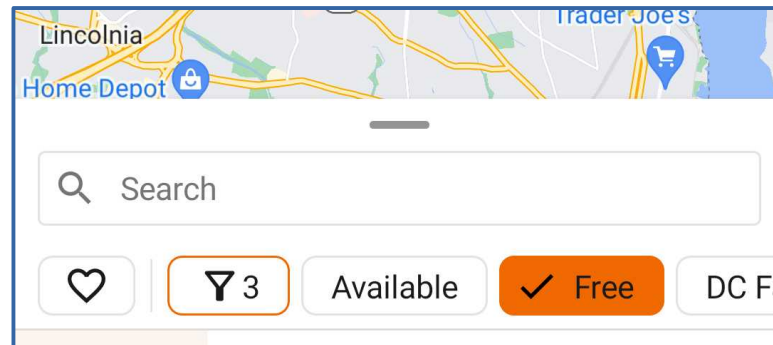


- Each circle identifies an area where one or more car charging stations are located.
- The number in the circle shows the count of car charging stations.
- If greater than 2, then tap the circle to zoom into the specific location of each car charger.
- The color key:
 - BLUE: Level 2 in use
 - GREEN: Level 2 is available
 - GRAY: station status is not available



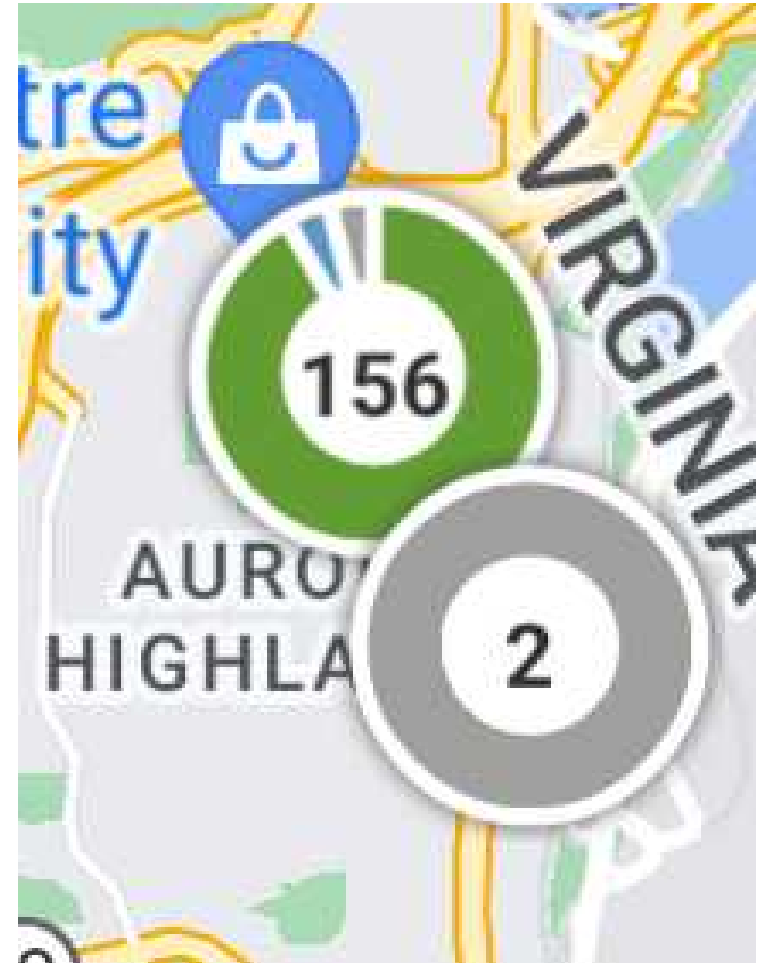
ChargePoint App Filters

- Below the map, tap the **Free button** to exclude car charging stations that are not zero-cost.
- Tap the **Available button** (to the left of Free) to exclude car charging stations that are in use.
- Tap the **Filter button**  to exclude car charging stations that are not compatible with your car, and to exclude car charging networks other than ChargePoint.



Arlington's free charging HQ

- Largest cluster in Arlington!
- In the multi-level parking garages for Amazon HQ2 in Crystal City.
- 156 zero-cost ChargePoint Level 2 J-1772 car charging stations.
- There may be a parking fee. Arlington County no longer permits free garage parking.



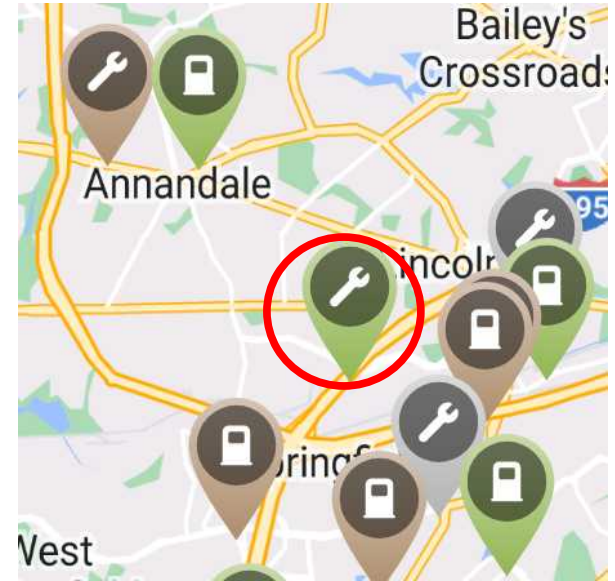
Other ChargePoint advantages

- Many fee-based ChargePoint Level 2 charging stations charge a modest fee per kiloWatt-hour, close to or lower than what I pay at home.
- If you find that no zero-cost car charging station is available, fee-based ChargePoint charging stations are often far more economical than say fee-based Blink charging stations.

The PlugShare App

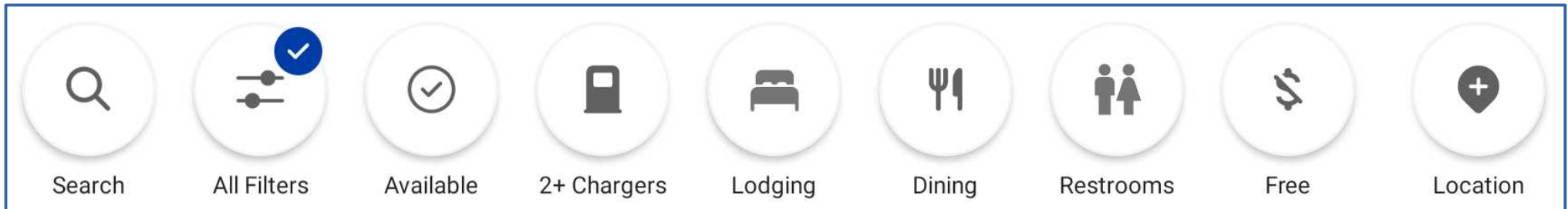


- Each map symbol depicts one car charging station locale.
- Color Code:
 - GREEN: Some stations are available.
 - GRAY: No stations are available.
 - BROWN: Private or restricted.
 - ORANGE: DC Fast (not shown here)
- **Wrench symbol** indicates station needs repair.



PlugShare app Filters

- Below the map, there are filter buttons. Scroll left and right to see all the buttons.
- The **Free button**: exclude fee-based charging stations
- The **Available button**: exclude occupied charging stations *according to PlugShare app users*
- The **All Filters button**: displays a list of all filters such as your vehicle brand&model, kilowatt range, and amenities.



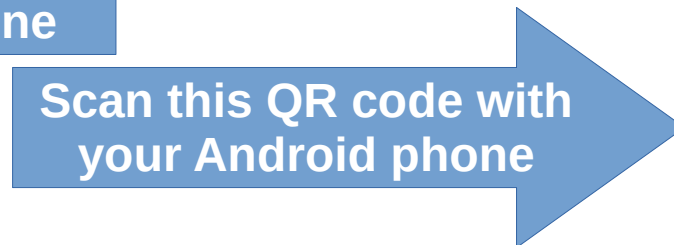
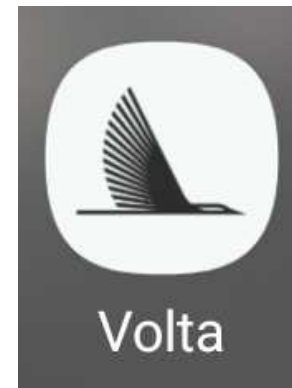
HOW TO OBTAIN THE FREE APPS

Summary of App features

- The Volta and ChargePoint network apps tell you which stations are in use and which are not.
- EXCEPT the ChargePoint stations at Springfield Mall do not show up in the ChargePoint app map.
- Don't be shocked if someone else beats you to an available station by say a minute or two.
- PlugShare info is crowd-sourced and is not able to report station availability with high accuracy.
- PlugShare identifies and maps non-network car charging stations. Most of those are zero-cost.

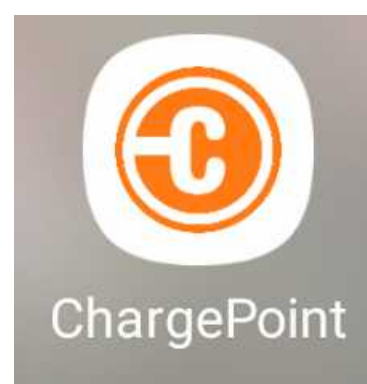
The Volta App

- Zero cost to install, and zero cost to use the app. ***All Volta Level 2 stations are zero-cost for 2 hours. All Volta DC Fast stations are zero-cost for 30 minutes.***
- Scan the QR code with your phone to open the store to the Volta app page.



The ChargePoint App

- Zero cost to install. No annual subscription fee.
- Scan the QR code with your phone to open the store to the ChargePoint app page.
- Not all ChargePoint stations are zero-cost.



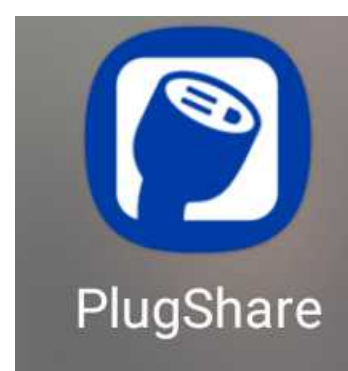
Scan this QR code
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The PlugShare App

- Zero cost to install. No annual subscription fee.
- Scan the QR code with your phone to open the store to the PlugShare app page.



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THE END

