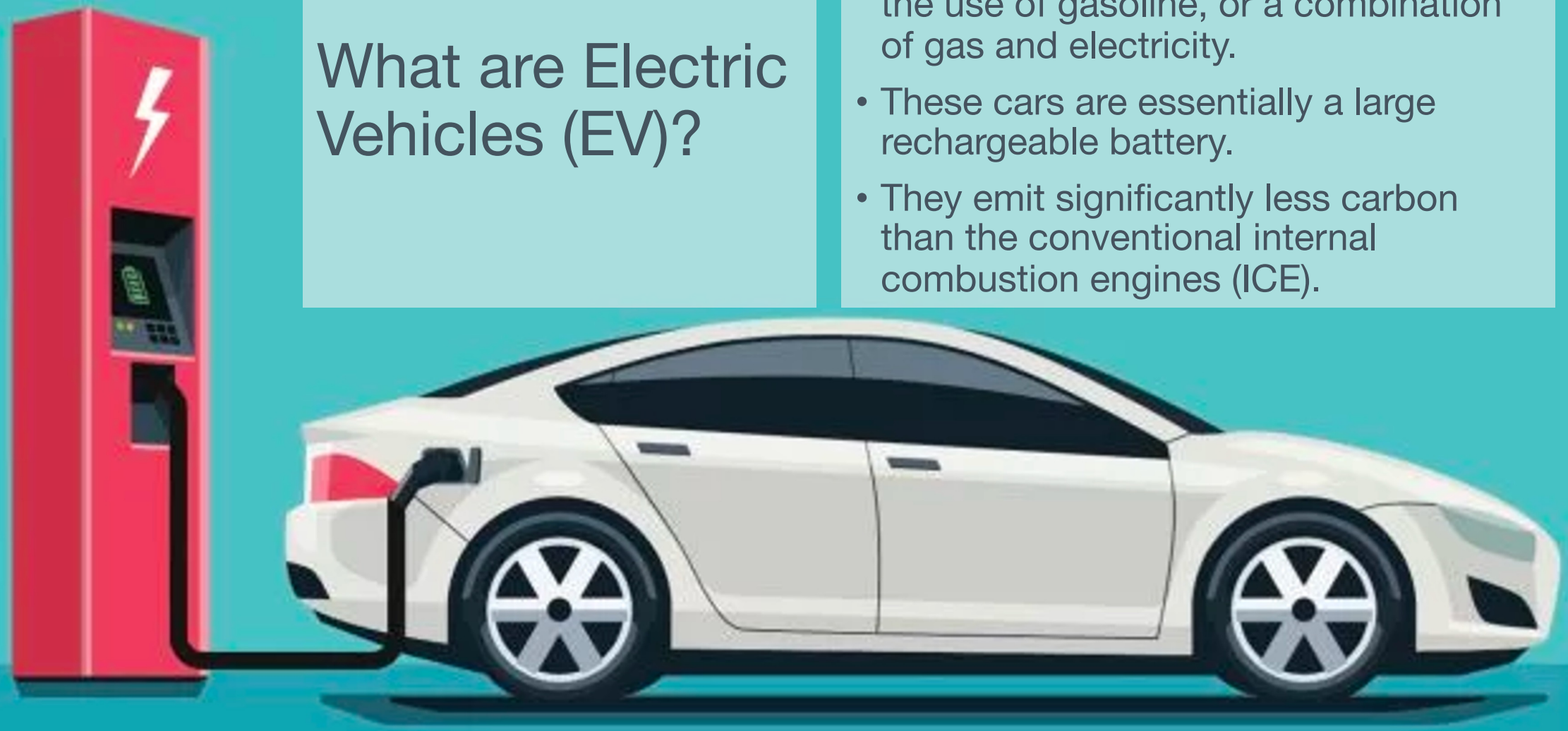
Electric Vehicle Types

Hybrid, Plug-in and Battery Electric Vehicles

Recommended for grades 7 – 12

What are Electric Vehicles (EV)?

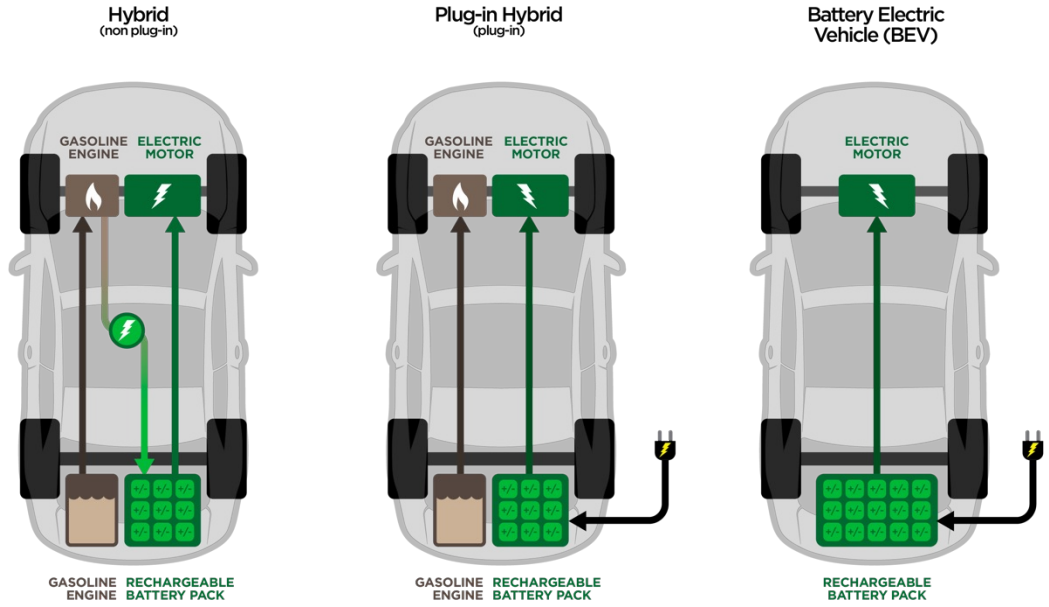
- An electric vehicle is a car that operates on an **electric motor** without the use of gasoline, or a combination of gas and electricity.
- These cars are essentially a large rechargeable battery.
- They emit significantly less carbon than the conventional internal combustion engines (ICE).



Source: www.greetechmedia.com

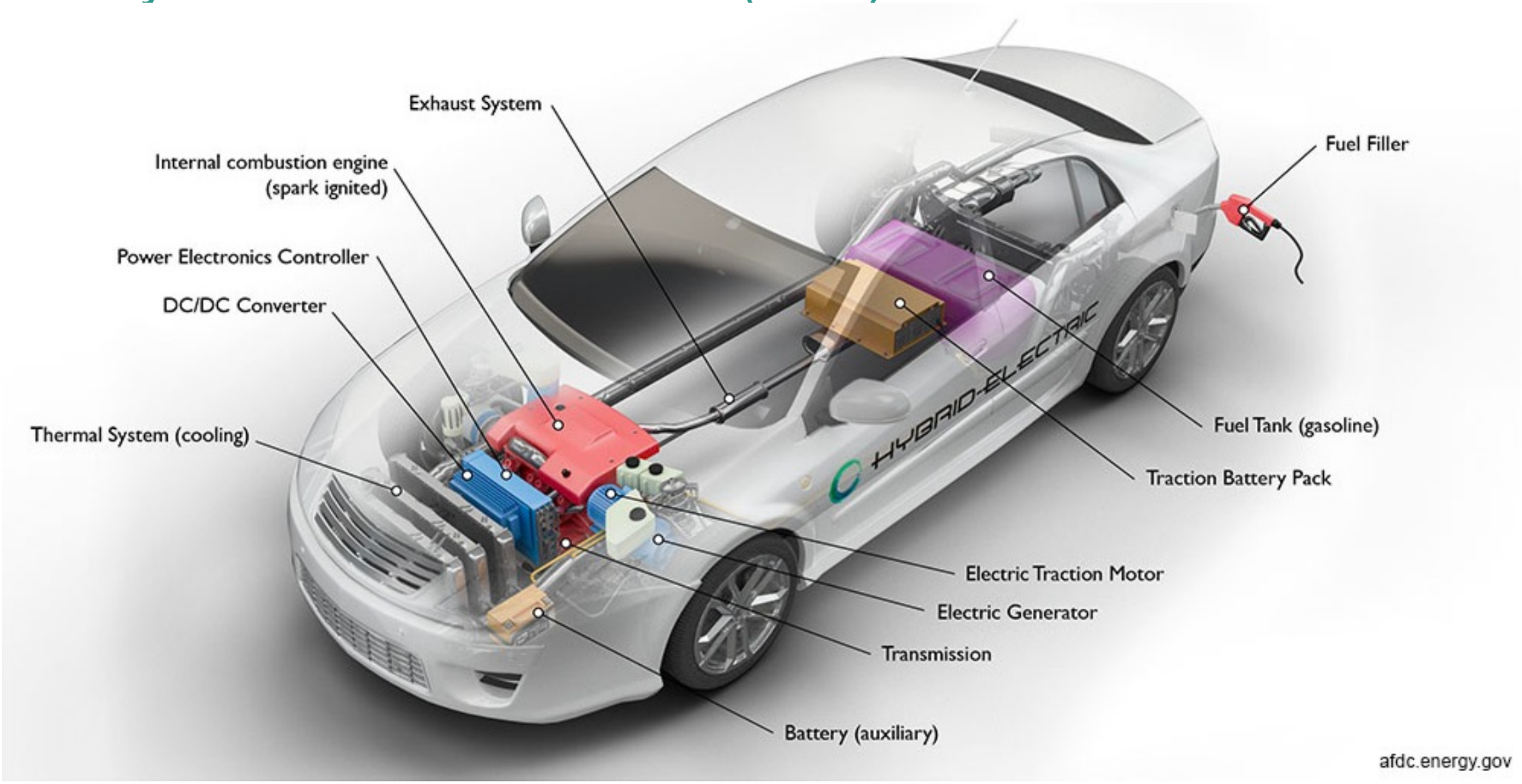
Types of electric vehicles

- **Hybrid:** Powered by gasoline and an electric motor. Battery is recharged while the vehicle is running on gas.
- **Plug-in Hybrid Electric Vehicle (PHEV):** Similar to conventional hybrids, except they can be plugged in to recharge the battery.
- **Battery Electric Vehicle (BEV):** Powered 100% by an electric motor and battery. All-electric cars do not burn gasoline, have gears or a transmission, or require oil for the parts. On average, all-electric cars can travel 200 – 250 km on a single charge.

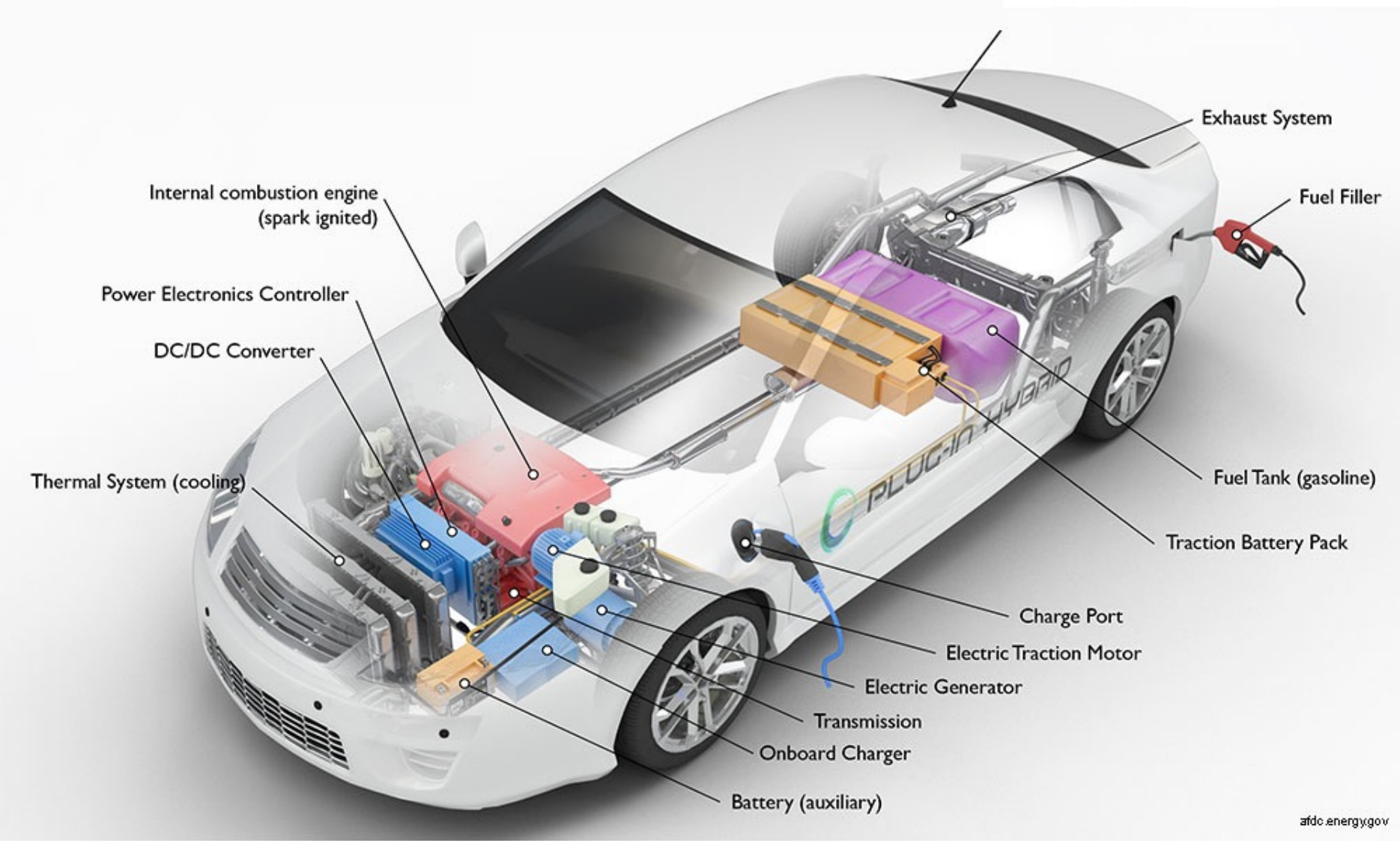


Source: www.nspower.ca

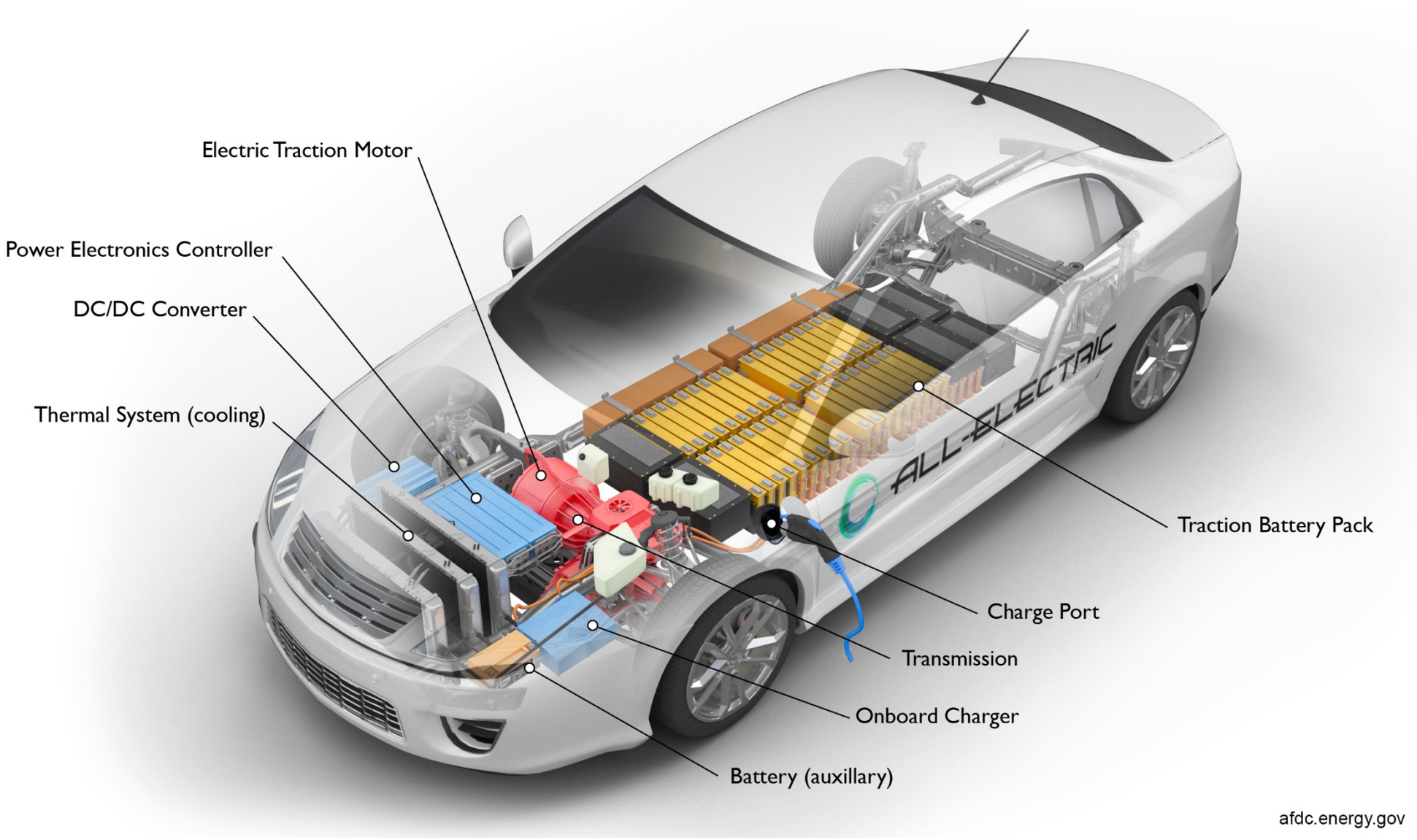
1. Hybrid Electric Vehicles (HEV)



2. Plug-in Hybrid Electric Vehicles (PHEV)



3. Battery Electric Vehicles (BEV)



afdc.energy.gov

Example EVs

Honda Clarity PHEV

Toyota Camry Hybrid

Volkswagen e-golf (BEV)

Regenerative Braking

- Regenerative braking conserves the energy otherwise lost due to braking
- Regenerative braking impacts efficiency and effectiveness
- Efficiency: regenerative braking can conserve 60-70% of the energy lost, which can then be later used for acceleration
- Effectiveness: how large of an impact regenerative braking has

Charging

- There are three levels of charging available:

Level 1

- 120 Volts, 15 Amps, 1.8 kW
- Portable charger and plugs into wall outlet
- 13 hours for full charge

Level 2

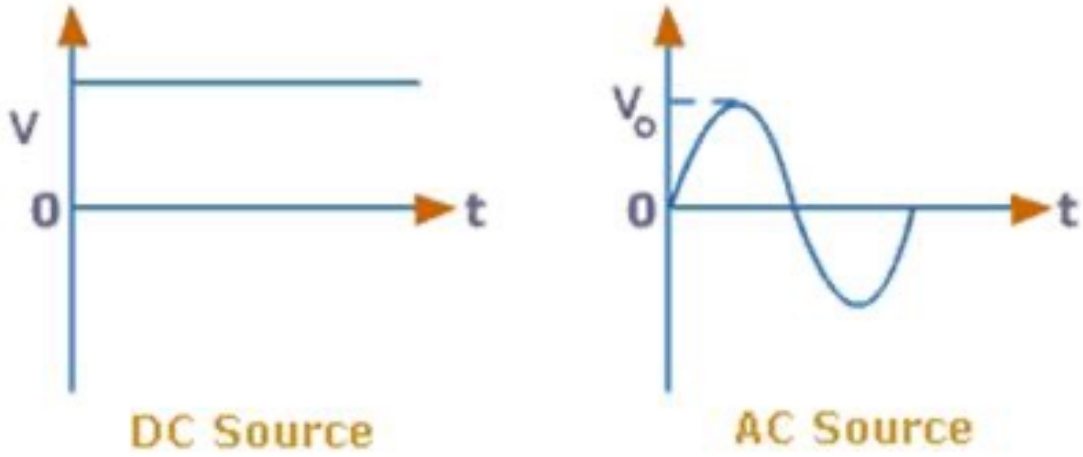
- 240 Volts, 30 Amps, 7.2 kW
- Portable charger and plugs into wall outlet
- 3-8 hours for full charge

Level 3

- 480 Volts, 100 Amps, 48 kW
- Super Charger
- 15-30 minutes for full charge

Alternating Current and Direct Current

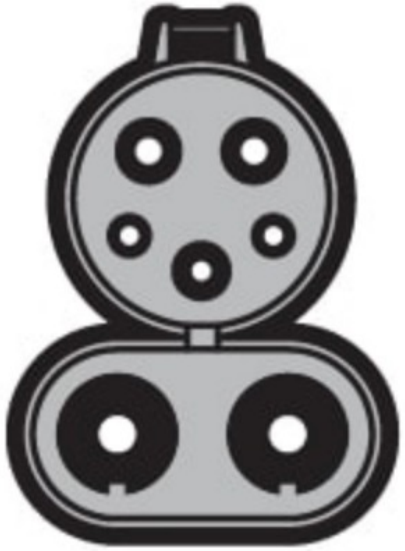
- The phrases, Alternating Current (AC), Direct Current (DC) describes the current's flow
- A power transformer converts power between AC and DC.
- Most of the electricity we use is delivered with AC. Flash lamps and batteries use DC.
- AC alternates directions causing "disruption" in flow
- DC goes in the same direction continuously



EV Charging Ports

DC = Direct Current
CCS = Combined Charging System
SAE = SAE International (Company)
J1772 = Charger name
CHAdeMO = Trade name

Level 1 & 2 J1772 Charge Port



DC Fast Charging SAE/CCS Combo

DC Fast Charging CHAdeMO

DC Fast Charging Tesla

AC Charger

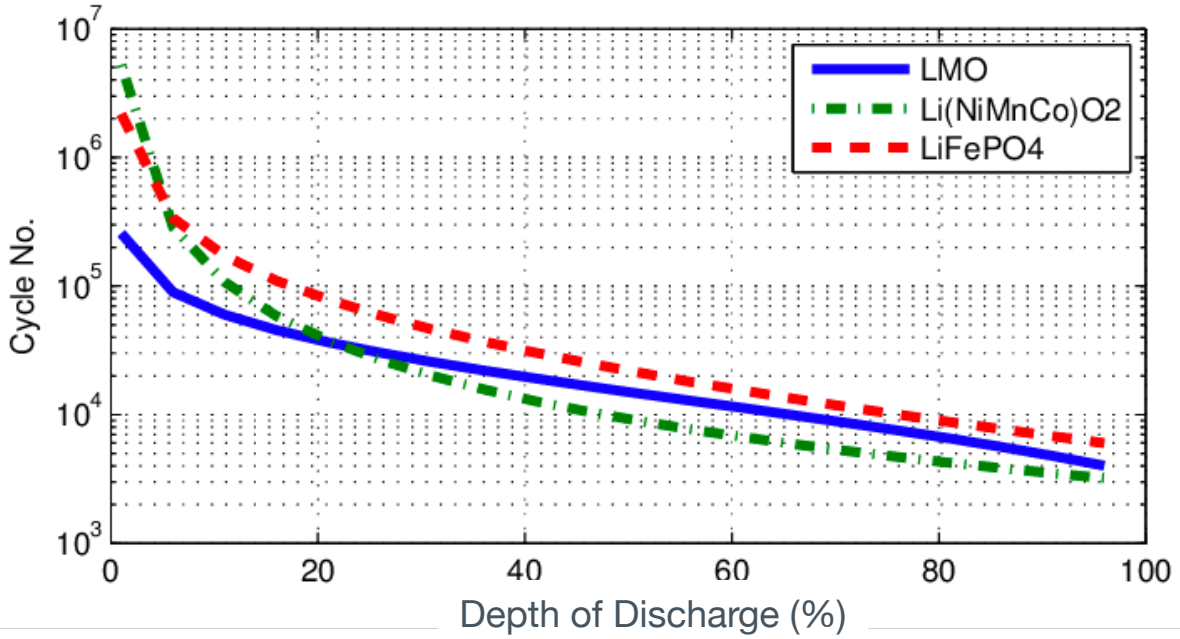
DC Fast Chargers

DC Fast Charging

- Most chargers deliver electricity as **AC**.
- How fast your car can charge depends on how fast it can convert AC to DC
  - This can take anywhere from 4 to 12 hours with a level 2 charger
- **DC charging speeds up this process** by eliminating the need to convert
  - Most cars are capable of charging 80% in 1 hour.
- 3 types of DC Fast Charging:
  - CHAdeMO
  - Combined Charging System (CCS)
  - Tesla Supercharger

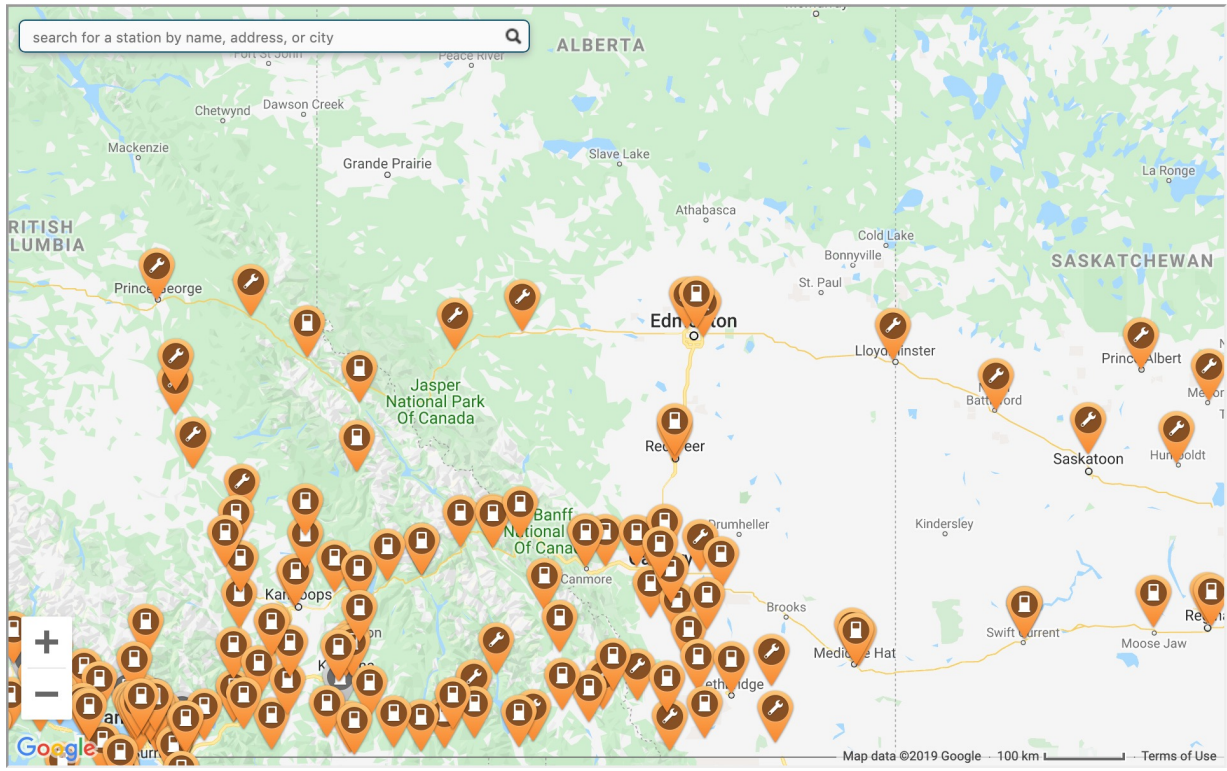
Cycle Life

- Cycle life is the number of complete charge and discharge cycles the battery can complete before capacity falls below 80%.
- Fast charging is convenient, but too often can damage the battery
- Consecutive fast charging can reduce the battery's capacity, and shorten its life



CHAdeMO DC Fast Charger

- CHAdeMO is the trade name of the device used to provide DC charging.
- Developed by the CHAdeMO Association
- 25,300 chargers world-wide (2019)
  - 9,200 – Europe
  - 3,200 – North America
  - 5,000 – Asia
  - 7,600 – Japan
  - 300 – Other
- Chargers are the same everywhere – you can travel the world with your EV!

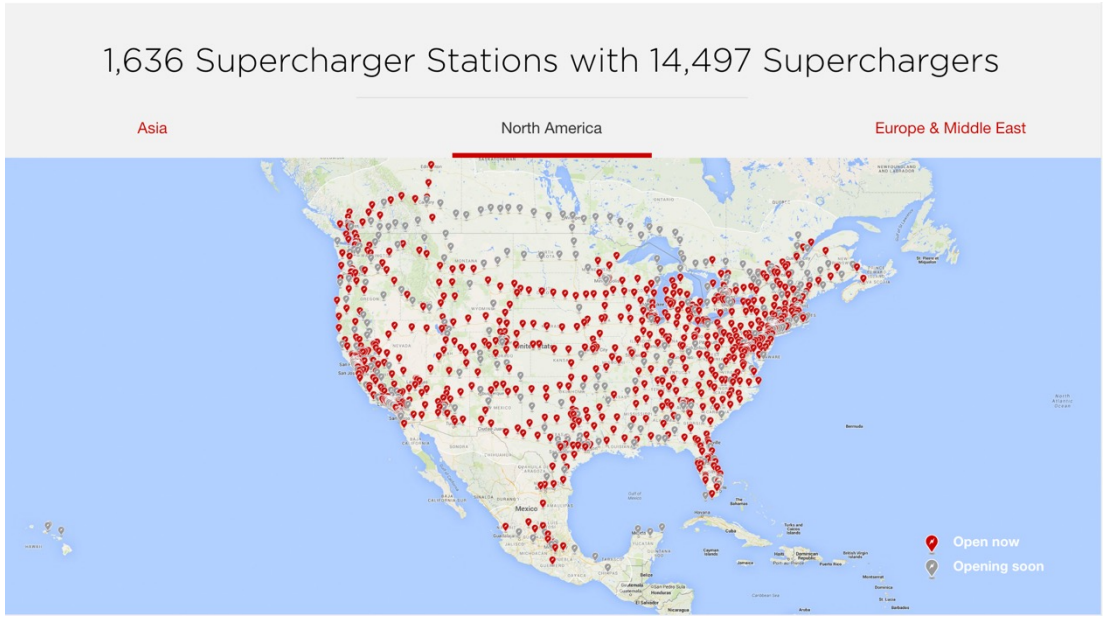


Combined Charging System (CCS) DC Fast Charger

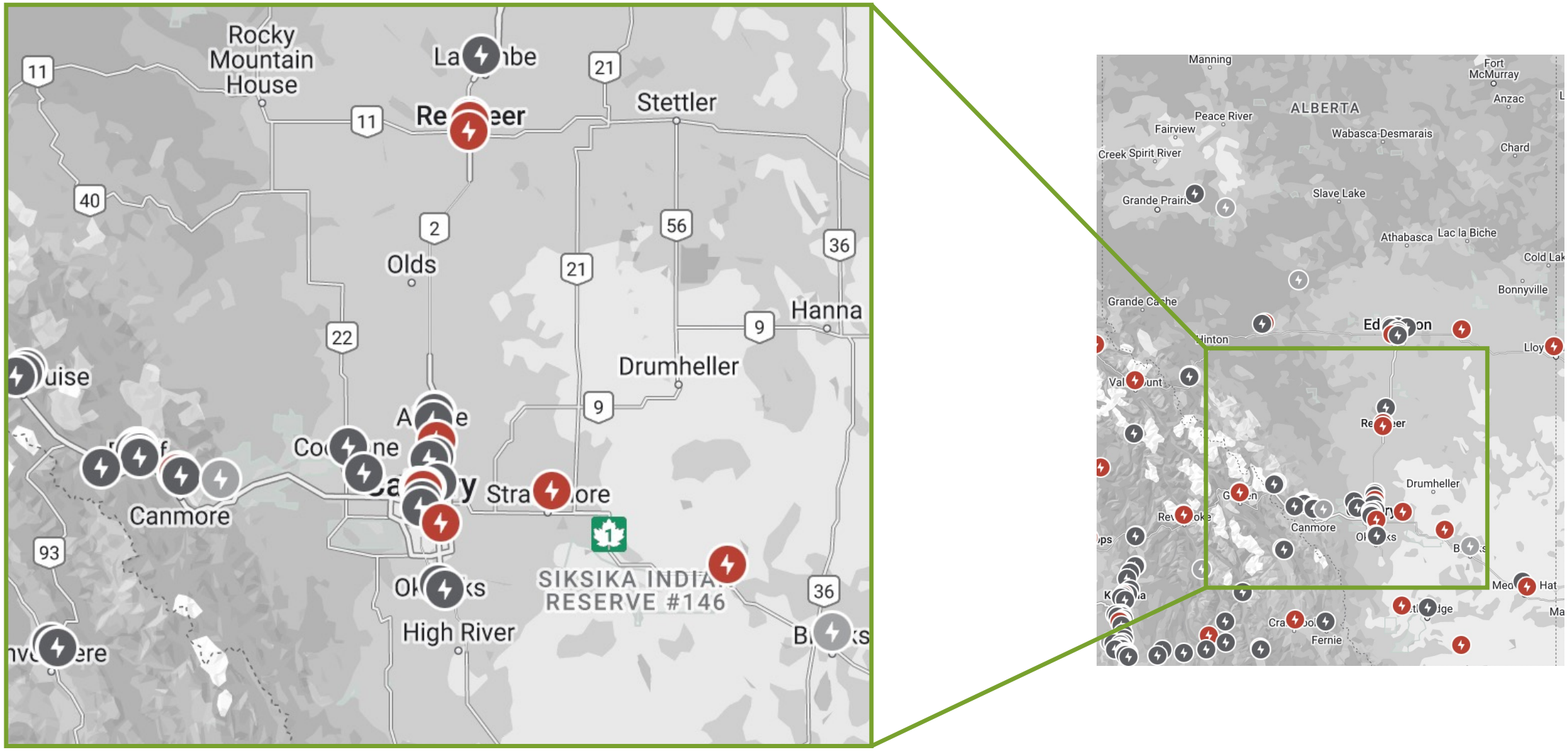
- Developed by the SAE J1772 committee
- CCS is an extension of the Level 1 and 2 J1772 charger
- CCS is supported by the following EV manufacturers:
  - Jaguar
  - Volkswagen
  - General Motors
  - BMW
  - Ford
  - Tesla
  - Kia
  - Hyundai

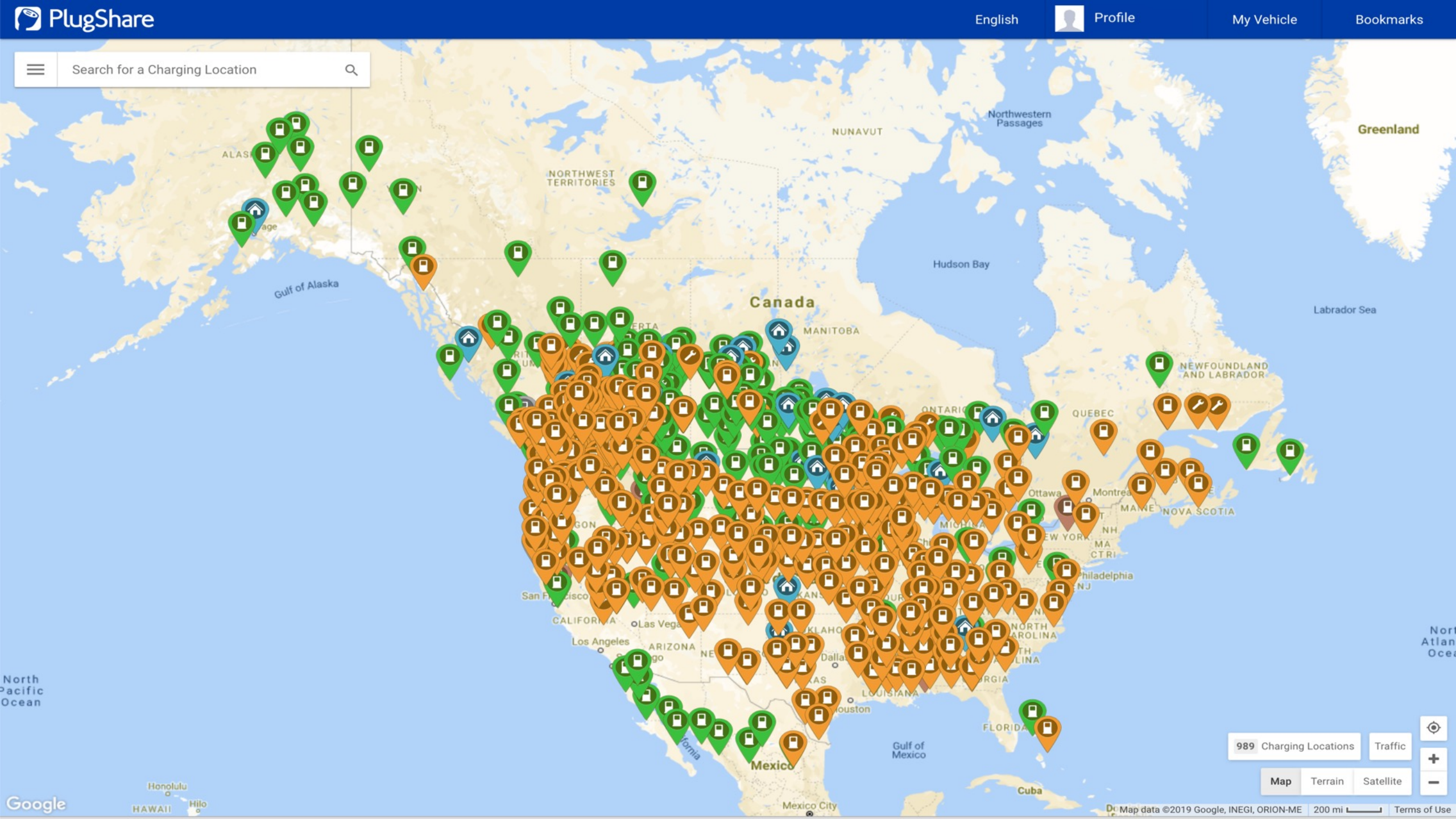
Tesla Supercharger DC Fast Charger

- Tesla Supercharger DC Fast Charging network was developed by Tesla
- This system is only compatible with Tesla cars (unless you have an adapter)
  - AC Tesla chargers are compatible with other EVs with the appropriate adapter



Current and Future Tesla Charging Station Locations (2024)




PlugShare
English
Profile
My Vehicle
Bookmarks
Search for a Charging Location
NUNAVUT
Northwestern Passages
Greenland
NORTHWEST TERRITORIES
Hudson Bay
Gulf of Alaska
Canada
MANITOBA
Labrador Sea
NEWFOUNDLAND AND LABRADOR
QUEBEC
ONTARIO
Ottawa
NOVA SCOTIA
Philadelphia
San Francisco
CALIFORNIA
Las Vegas
Los Angeles
ARIZONA
Dallas
Houston
LOUISIANA
FLORIDA
Gulf of Mexico
Mexico
Cuba
Mexico City
North Pacific Ocean
Honolulu
HAWAII
Hilo
989 Charging Locations
Traffic
Map
Terrain
Satellite
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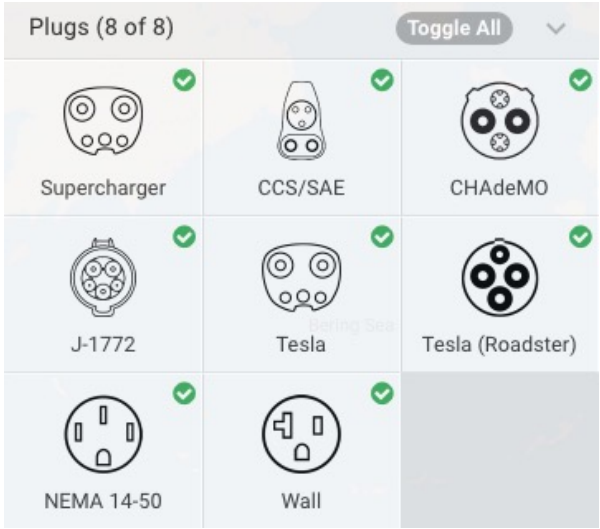
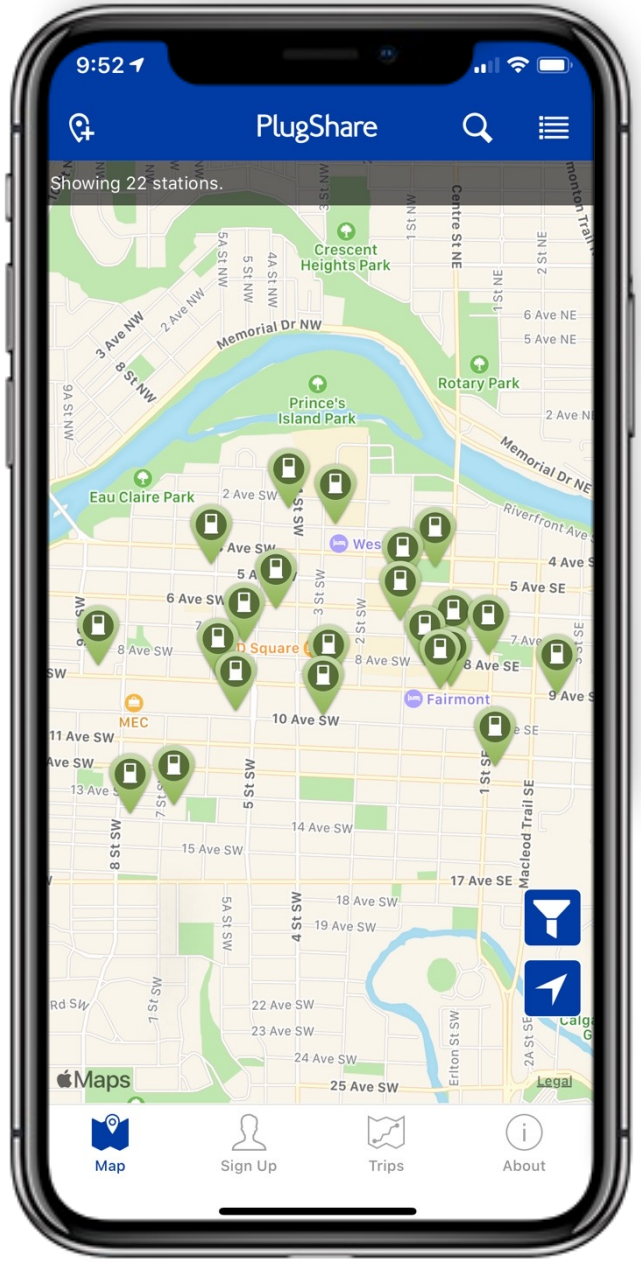
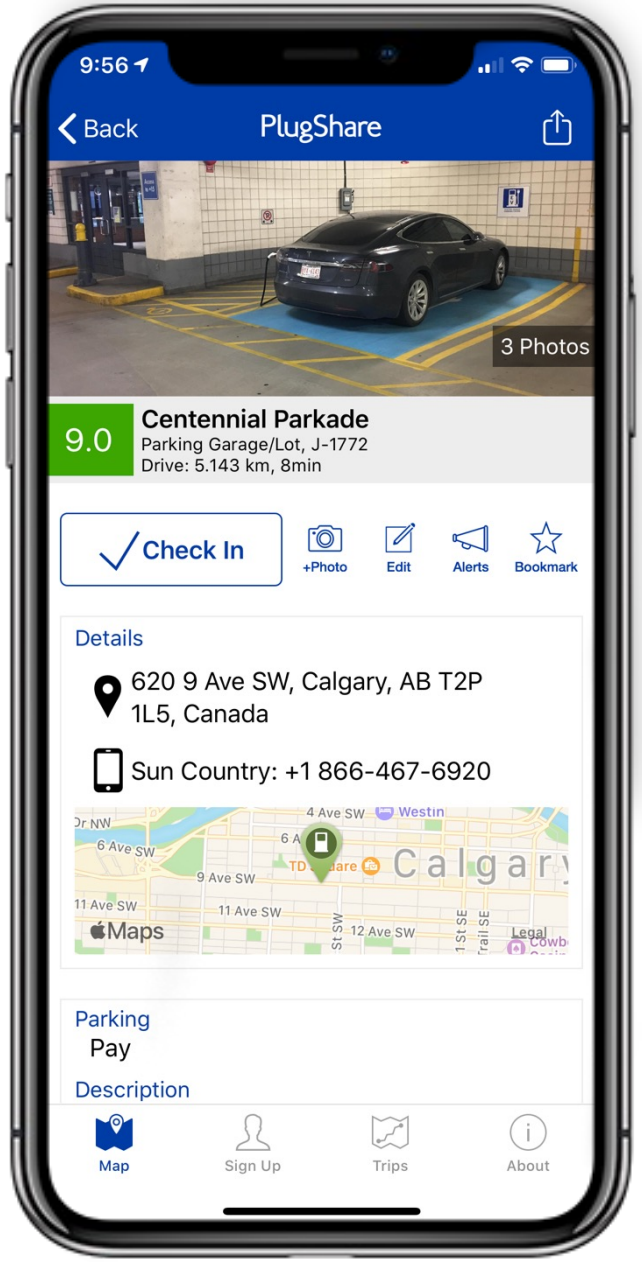
PlugShare

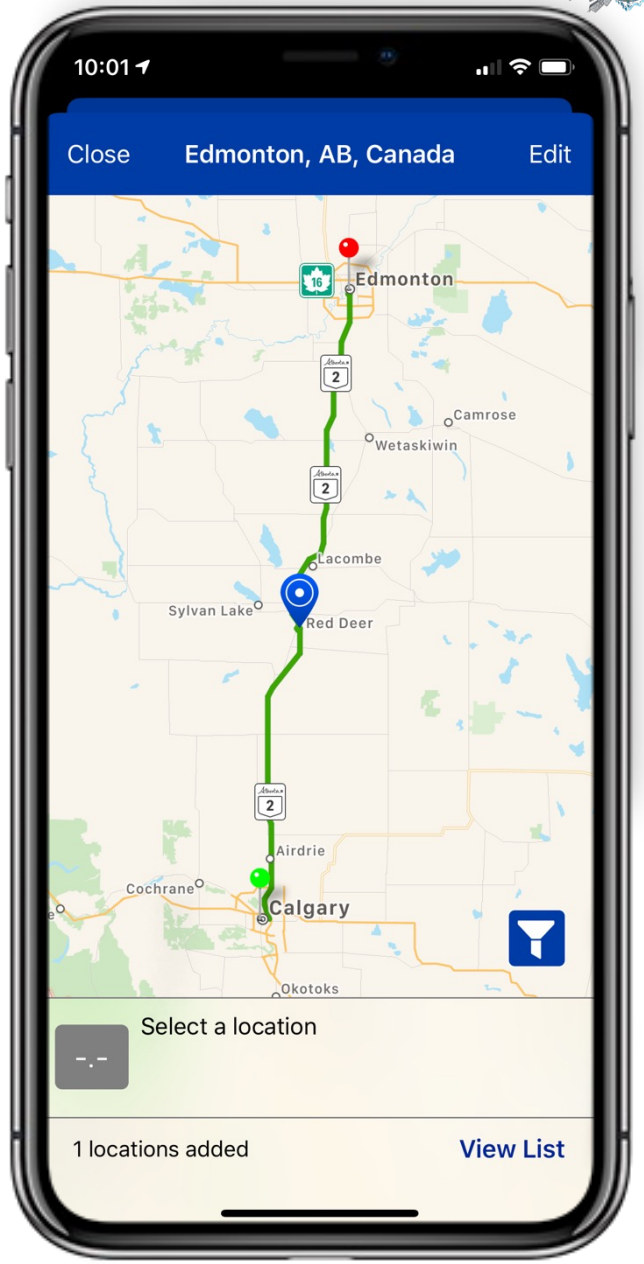
- What is Plugshare? An interactive website that shows all public and private charging stations all over the world!
- Includes the charger's rating, charging level, charger type, network the charger is connected to, and more.
- Share your own personal charger with other EV users.
- Plan your trip with the app. Find where stations are and plan when you need to recharge.



PlugShare Mobile App







Other Charging Apps

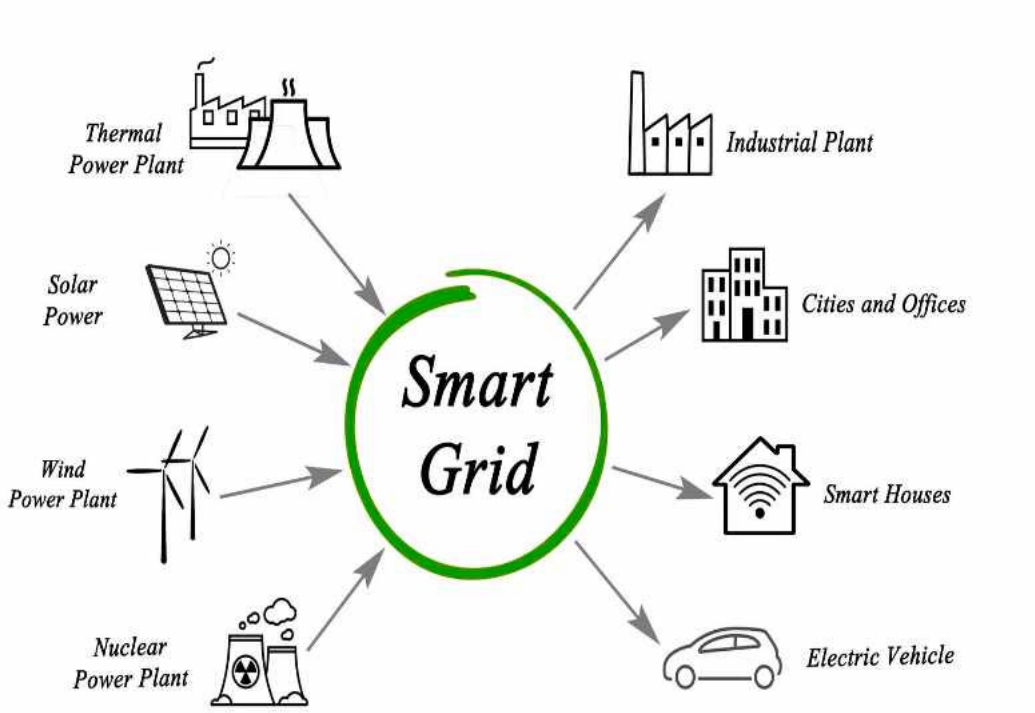
TO FIND A CHARGING STATION

- **ChargeHub**
  - "Find every charging station in Canada and the USA with ChargeHub's live-updated map"
- **Chargemap**
  - Find charging stations globally. Chargemap offers a universal charging pass to use at stations
- **Open Charge Map**
  - An easy-to-read amp showing registered chargers globally

TO CHARGE

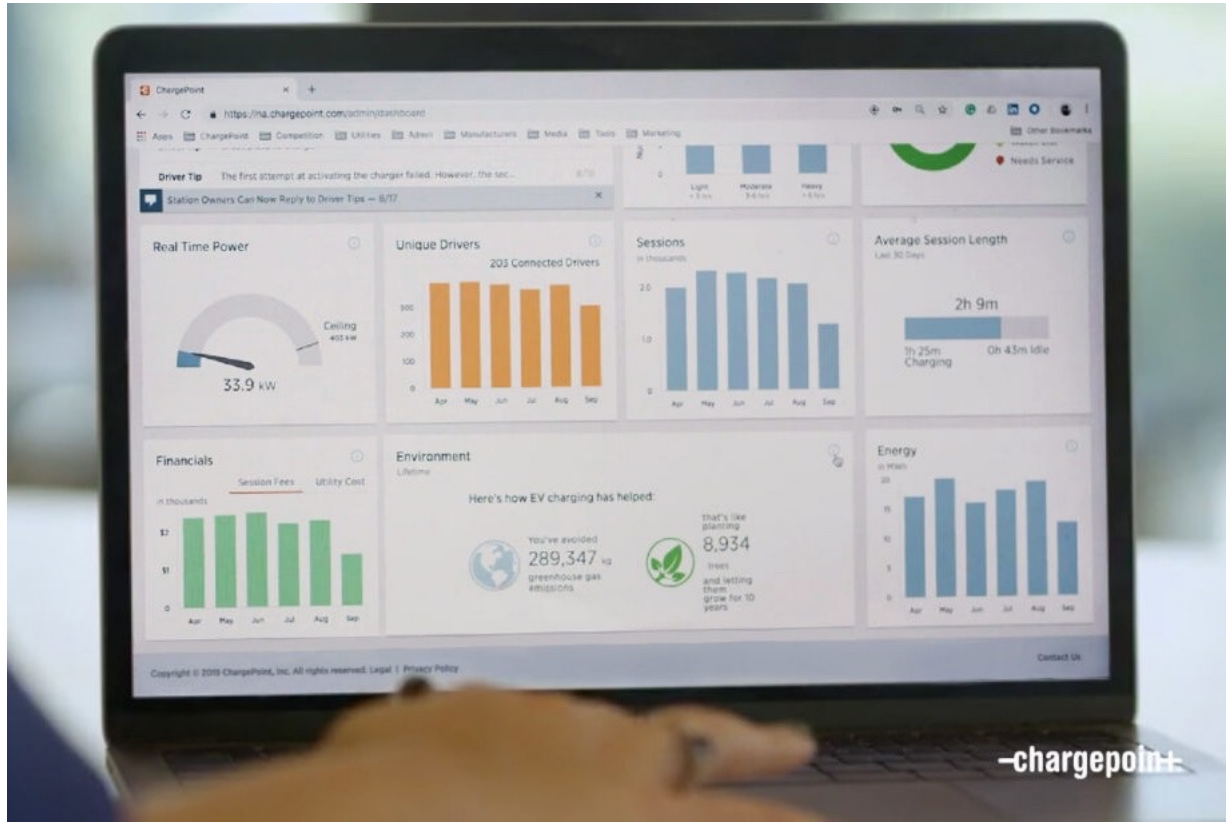
- **ChargePoint**
  - ChargePoint has their own line of chargers. They are North America's largest charging network
- **Greenlots**
  - A member of the Shell Group. Greenlots has deployed their charging network across 13 countries

Smart Grids



- Electric vehicles draw electricity from the grid
- The more EVs there are, the more demand there is on the grid
- This means the grid needs some modifications: we need a smart grid
- The grid was designed in the 20th century for one-way flows
- A smart grid will allow for bidirectional flows to accommodate residential solar, and EV charging

Smart Charging Software



- In addition to smart grids, smart charging software is on the way to manage production and consumption
- Smart grid software will assist in managing your charging so that not all EVs are charging at the same time
- You can manage when you charge your car
- Example – Chargepoint

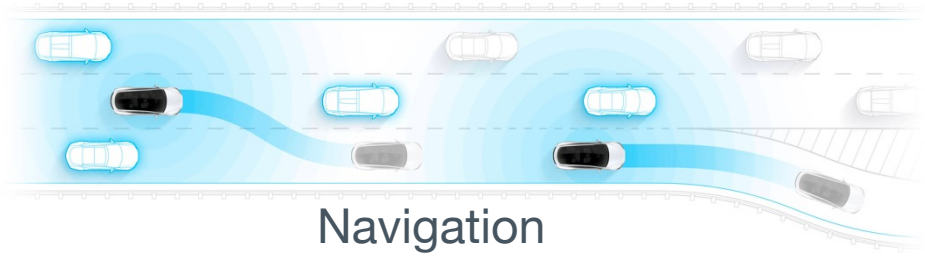
Autonomous vehicles

- **Autonomous vehicle: a self-driving car**
- The City of Calgary launched an autonomous vehicle pilot project
- 12 passenger, fully autonomous shuttle
- Shuttle traveled between the Calgary Zoo to the Telus Spark Science Centre in September 2018
- The shuttle has a max speed of 12 km/h

- Visit https://www.ridewithela.ca/ or more information

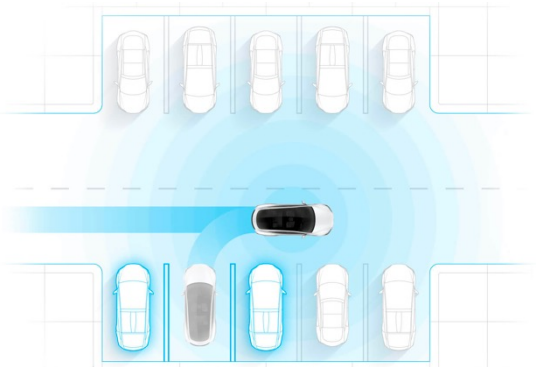
Auto-pilot and self-driving capabilities

- Autopilot: a device that steers a vehicle without contribution from a person (self-driving)
- What is autopilot?
  - Autopilot is a driver assistant. Humans must be present in the vehicle
- What can an autopilot car do?
  - Self park
  - Collision avoidance
  - Land departure warning
  - Autosteer
- Tesla has these capabilities, and more!



Navigation

Autosteer



Parking assistance

Thank you!

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