

Battery Electric Vehicles

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ICEV = Internal Combustion Engine Vehicle (e.g., Honda Civic)

HEV = Hybrid Electric Vehicle (e.g., Toyota Prius)

PHEV = Plug-in Hybrid Electric Vehicle (e.g., Toyota Prius Prime)

BEV = Battery Electric Vehicle (e.g., Tesla Model 3)

EV = PHEV or BEV

kWh = battery energy, kW = battery charging power

SOC = State Of Charge (0%-100%)

Burning 1-gallon gasoline = 33.7 kWh

tinyurl.com/BEVs2019 and tinyurl.com/BEVs2020

My Two PHEVs & Five BEVs



Failed to convert to Lilon.

2005 Prius converted to PHEV 2006 HiHy converted to PHEV 2007 Chinese Pickup lead-acid BEV



leased



leased



2012 Nissan LEAF 73 miles

2015 Nissan LEAF 84 miles



2017 Chevrolet Bolt EV 238 miles



Tesla Model 3 Long Range RWD 310-miles

Talk Outline

- **Environmental reasons to drive battery-electric vehicles (BEVs).**
- **Economic reasons to drive BEVs.**
- **Comparison to internal-combustion-engine vehicles (ICEVs).**
- **Details about BEVs.**
- **Enjoyment of driving BEVs.**
- **Renewable energy to charge BEVs.**
- **Current long-range BEVs (range > 200 miles).**
- **Medium-range BEVs for local driving (range < 200 miles)**
- **BEV pickup trucks and schools buses**
- **Charging BEVs.**
- **Long trips in long-range BEVs.**
- **Plug-in hybrid vehicles (PHEVs).**
- **Future of cars.**

**Many graphs and pictures have
Internet links behind them.**

El Niño increases global warming & La Niña decreases global warming.

NASA

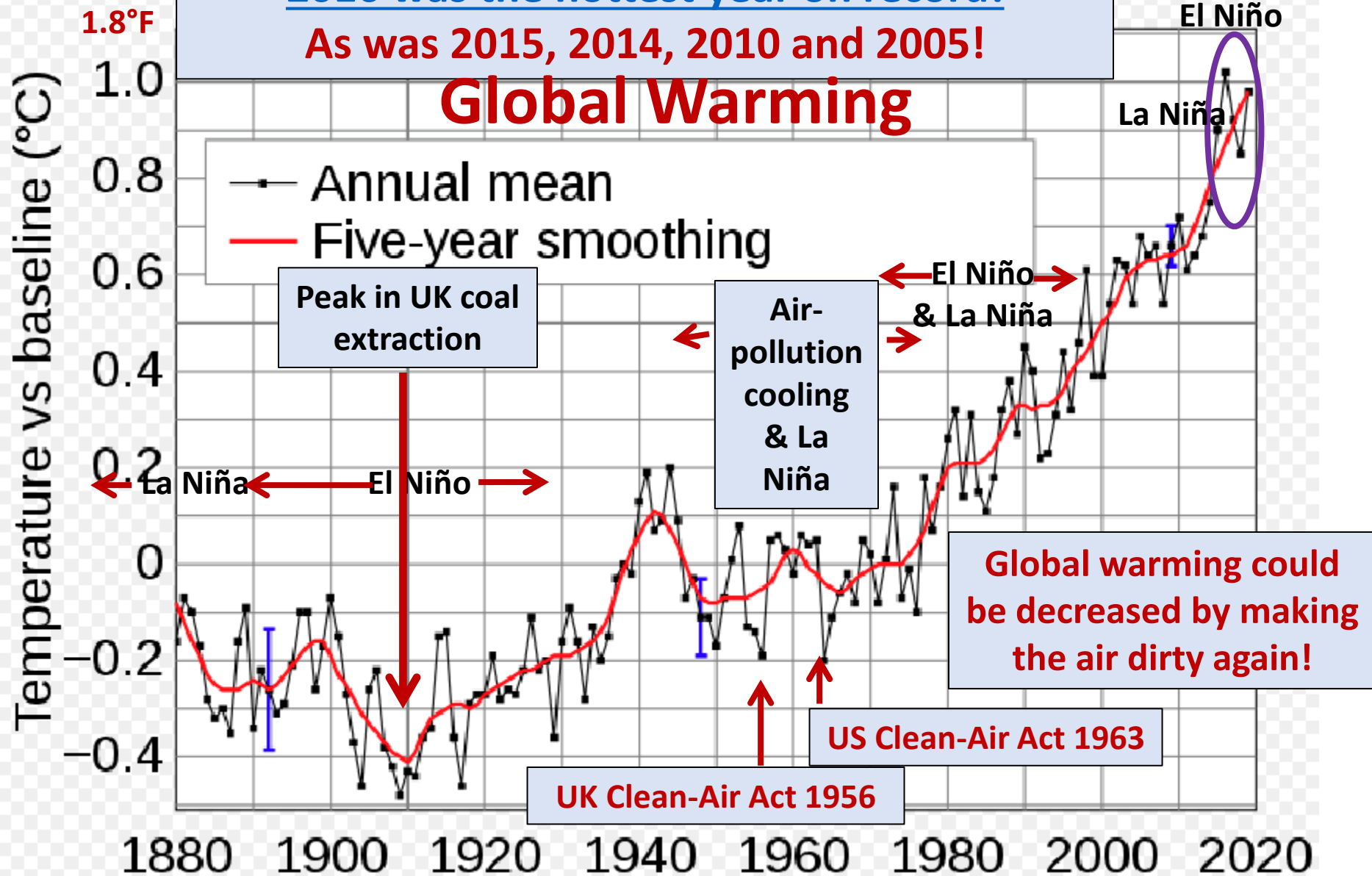
[Tinyurl.com/GlobalWarmingRoper](https://tinyurl.com/GlobalWarmingRoper)

1951-1980 base

2016 was the hottest year on record!

As was 2015, 2014, 2010 and 2005!

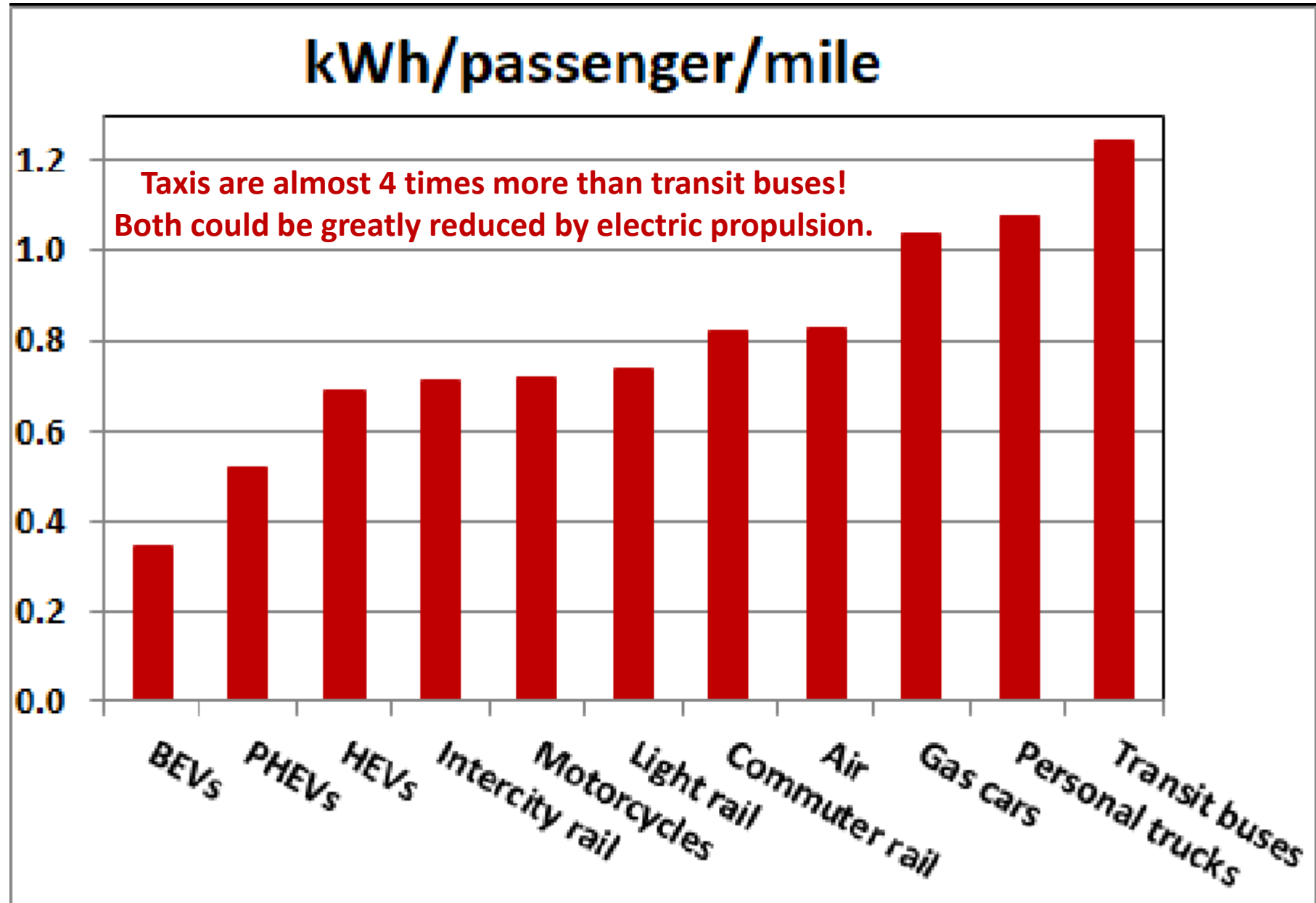
Global Warming



Environmental Aspect of BEVs

- Advantages
 - Reduction in carbon-dioxide emissions compared to ICEVs even with coal electricity.
 - Much lower operating and maintenance costs reduce environmental footprint compared to ICEVs.
 - Reduction in local pollutants, including sound noise
 - Refuel (charge) at home, best using solar energy.
 - Low noise pollution.
- Disadvantages
 - Motors have some rare-earth and critical metals.
 - More carbon-dioxide emitted in manufacture than ICEVs.
 - Tires can wear out slightly quicker than for ICEVs because of high acceleration.

Energy-Usage Efficiency

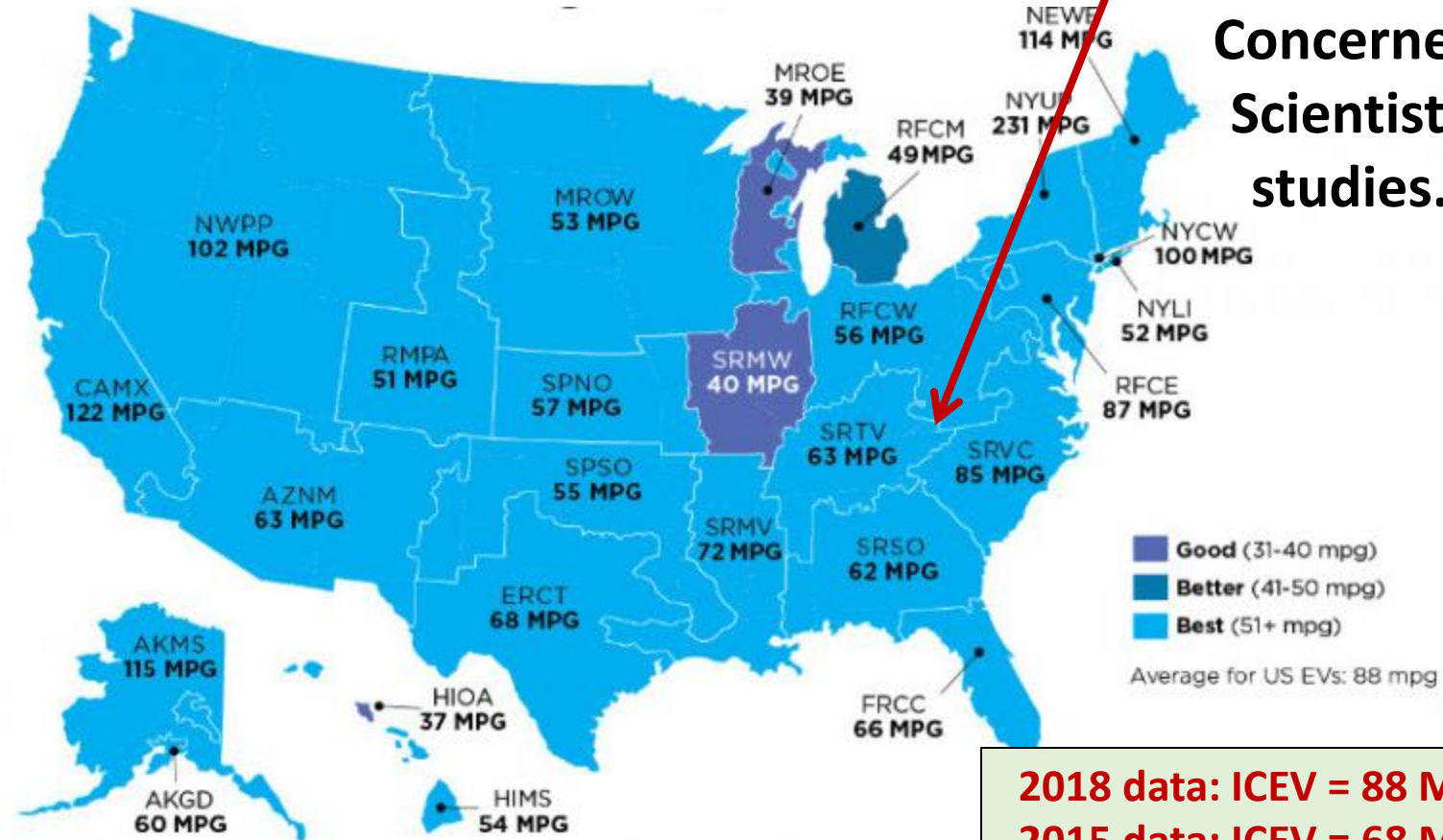


Electric Vehicles vs Gasoline Vehicles GHG Emissions

65 mpg ICEV for Tesla Model 3.

Minimum MPG for ICEV to match BEV GHG emissions.

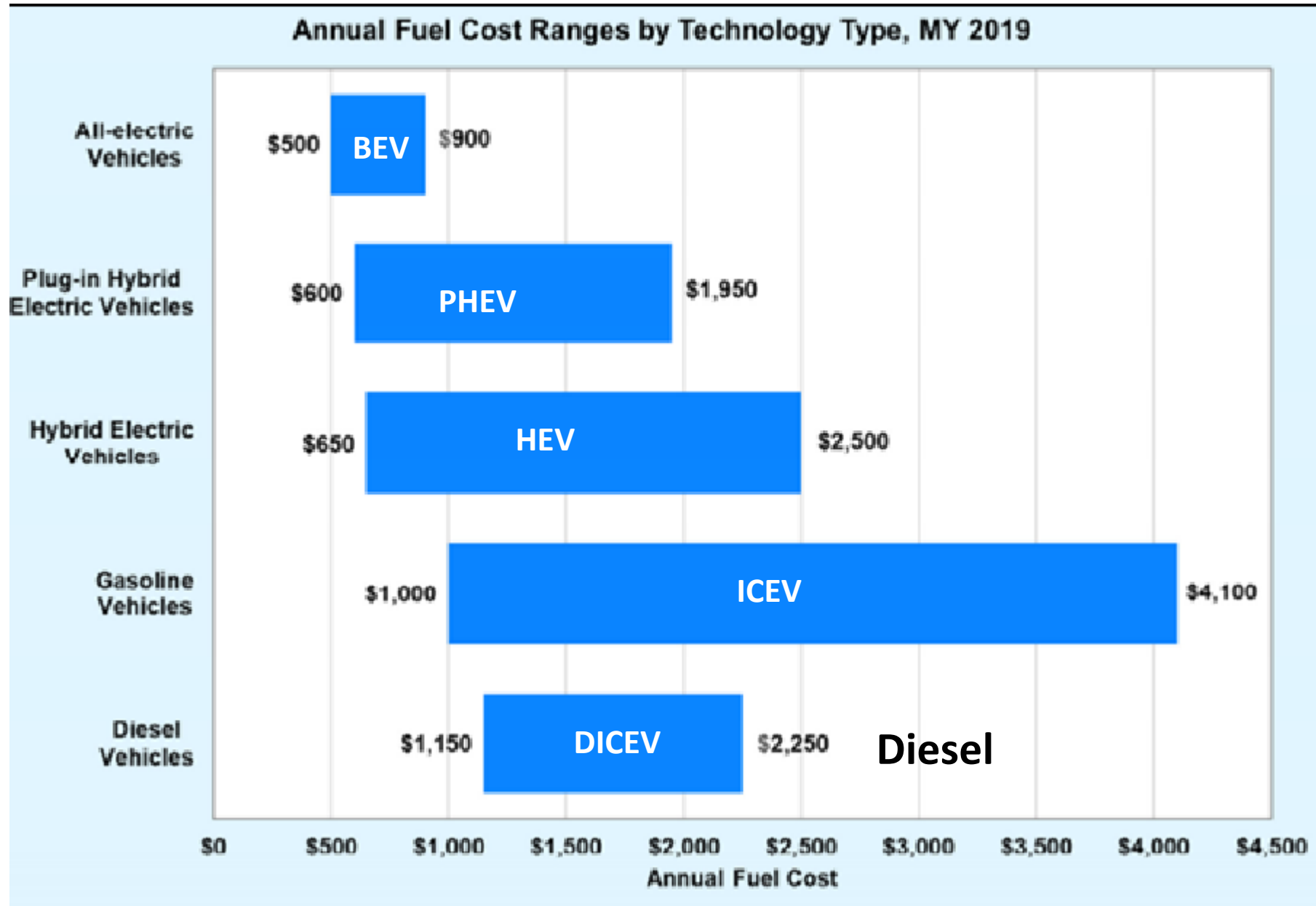
**Union of
Concerned
Scientists
studies.**



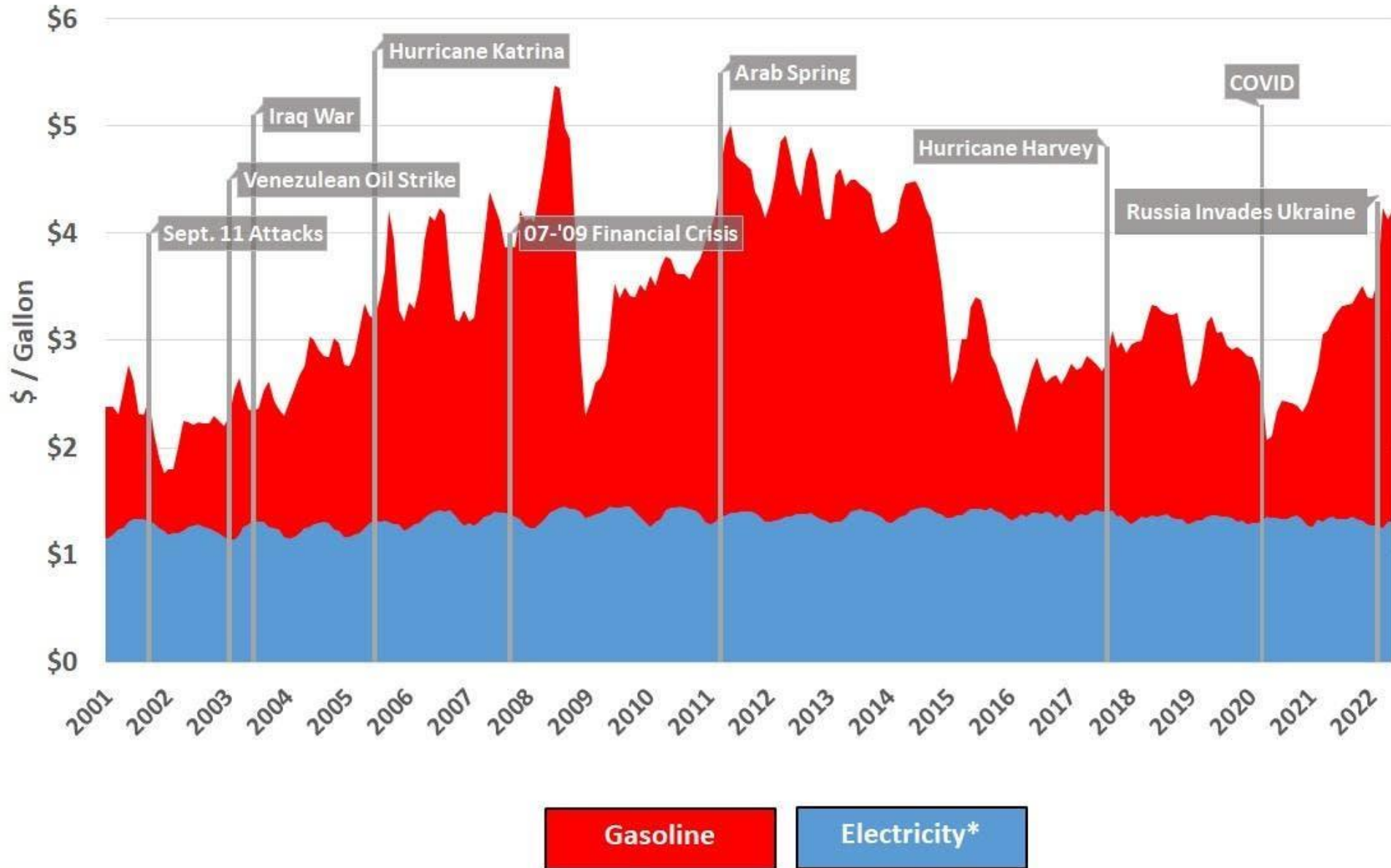
2018 data: ICEV = 88 MPG
2015 data: ICEV = 68 MPG

2018 US ICEV average = 22 MPG
Toyota Prius Eco = 56 MPG

BEV vs ICEV Fuel Cost Range



Gasoline and Electricity Prices: Jan 2001 - May 2022



* Shown in \$/"eGallon" or the cost of fueling a vehicle with electricity compared to a similar vehicle that runs on gasoline
Data source: Energy Information Administration, May 2022; Monthly averages

ICEV vs BEV Needed Maintenance

ICEV maintenance NOT needed for a BEV

- Mechanical brakes (used constantly)
- Oil and oil-filter regular changes
- Transmission fluid changes
- Mufflers and tail pipes
- Catalytic converters
- Belts
- Spark plugs
- Many engine moving parts to wear out

• BEV maintenance

- Mechanical brakes are **used only in emergencies and at low speed**. Otherwise **electricity regeneration** slows or stops a BEV.
- Electric motors usually run 24/7 for many years without maintenance or repairs.
- Rotate tires at about 10,000-miles intervals.
- Battery/electronics coolant change at 50,000 miles.
- Solid-state electronics are very reliable.

EV Buying Experience

- Sales persons are often poorly informed about features and technology of EVs.
- Sales persons are often poorly informed about different available charging possibilities.
- Customers are often poorly informed about features, technology and charging for EVs.
- Dealers do not like the fact that it takes longer to inform customers about EVs than ICEVs.
- Dealers do not like low maintenance costs for BEVs.
- **For the above reasons Tesla decided to not sell their BEVs through dealers.**

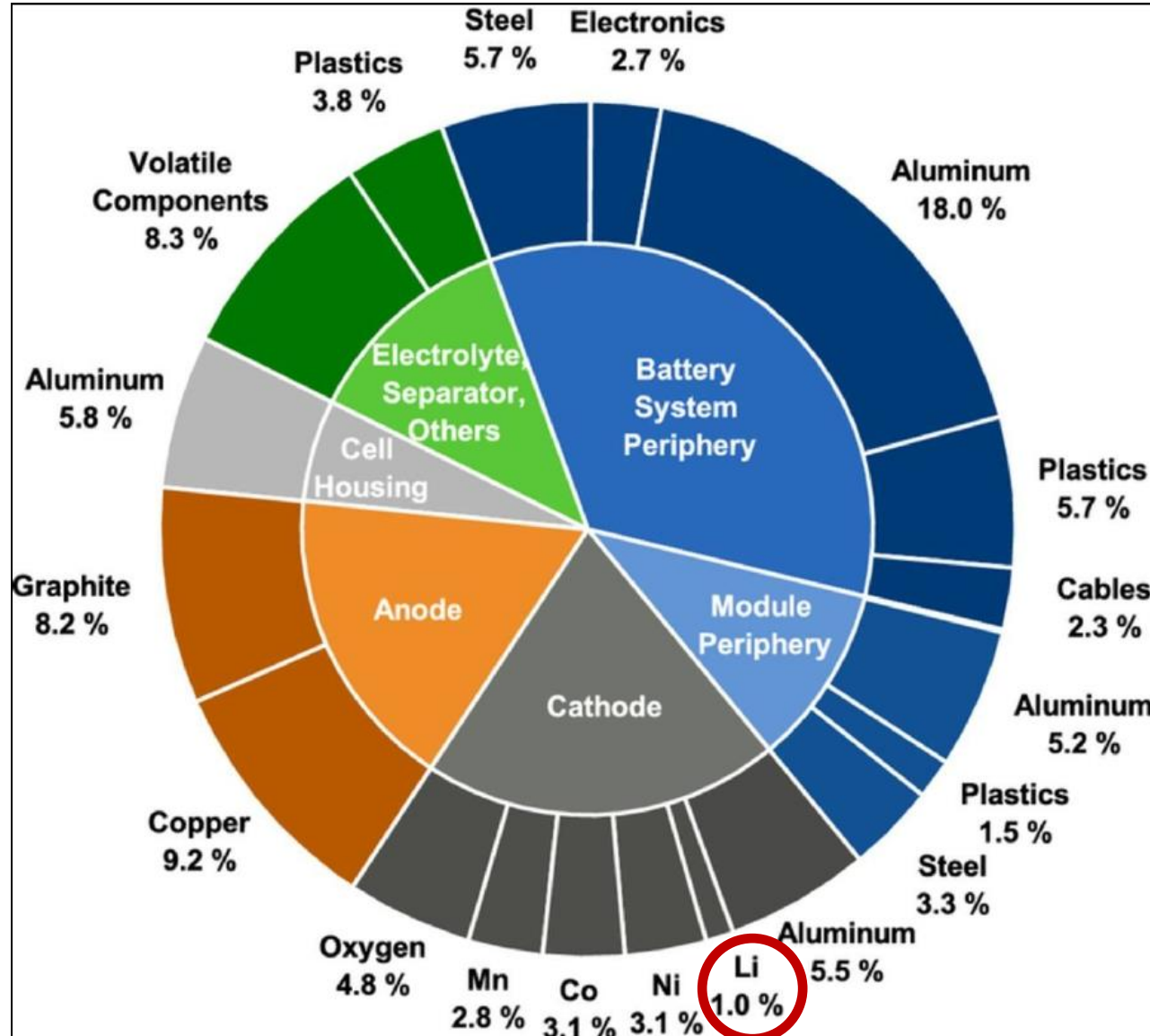
State Laws about Buying Teslas

- 16 states that forbid sales of Tesla BEVs: **AL, AR, CT, IA, KS, KY, LA, MI, MT, NE, ND, OK, SC, SD & TX**
- 9 states that limit the number of Tesla stores: **CO(1), NC(1), VA(2), GA(5), MD(4), NJ(4), NY(5), OH(3) & PA(5)**
- **Michigan law:** “A manufacturer shall not...sell any new motor vehicle directly to a retail customer other than through franchised dealers.”
 - **A Michigan legislator:** “The Michigan dealers do not want you here. The local manufacturers do not want you here. So you’re not going to be here.”

What about BEV Batteries?

- BEV batteries are guaranteed for defects for 8 years and 100,000 miles. (**Tesla Model 3 Long Range for 120,000 miles**)
- Lithium-ion batteries lose capacity with time, usually quicker at first and slower later.
- [Tesla Model 3](#) has a 70% degradation warranty within 8 years. Most will degrade much less than that depending on how they are driven and charged.
Projected lifetime (70% capacity) = 300,000-400,000 miles.
- New batteries that will last longer and cost less are being developed. **Tesla states next battery will last 1-million miles and will be available soon!**

Lithium-Ion Battery Components



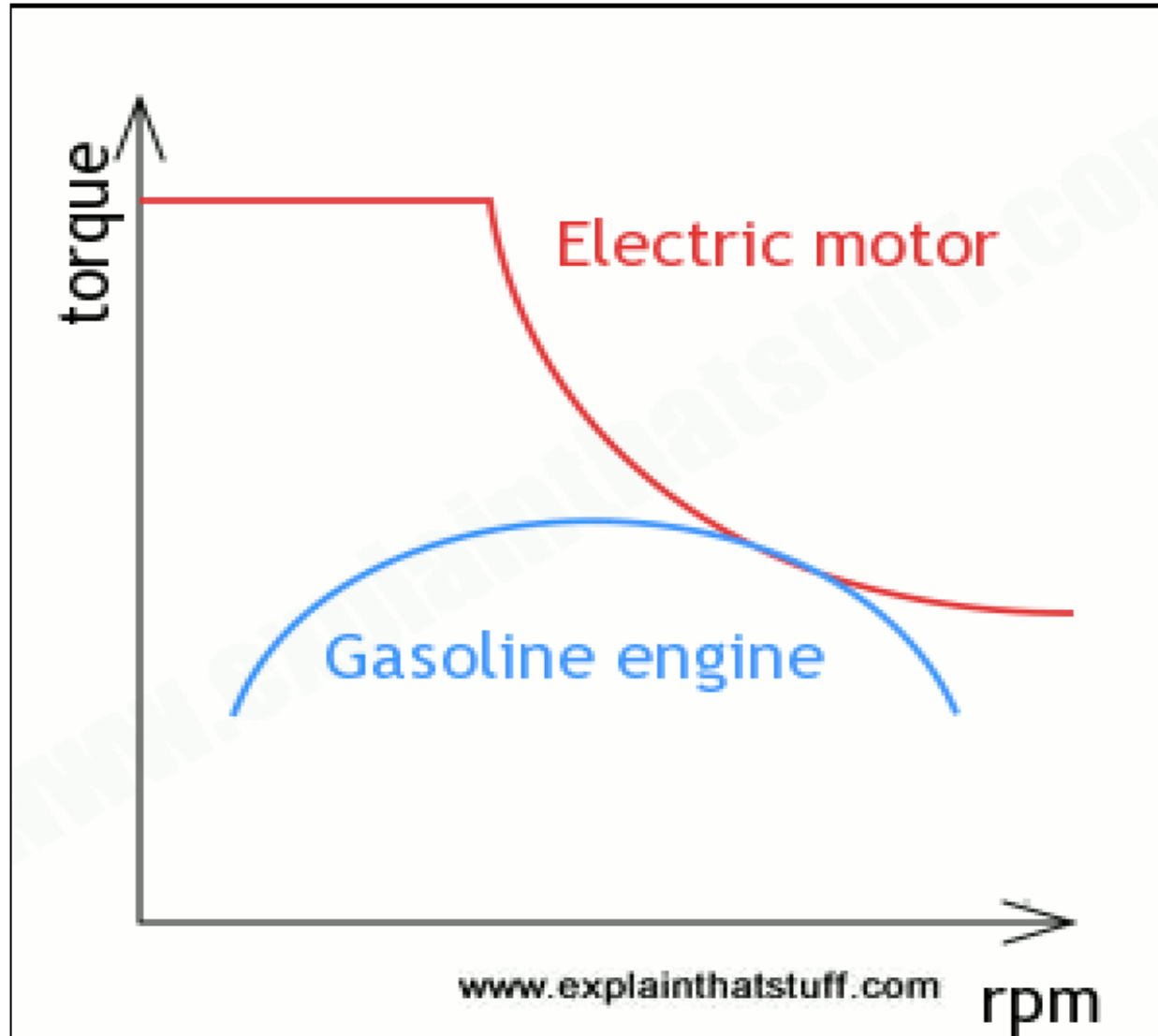
Note that Lithium (Li) is a small fraction. The main abundance problems are for Cobalt (Co) and Nickel (Ni). Tesla plans to eliminate Cobalt in Lithium-Ion batteries.

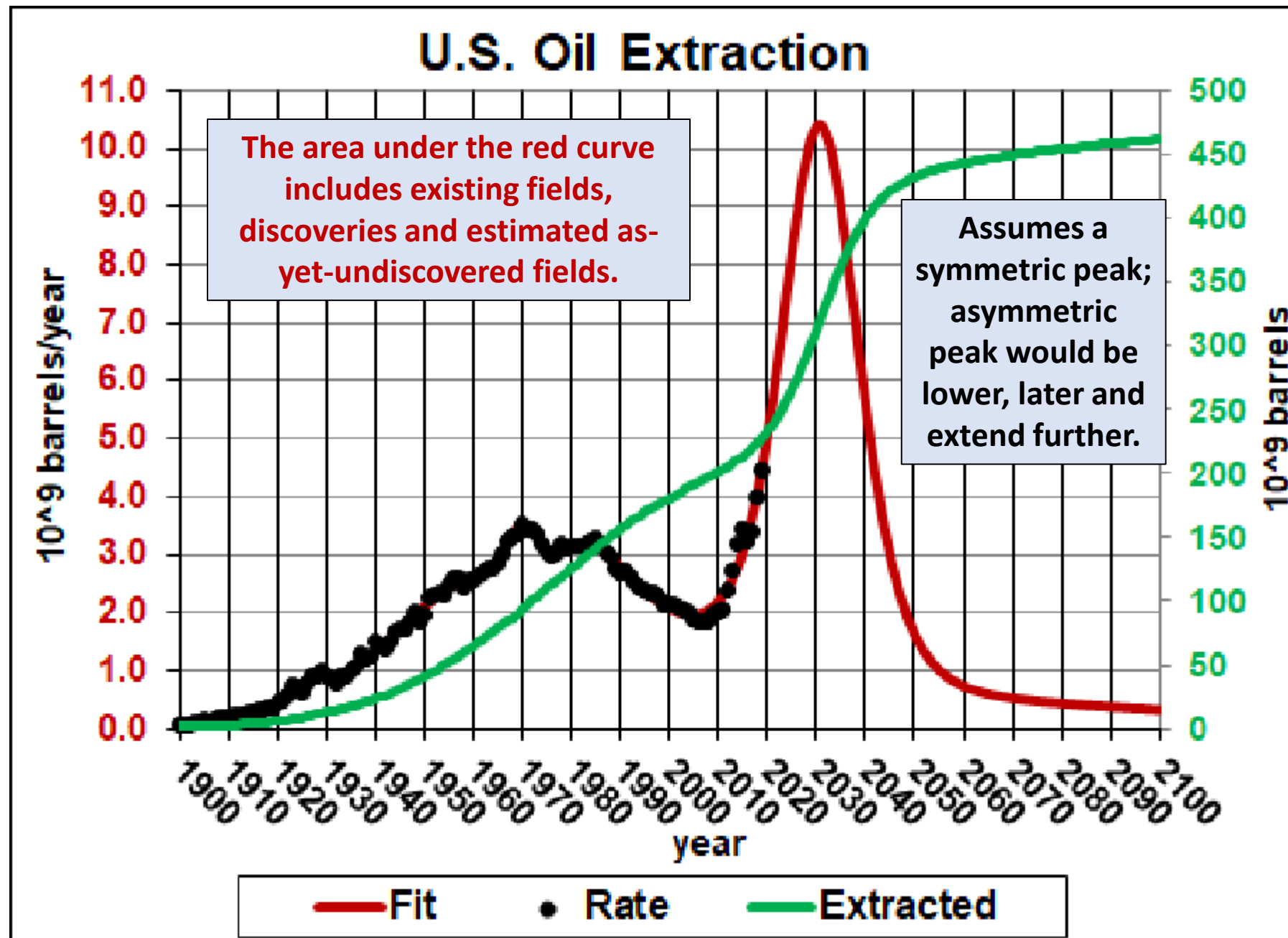
Enjoyment!

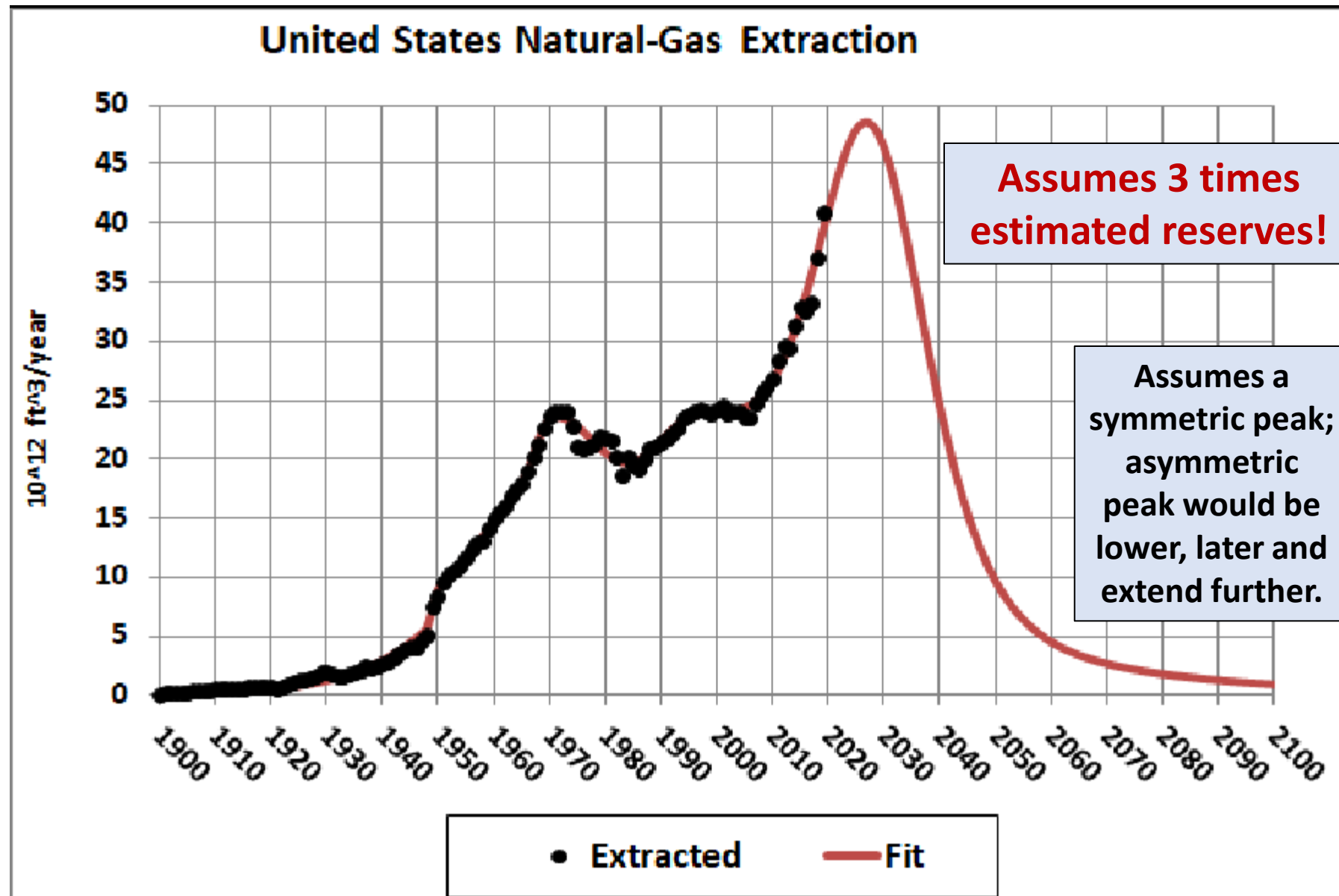
- Very quiet. ([New regulations](#) require sound below 19 mph.)
- High acceleration! (See next slide.)
- Most battery charging overnight at home.
 - No fumes or bad weather when charging in garage.
- Much free < 10-kW public charging.
- Low center of gravity enhances safety and performance (heavy battery underneath).
- One-pedal driving = foot off pedal stops BEV.

0-30 mph Acceleration is a **BIG DEAL!**

- **High torque at low speed! Triple acceleration same efficiency as for ICEV.**
- Can get to the next traffic light far ahead of ICEV cars with no roar.
- Can maneuver much better in tight traffic.

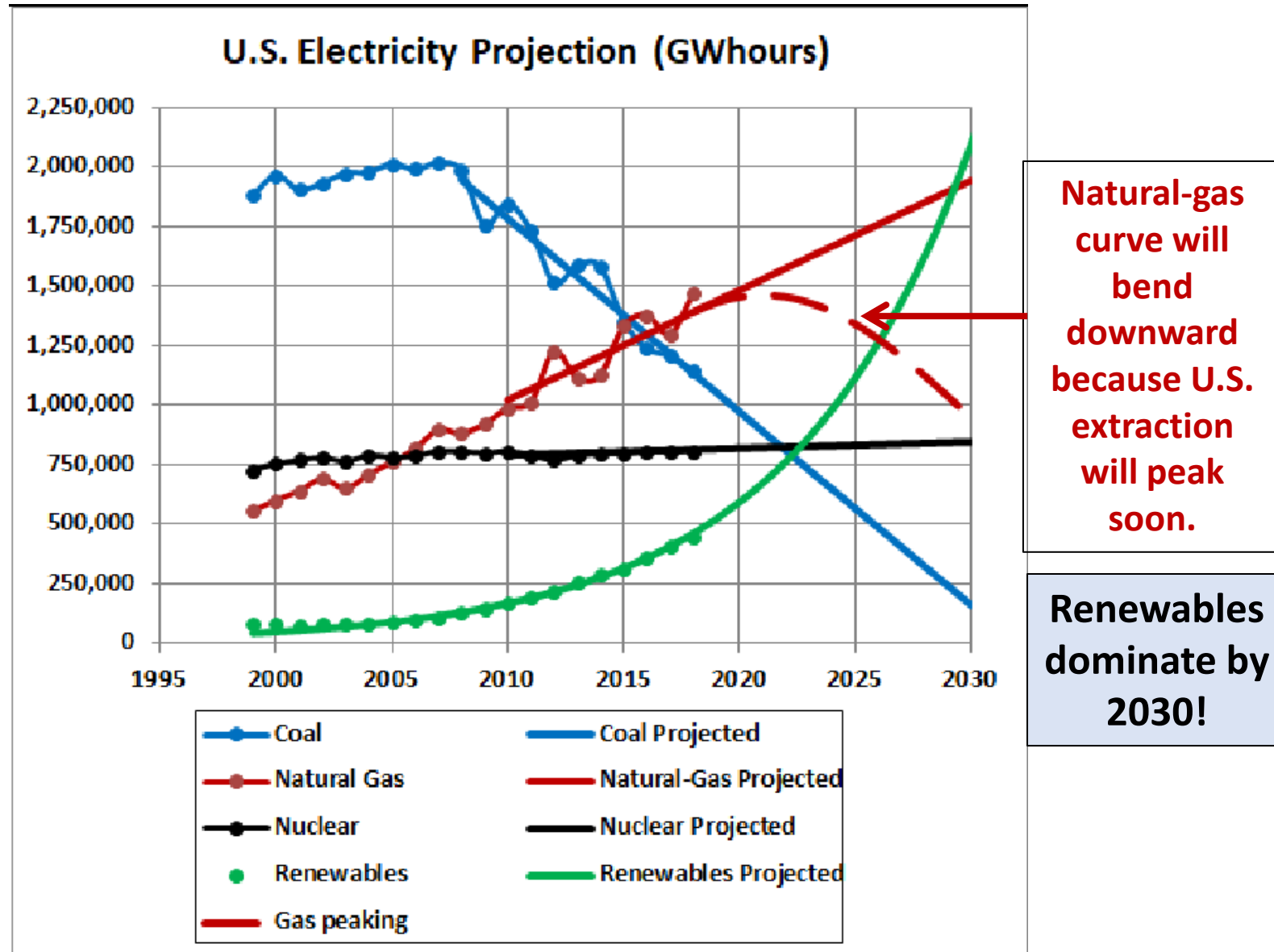






Do not plan to power future vehicles with natural gas!

Solar/Wind/Biomass are Passing Coal for U.S. Electricity Generation



Renewables = wind, solar, and biomass, **not including hydropower**.

Tesla Model 3

Consumer Reports:
Tesla Model 3 is “most satisfying” car, more than Porsche or Corvette.



TM3 is managed by smartphone or RFID card or fob. Auto open and close with smartphone.

Average gasoline car in 2018: 25 MPG


TM3 had 8 Car-of-the-Year awards in 2018-20.

Model	EPA Range	MPGe	Price
Standard Range *	220	131	\$35,900
Standard Range Plus	250	141	\$39,990
Long Range *	330	130	\$45,900
AWD	322	121	\$48,490
Performance (AWD)	322	121	\$56,990

Autopilot software is included in all 5 versions. Order online. * = phone order. If leased, returned to Tesla.

US 2018 average price of a light vehicle was \$37,577.

Tesla Model 3 Dashboard

A photograph of the interior of a Tesla Model 3, showing the dashboard and steering wheel. The dashboard is a large, horizontal screen displaying a map and navigation information. The steering wheel is black with the Tesla logo in the center. The interior features a combination of black and light-colored wood trim.

Tesla BEVs have regular software updates, about one per month, to add new features and fix problems. My TM3LR-RWD had 30 updates in first 22 months. It now has many features it did not have originally.

**All car controls are on the 15" screen or on the steering wheel and steering column.
Adaptive cruise control is simplest.
Cabin air flow is across entire dashboard.
Excellent navigation including Superchargers and Destination Chargers.**

What is Tesla Autopilot?

- **Requires slight torque on steering wheel.**
- 8 cameras, 12 ultrasound sensors & forward radar
- Automatically brakes as leading car slows.
 - Also, occurs with adaptive cruise control (TAAC).
- Stays between lane lines; changes lanes after turn-signal activation.
- **Makes driving on long trips less tiring since attention can be concentrated on nearby traffic instead of lanes, acceleration and braking.**
- **Full Self Driving (FSD, extra cost)(in development)**
 - Auto Lane Change, Autopark, Summon, Smart Summon
 - Automatically turns onto ramps when navigating trips.
 - **Future:** respond to stop lights/signs, auto city driving.

Tesla Model Y SUV



Built on Model 3 skateboard.

Model	Range (mi)	MPGe	Price
LR RWD	300	137	\$48,000
LR AWD	316	121	\$52,990
Performance	315	121	\$60,990

Chevrolet Bolt EV



Range: 259 miles MPGe: 119 Price: \$36,620

US 2018 average price of a light vehicle was \$37,577.

There are two trims in order of increasing cost: LT & Premium.

Hyundai Kona Electric



**Federal
tax credit
= \$7500**

Range: 258 miles

MPGe: 120

Price: \$36,450

US 2018 average price of a light vehicle was \$37,577.

Hyundai Ioniq Electric



**Federal
tax credit
= \$7500**

Range: 170 miles

MPGe: 133

Price: \$30,315

US 2018 average price of a light vehicle was \$37,577.

Kia Niro Electric



**Federal
tax credit
= \$7500**

Range: 239 miles MPGe: 112 Price: \$39,495

US 2018 average price of a light vehicle was \$37,577.

Kia Soul Electric



**Federal
tax credit
= \$7500**

Range: 243 miles

MPGe: 114

Price: \$33,950

Tesla Model S AWD



Model	EPA Range	MPGe	Price
Long Range (AWD)	390	111	\$79,990
Performance (AWD)	348	104	\$99,990

**Autopilot
software
included in both
versions.
Order online.**

Tesla Model X AWD SUV



Model	EPA Range	MPGe	Price
Long Range (AWD)	351	96	\$84,990
Performance (AWD)	305	90	\$104,990

**Autopilot
software
included in both
versions.
Order online.**

Jaguar i-Pace AWD



**Federal
tax credit
= \$7500**

Price	Range	MPGe	0-60
\$69.500	253	76	4.5

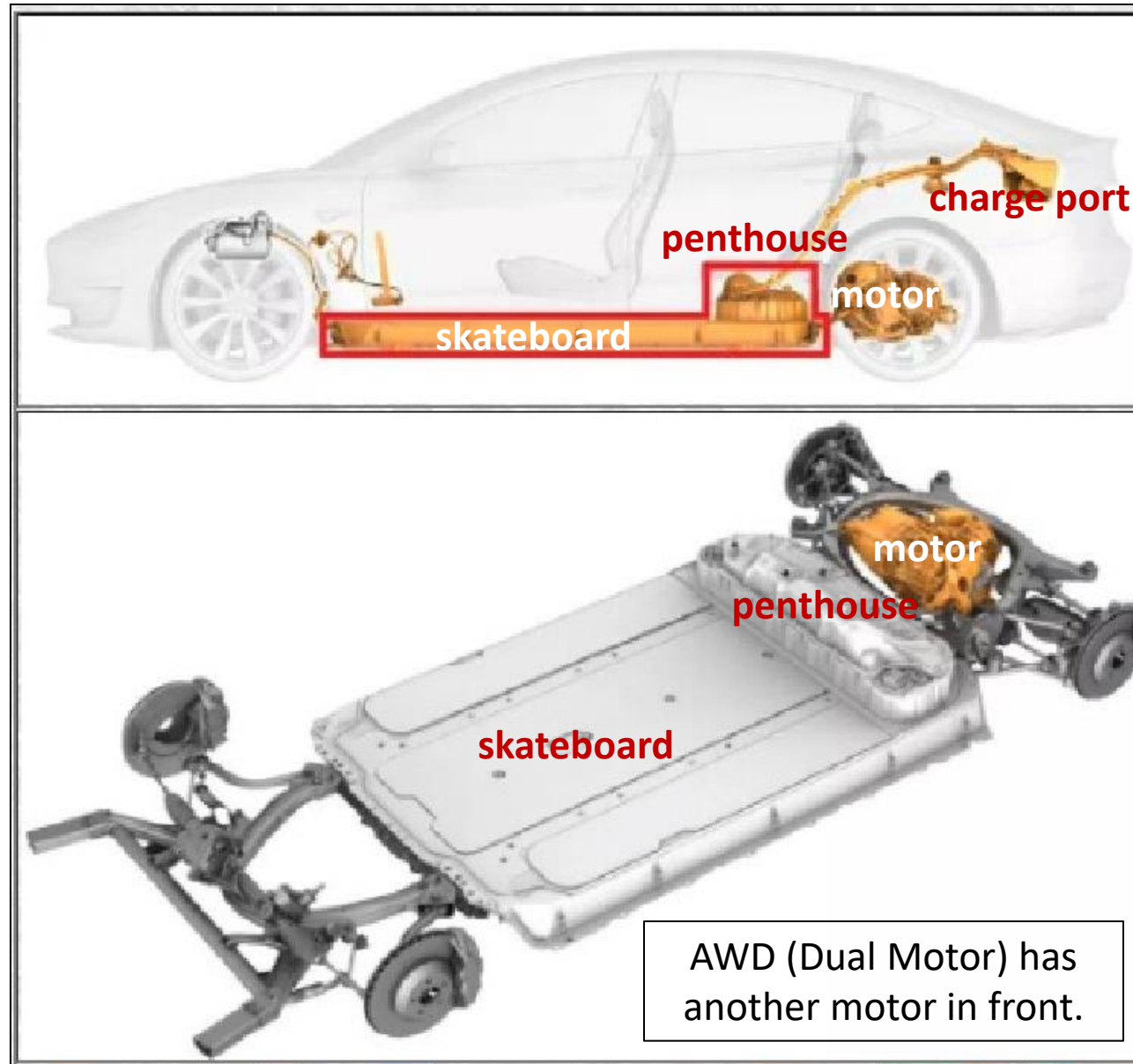
Audi e-Tron AWD

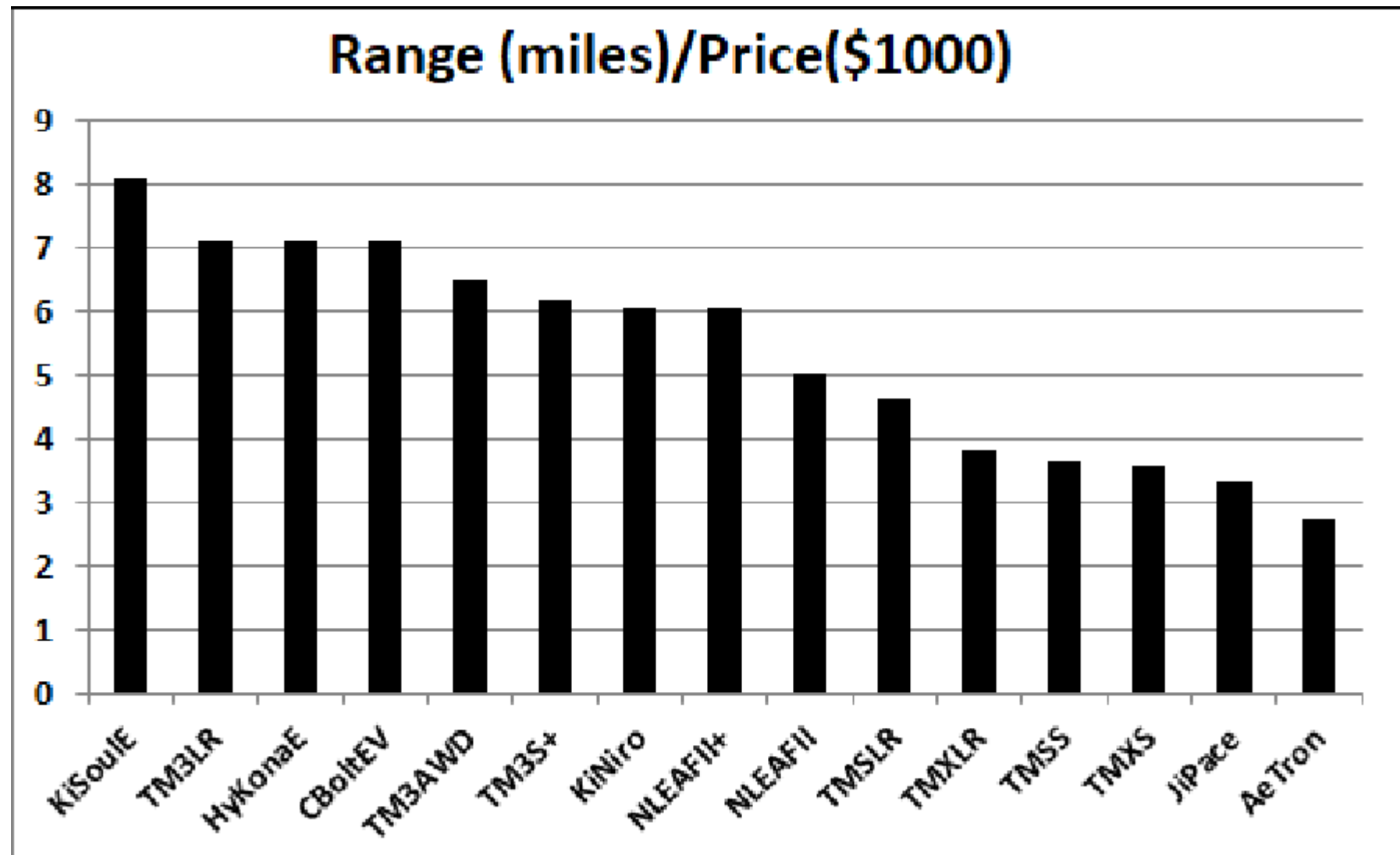


**Federal
tax credit
= \$7500**

Model	Price	Range	MPGe	0-60
50	\$56,100	186	97	6.8
55	\$74,800	242	94	5.5

Tesla Model 3 Drive Train



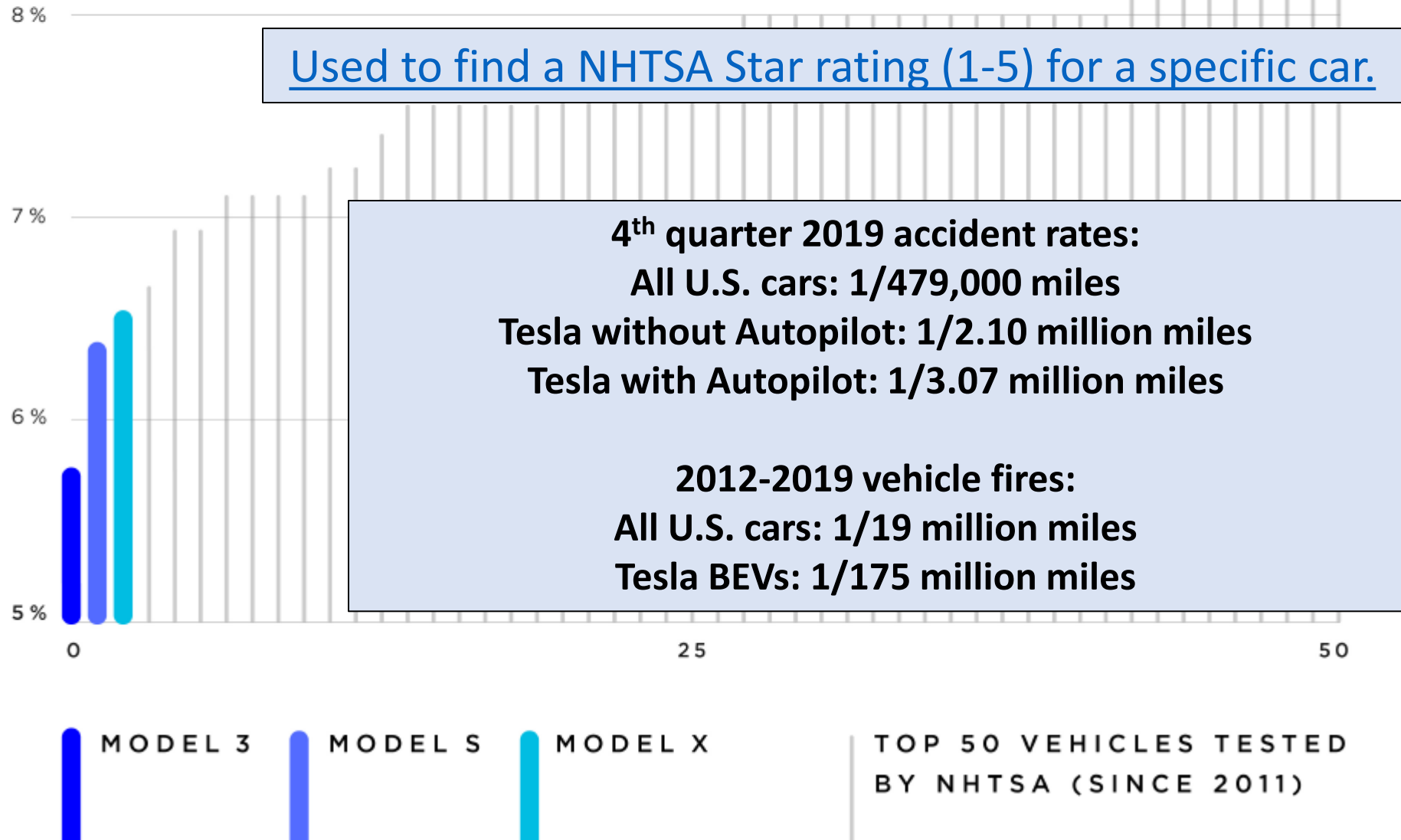


KiSouIE=Kia Soul Electric, **TM3LR**=Tesla Model 3 Long Range, **HyKonaE**=Hyundai Kona Electric
CBoltEV=Chevy Bolt EV, **TM3AWD**=Tesla Model 3 AWD, **TM3S+**=Tesla Model 3 Standard Plus
KiNiro=Kia Niro, **NLEAFII+**=Nissan LEAF II Plus, **NLEAFII**=Nissan LEAF II, **AeTron**=Audi eTron
TMSLR=Tesla Model S Long Range, **TMXLR**=Tesla Model X Long Range, **JiPace**=Jaguar iPace

LOWEST PROBABILITY OF INJURY

TESTED BY NHTSA

NHTSA = National Highway Traffic Safety Administration



BEV Supercar: Tesla Roadster 2



Range (mi)	0-60 mph (s)	Top Speed (mph)	Price	
620	1.9	250	\$250,000	

Available 2021

BEV Supercar: Porsche Taycan



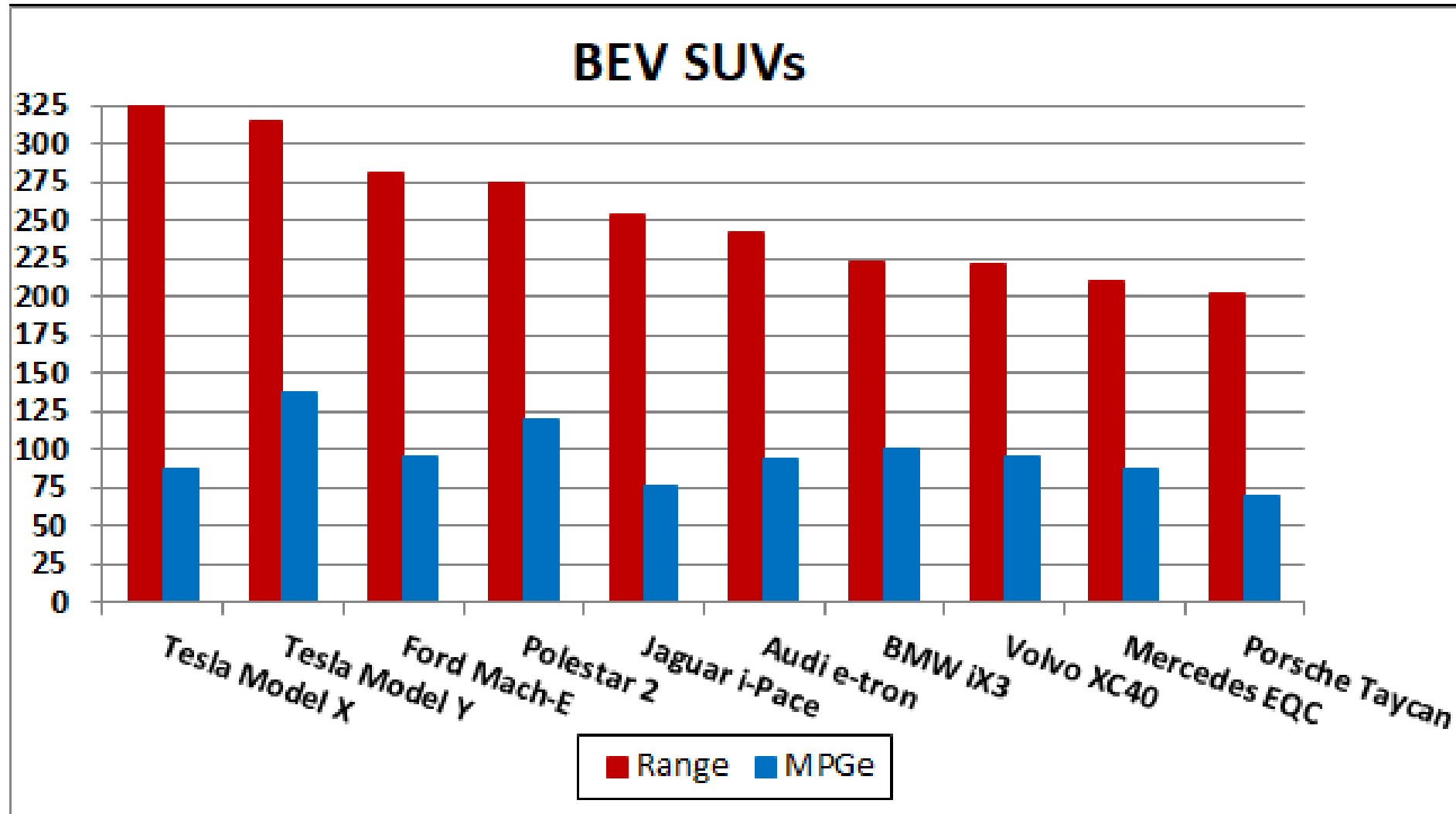
**Federal
tax credit
= \$7500**

Model	Range (mi)	MPGe	Price
<u>4S</u>	226-257	96-92	\$103,800
<u>Turbo</u>	201	69	\$150,900
Turbo S	192	68	\$185,000

Available now

<https://electrek.co/2019/12/11/porsche-taycan-turbo-201-mile-epa-range/>

BEV-SUVs Range & MPGe Comparison



Probably range is more important than efficiency.

Ford Mustang Mach-E



**Federal
tax credit
= \$7500**

Model	EPA Range (miles)	Efficiency (MPGe)	Price
Standard Range RWD	230	<u>102</u>	\$39,000
Long Range RWD	300	102	\$48,000
Long Range AWD	280	96	\$52,000
Performance (AWD)	280	96	\$61,000

**Available in
early 2021.**

Average gasoline car in 2018: 25 MPG

US 2018 average price of a light vehicle was \$37,577.

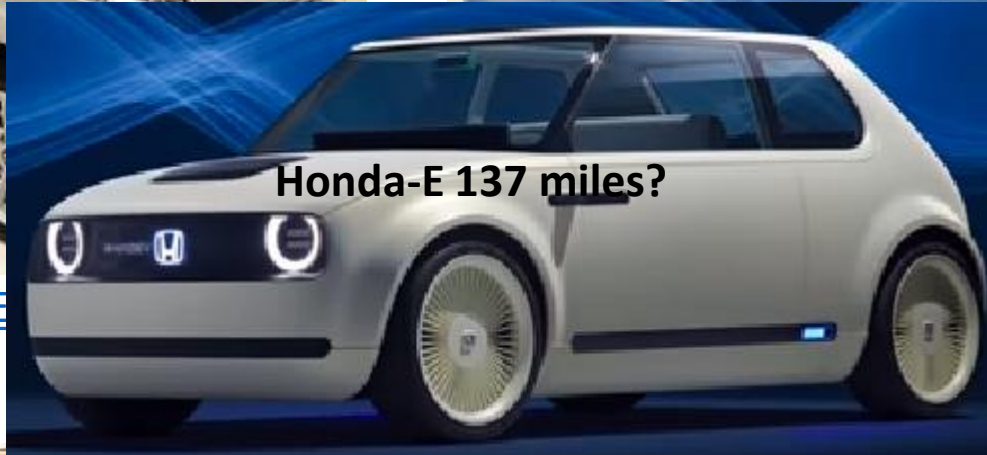
BEV Mini-Compacts



[Smart ForTwo EV](#)
68 miles 75 mph



[Spark EV](#)
\$13,095



Honda-E 137 miles?



[Mini Cooper SE Electric](#)
110 miles \$29,900



[Fiat 500e](#) ~125 miles \$?

Volkswagen BEV Plans



ID.3

ID. Buzz

ID. Crozz



ID. Vizzion



ID. Beach Buggy

Electric Pickup Trucks



- [Rivian](https://rivian.com) electric pickup and SUV (rivian.com).
- [Tesla Cybertruck](#)
- [Ford F150 electric promised.](#)
- [Many Electric trucks promised](#)
- [Top 10 future electric pickup trucks](#)

Tesla Cybertruck



Type	Range (Miles)	0-60 mph	Storage (ft^3)	Towing (lbs)	Clearance (in)	Price (\$)
SM RWD	250	6.5	100	7,500	16	\$39,900
DM AWD	300	4.5	100	10,000	16	\$49,900
TM AWD	500	2.9	100	14,000	16	\$69,900

Electric Buses

- About 650 e-buses on US roads at end of 2019, more than double 2018.
- Hundreds of thousands of e-buses in China.
- California replacing 200 polluting diesel school buses by e-buses.
- 50 e-school-buses in Virginia by end of 2020.
- <http://www.roperId.com/science/ElectricSchoolBuses.pdf>



BEV Charging Terms

- Battery energy is in **kilowatt-hours (kWh)**
 - Burning 1 gallon of gasoline = 33.7 kWh
 - E.g., Tesla Model 3 LR (TM3LR) has a 78-kWh battery
- Charging power is in **kilowatts (kW)**
 - Chargers start at peak power, then decrease power.
 - Typical garage charger provides **7.2 kW peak power**.
 - E.g., charging TM3LR: $(75\text{-kWh}/7.2\text{-kW})/85\% = 12$ hours
 - Tesla V2 Supercharger (150 kW) charges TM3LR = 35 min
 - Tesla V3 Supercharger (250 kW) charges TM3LR = 21 min

Charging BEVs

- **Level-1:** 120-volts AC, 1.12-kW, for all EVs (Everywhere!) (SAE-J1772 portable charging station that comes with an EV)
- **Level-2:** 240-volts AC, 3.3-kW to 19-kW charging station with SAE-J1772 plug, for all BEVs & PHEVs (Your parking space, Kroger, InnVT, Campus Automotive)
- **Level-3:** 480-volts DC, 35-kW - 350-kW, only for BEVs (Blacksburg Town Hall 40-kW)
 - CHAdemo standard (Asian) (maximum 150-kW in 2017)
 - SAE CCS standard (USA & Europe) (Level-2/3 one

Most charging occurs at home in a garage, driveway or parking space.

Charging BEVs

- **SAE-J1772 cord that comes with an EV** can have a [pigtail that allows level-2 charging](#) with a standard 240-volts outlet or 120-volts outlet.
- An [adaptor is available](#) to allow Teslas to charge at level-2 SAE-J1772 charging stations.
- 250-350 kW charging stations are being installed.
- [Tesla Wall Connector](#): **240-volts AC, 11.5-kW** for Tesla BEVs.
- [Tesla Superchargers](#): **480-volts DC, 125-150-kW** only for Tesla BEVs
([Version 3](#) now being installed for **250-kW**
77 installed or under construction)

Charging BEVs

- **Most charging occurs at home in a garage, driveway or parking space. For me ~99% of time.**
- Charging at work doubles the range.
- I charge my Tesla Model 3LR when it gets below 30% up to about 75% (about once a week), unless there will be a long trip the next day.
- **Never fully charge** at intermediate charging stops.
- I like to have **~20% SOC left** when I get to a destination to allow for delays due to wrecks and detours.
- **ICE'd!** Leave firm polite note on windshield of ICEV.
- Road-charging etiquette
 - Charge only when necessary.
 - Charge up and move on.
 - Don't unplug a charging car.
 - Leave note asking charging car to plug yours in.
 - Neatly wind the cable on its holder after charging.

How Fast Do BEVs Charge

- Terms: **kWh** = battery energy, **kW** = energy/hour
- Tesla BEVs:
 - Model 3 SR+: 250 miles, 54 kWh, 170 kW
 - Model 3 LR: 322 miles, 75 kWh, 250 kW
 - Model S: 390 miles, 100 kWh, 200 kW
 - Model X: 351 miles, 100 kWh, 200 kW
- Chevrolet Bolt EV: 259 miles, 66 kWh, 50 kW
- Nissan LEAF II: 226 miles, 62 kWh, 44 kW
- Jaguar i-Pace: 234 miles, 90 kWh, 100 kW
- Audi e-tron: 242 miles, 95 kWh, 150 kW
- Porsche Taycan: 257 miles, 93 kWh, 270 kW
- Ford Mach-E: ~300 miles, 99 kWh, 150 kW

**Average power
= 85% of
maximum
power for
battery fillup.**

Tesla Supercharger in Carlisle PA



Tesla Supercharger in Future

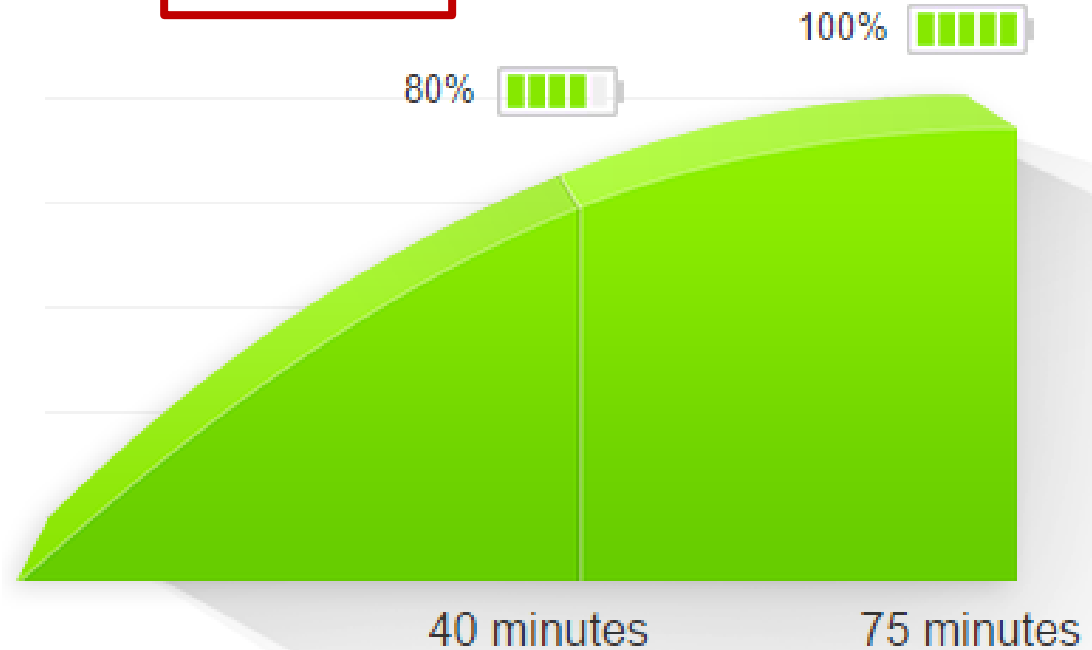


Charging Times for Fast Chargers

Charging starts off fast and decreases slowly at first and then decreases faster toward the end.

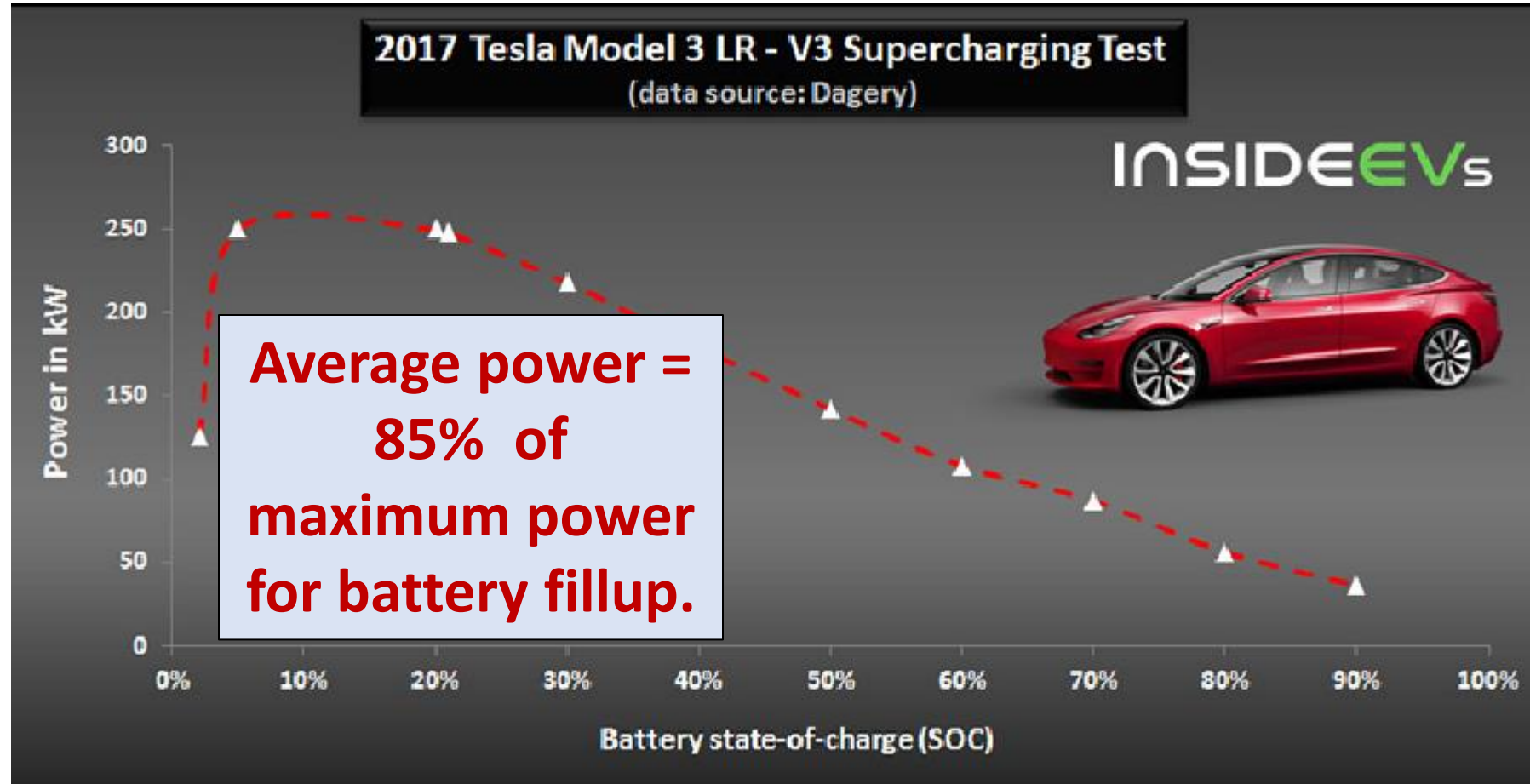
Supercharger Charging Profile

Based on 90 kWh Model S



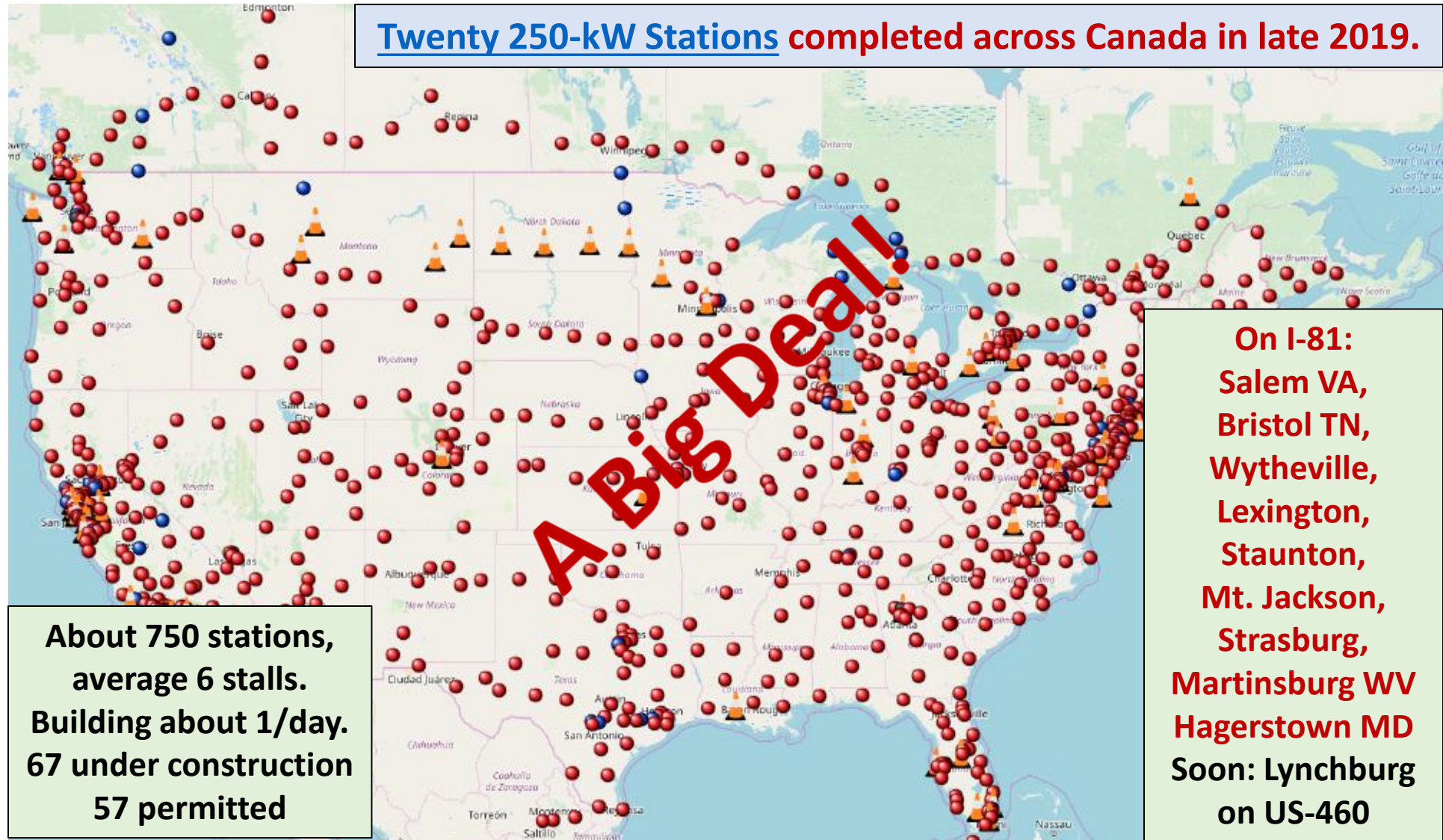
Charging from 10% to 80% is quick and typically provides ample range to travel between most Superchargers. Charging from 80% to 100% doubles the charge time because the car must reduce current to top off cells. Actual charge times may vary.

Charging Times for Fast Chargers



Charging starts off fast and decreases slowly at first and then decreases faster toward the end.

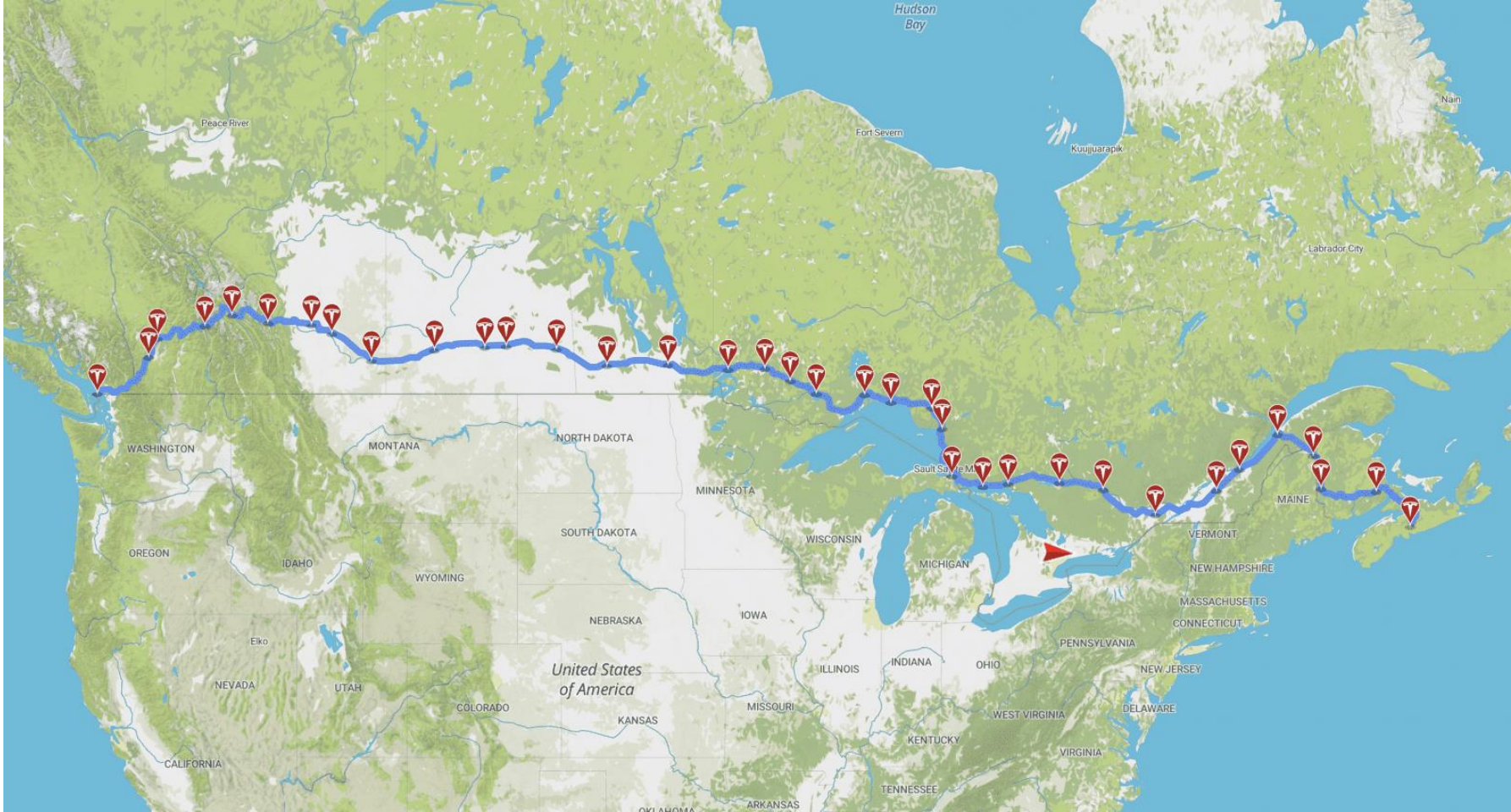
Tesla Superchargers



Roper home charger: 9.6 –kW; **Tesla Superchargers**: 150-kW being updated to 250-kW.

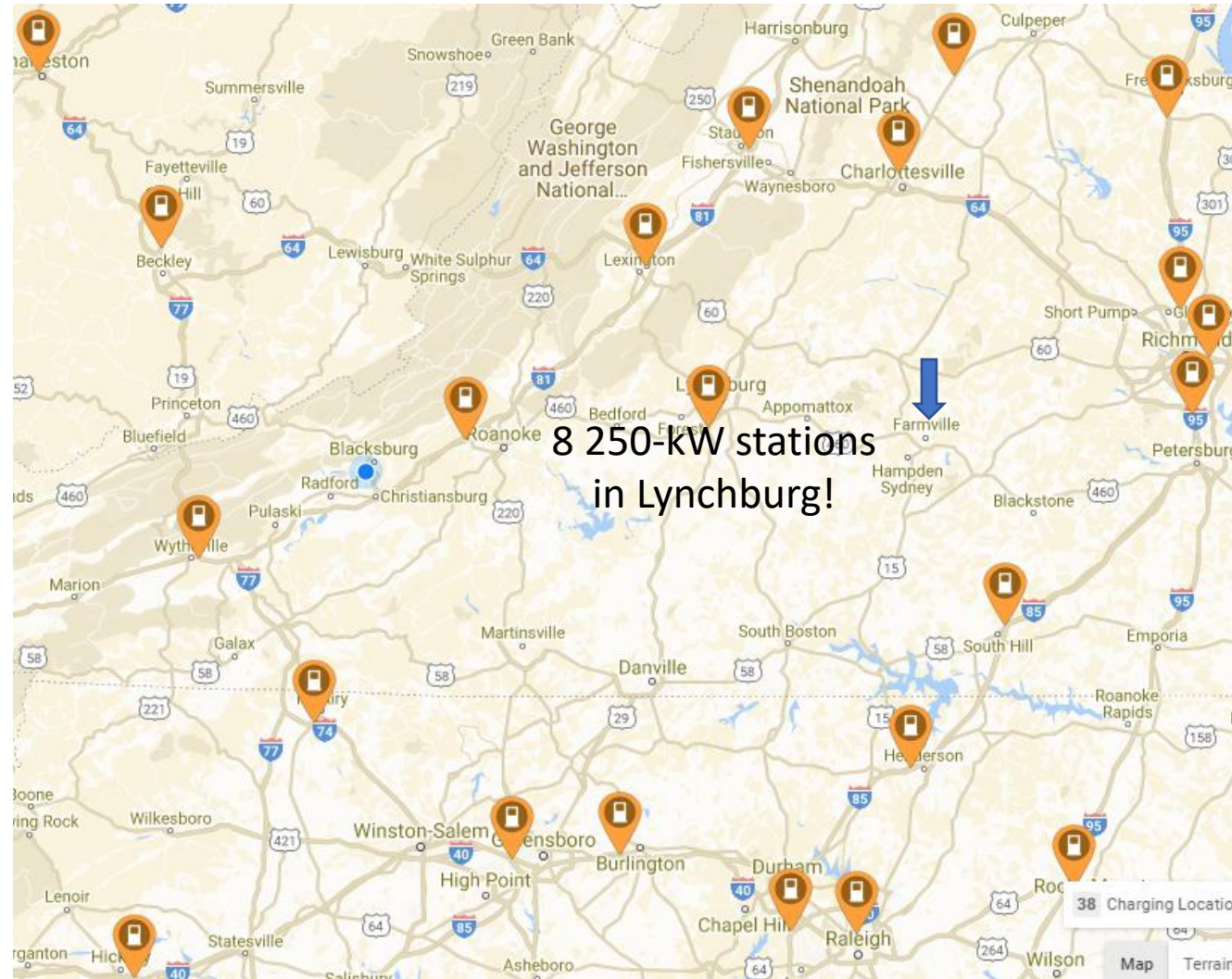
The Lynchburg Supercharger will have 250-kW capability!

Tesla Superchargers Across Canada



36 superchargers, most of which are 250-kW Version 3!

Tesla Superchargers in Southern Virginia



**2 SCs in
Richmond
with 20
stations
each!**

A Tesla Supercharger is being built in Farmville VA that will allow direct Tesla travel between Blacksburg/Roanoke and Richmond on US-460 and direct travel between Charlottesville and Tricities North Carolina on US-15.

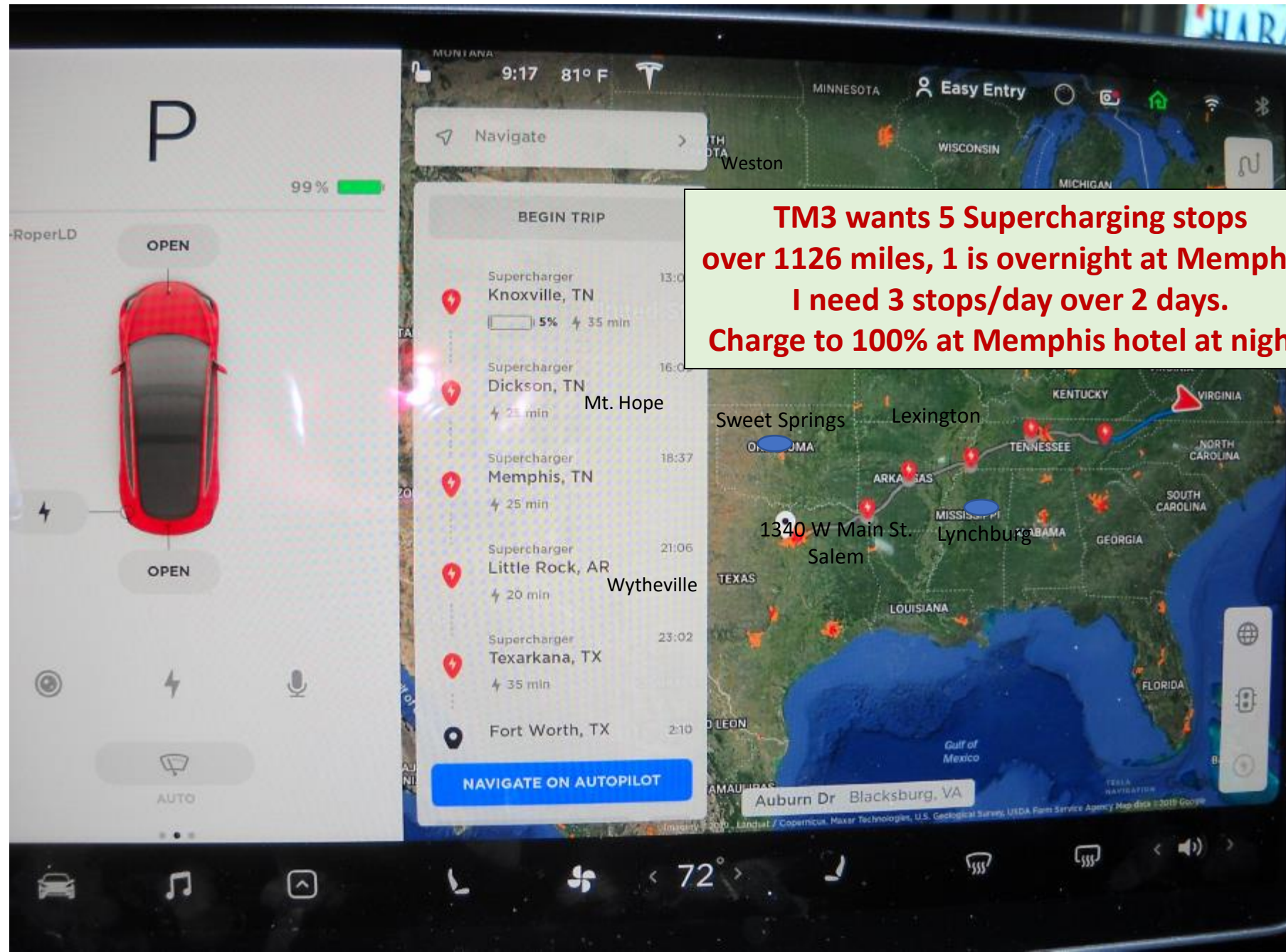
What It's Like to Use Superchargers

- You can see a list of nearby Superchargers (SCs) on the Tesla large fast screen.
- SCs are at shopping centers, hotels, and gasoline stations, such as Sheetz.
- Simply plug Tesla in and go do what you need or want to do; payment is automatic to credit card.
- Can [use Tesla screen](#) while charging to play many games, listen to music, play chess, watch TV shows or movies using Netflix, YouTube or Hulu and sing along with “Caraoke”.
- You can see charging status on your smartphone.

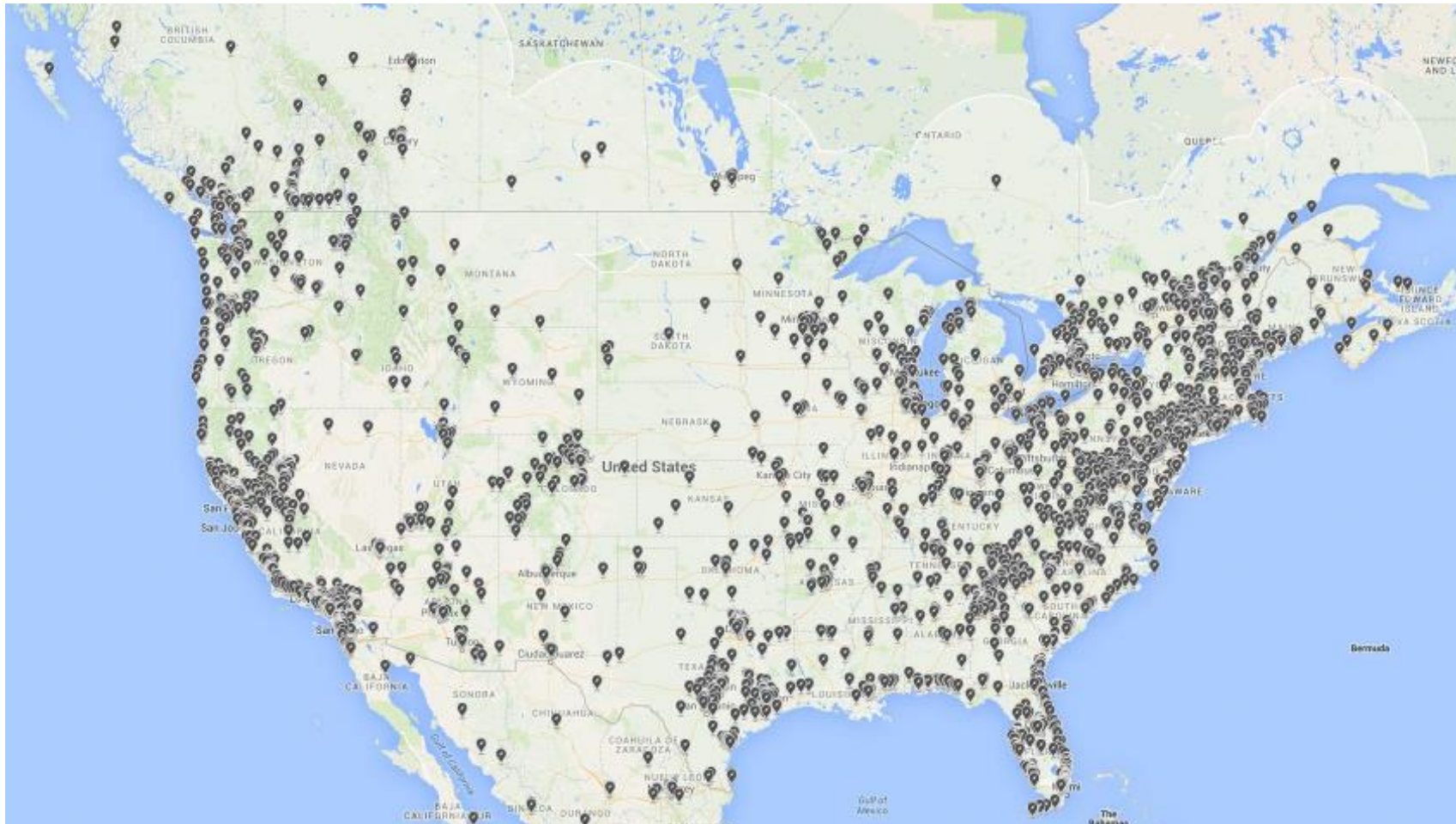
How to Drive a Tesla Long Distance

- Charge to near 100% at home.
- Use Tesla Navigation on the car screen.
- Charge at screen-indicated Superchargers or more often to the amount desired to get to the next Supercharger on the route.
- Choose a hotel with a charging station for overnight sleep to charge near 100% for the next day. (Most good hotels have charging stations, usually provided by Tesla. Use plugshare.com to find them.)
- With charging stations provided by Electrify America, EVGO and other companies, similar long trips may be possible for other long-range BEVs in a few years.

Tesla Model 3 trip from Blacksburg VA to Fort Worth TX

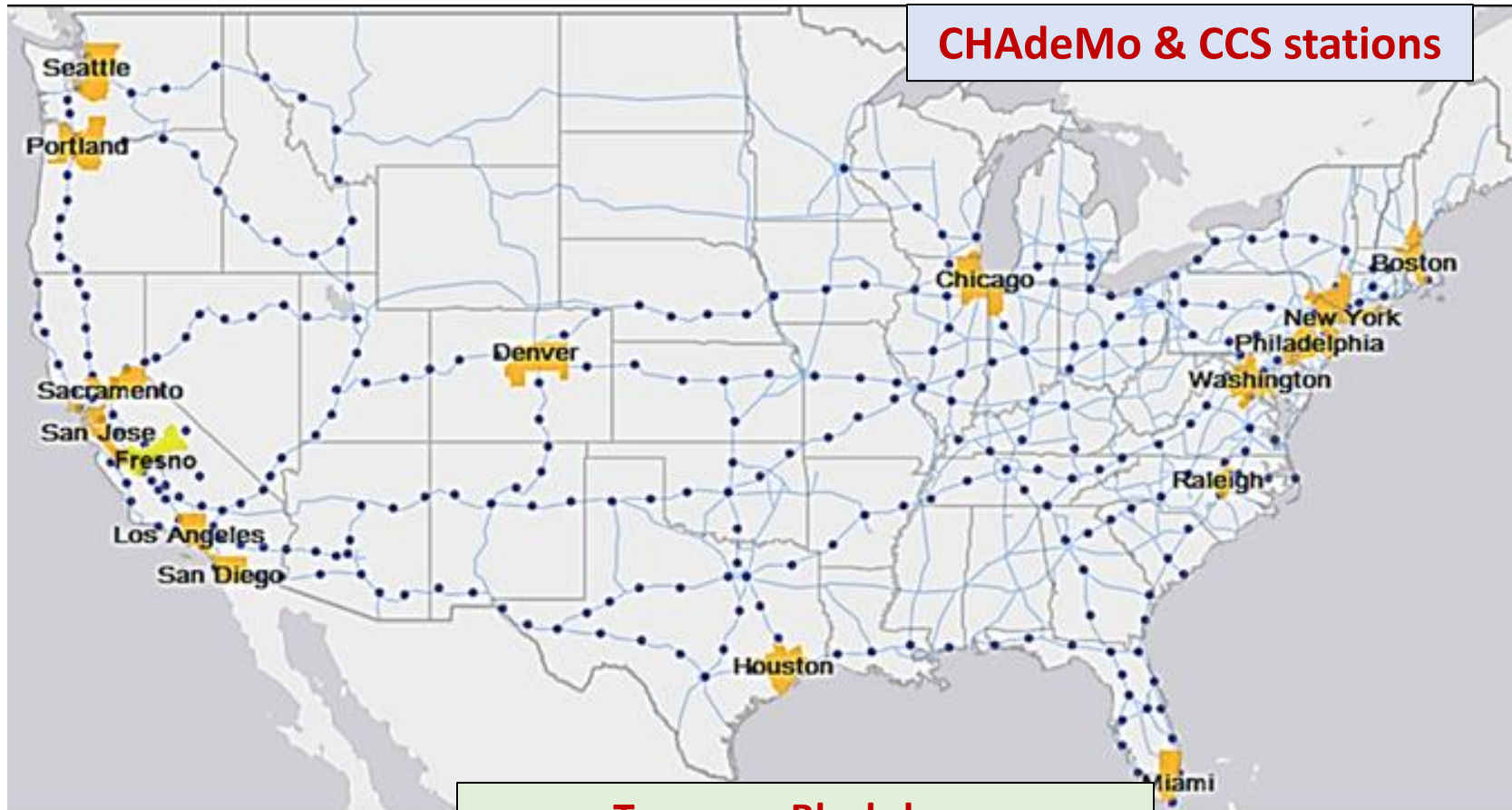


Tesla Destination Chargers



**At hotels, parks, businesses, multi-family complexes and workplaces.
Usually there is no fee to use Destination Chargers.**

Electrify America Fast-Chargers Plan



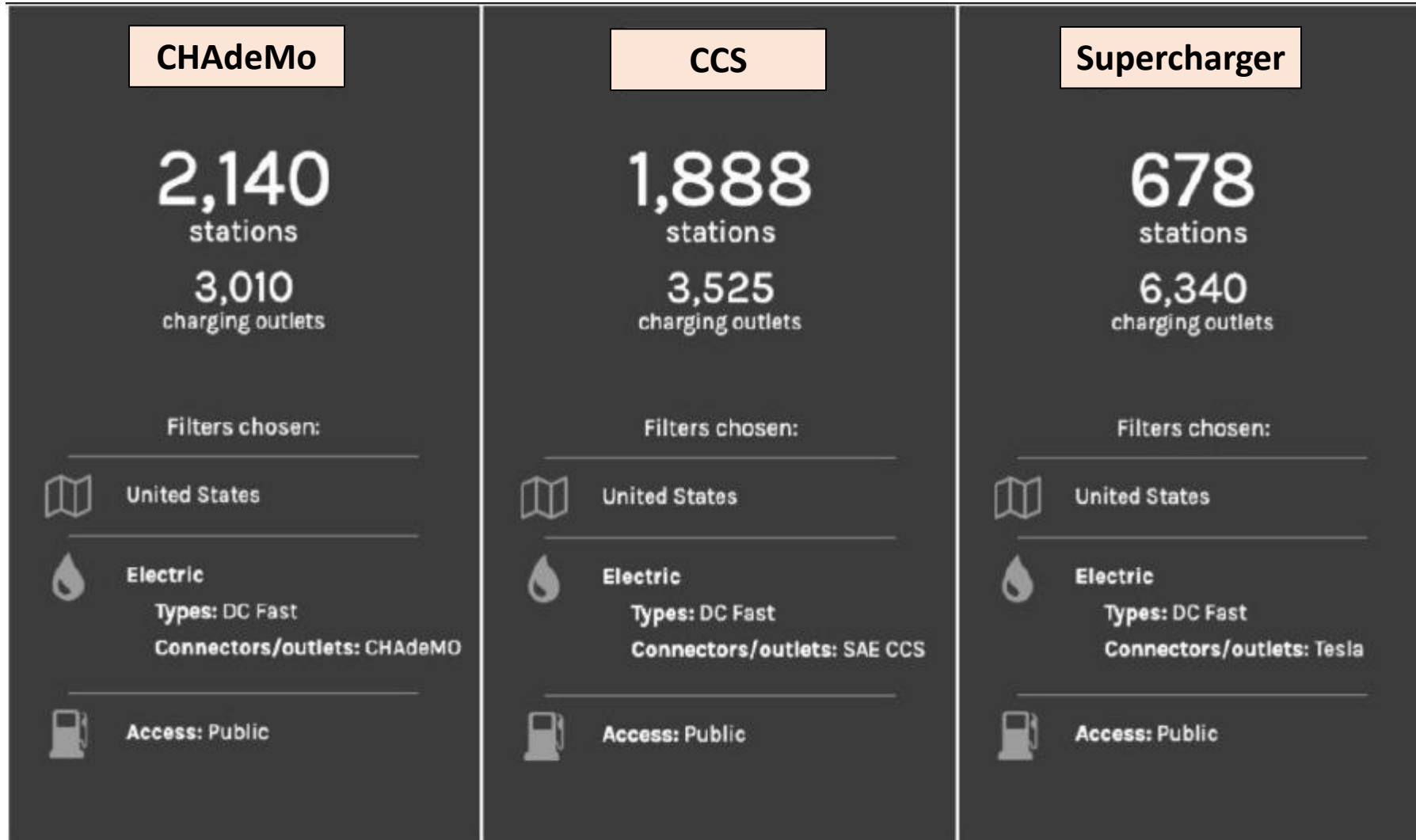
**Two near Blacksburg:
I-81 exit 156 near Fincastle and
Wytheville at a Sheetz Station.
One is under construction at a
Sheetz station on Peters Creek Road.**

Other U.S. Charging Networks

- [Blink](#) ~1680 sites
- [Chargepoint](#) ~6083 sites
- [EVgo](#) ~774 sites
 - Evgo is starting to [add a 50-kW Tesla connector at its sites.](#)
- [Greenlots](#) ~392 sites (subsidiary of Shell)
- [Semaconnect](#) ~1166 sites
- [Webasto](#) ~164 sites

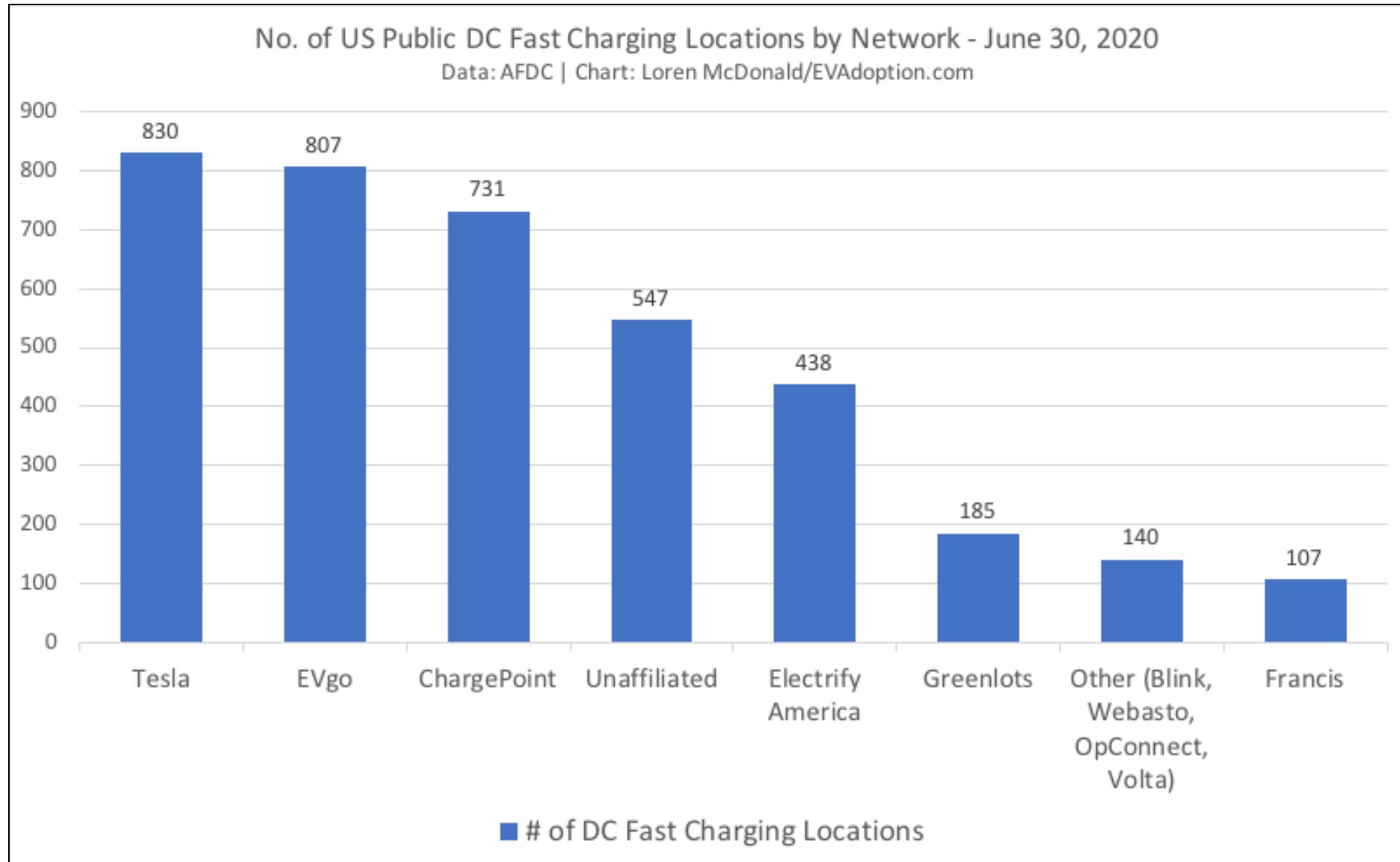
Many < 10-kW chargers have no fee to use.

Fast Chargers in the U.S.



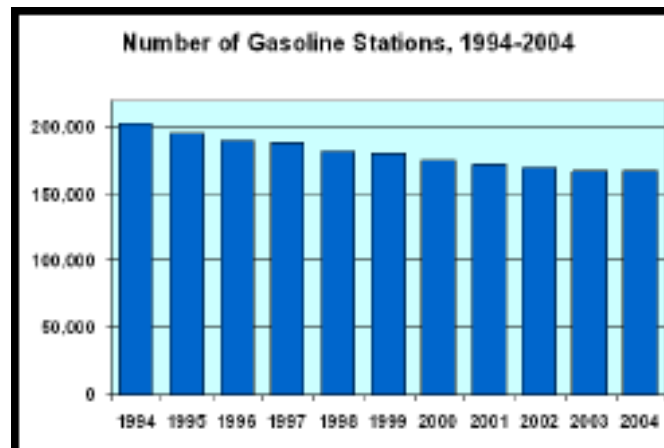
CHAdeMO, CCS, and Supercharger - Alternative Fuels Data Center, Aug. 20, 2019
With a \$450 adapter Teslas can use CHAdeMO stations as well as Superchargers,
for a **total of 2,818 locations and 10,124 charging stations!**

Fast Chargers in the U.S.



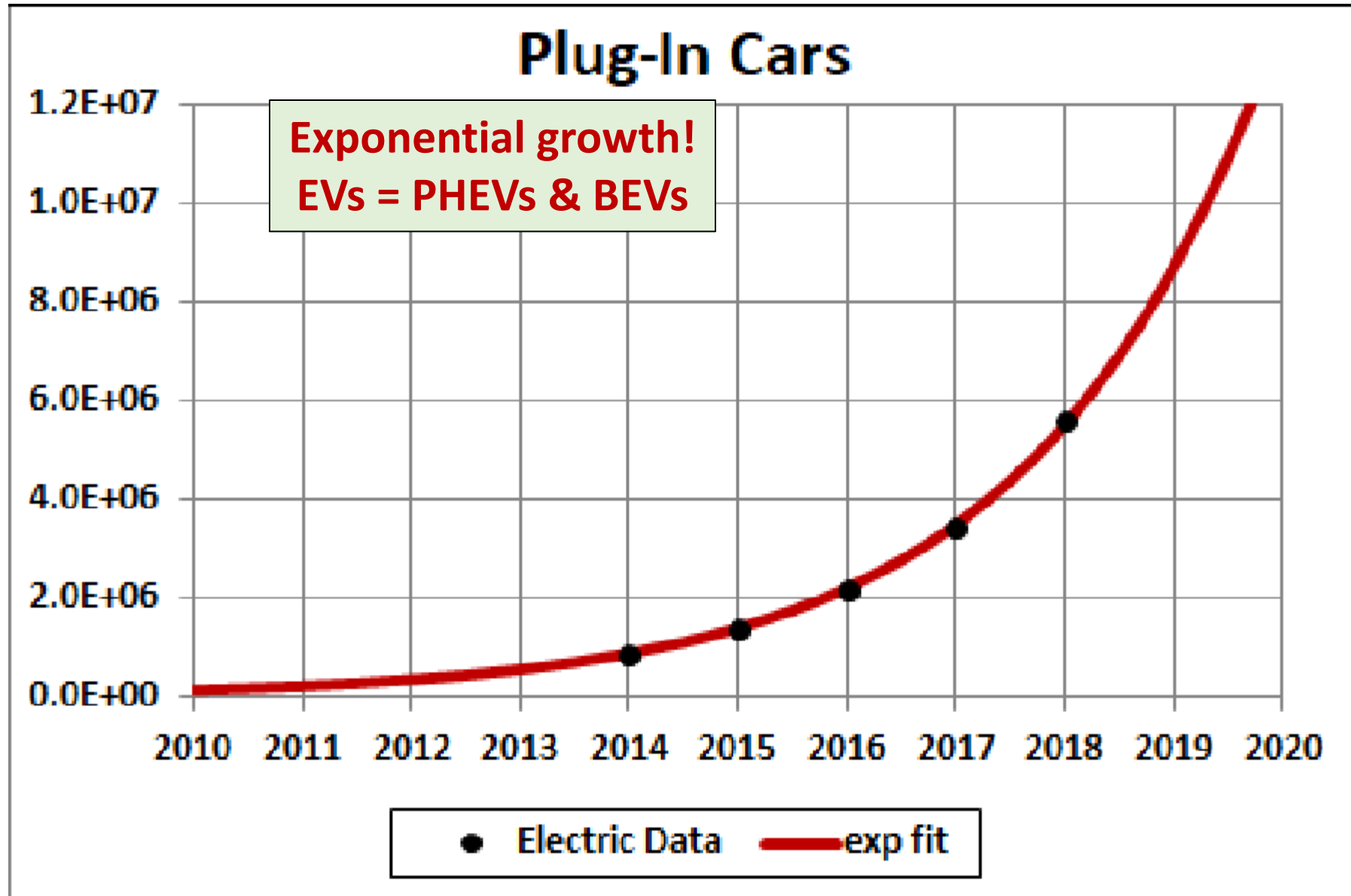
Fuel in the Middle of “Nowhere”?

- Here is an estimate of 5-billion 120-V electrical outlets in the US: [How many electrical outlets exist in the United States?](#)
- Here is a survey of 186,000 gasoline stations in the US: [How many gas stations are there in the U.S?](#)

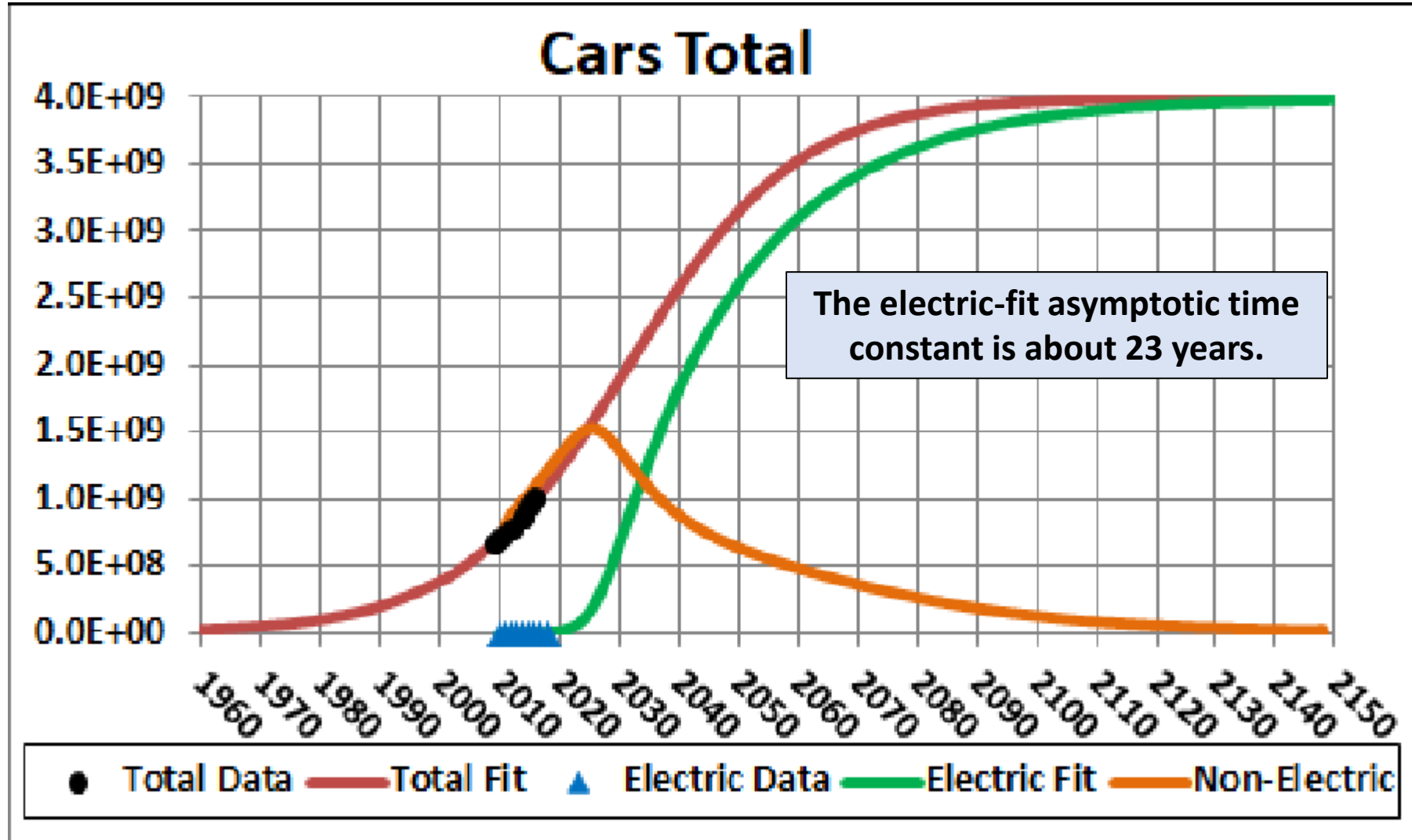


Plug-In Hybrids (PHEV)

- [Toyota Prius Prime](#): 25 miles EV @ **133 MPGe**
- [Toyota RAV4 Prime](#): 39 miles EV @ 90 MPGe, **AWD**
- [Mitsubishi Outlander](#): 22 miles EV @ 74 MPGe, **AWD**
- [Honda Clarity](#): 47 miles EV @ 110 MPGe
- [Chrysler Pacifica](#): 33 miles EV @ 82 MPGe, van
- [BMW Rex](#): 97 miles EV, 111 MPGe, **2.4-gal. gas tank**
- [Ford Fusion PHEV](#): 21 miles EV @ 103 MPGe
- [Hyundai Ioniq PHEV](#): 29 miles EV @ 119 MPGe
- [Kia Niro PHEV](#): 28 miles EV @ 105 MPGe
- Several more expensive (Cadillac, Porsche, Volvo, etc.)



World Light Vehicles (Assume 4-billion leveling off.)



If this analysis is approximately correct, about half of the cars in the world will be electric by about year 2035 and almost all cars will be electric by 2100. Probably by 2100 almost all electric cars will be BEVs with few PHEVs.

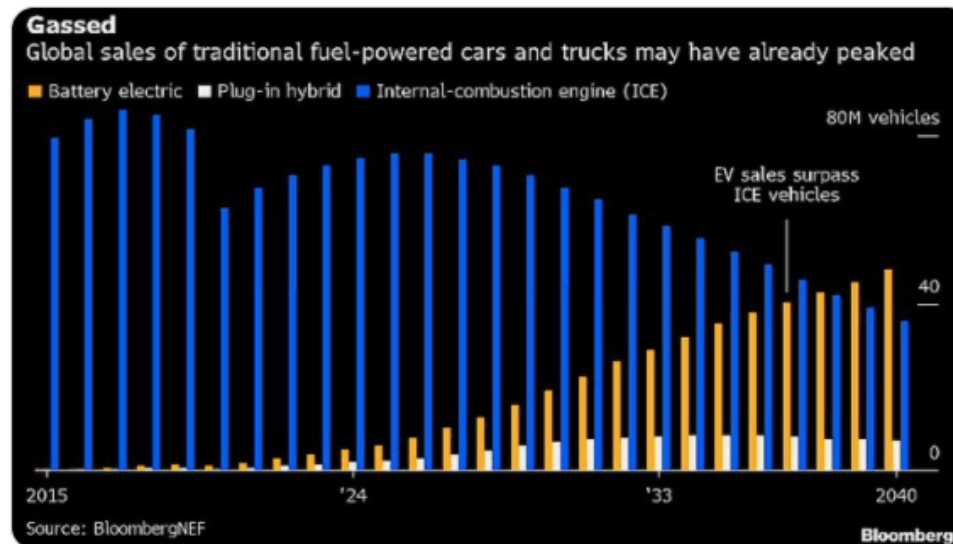
Another View about Future cars



Holger Zschaepitz
@Schuldensuehner

Peak combustion already hit as electric vehicle sales keep growing. The pandemic-ravaged econ is expected to give electric vehicles boost in China, Europe & other countries except US. But Electric Vehicles to surpass combustion engine cars not until 2037.

bnef.turtl.co/story/evo-2020...



6:58 am · 21 May 2020 · [TweetDeck](#)

36 Retweets 85 Likes

Autonomous Vehicles

- **Level 0:** All major systems are controlled by humans.
- **Level 1:** Certain systems, such as cruise control or automatic braking, may be controlled by the car, one at a time.
- **Level 2:** The car offers at least two simultaneous automated functions, like acceleration and steering, but requires humans for safe operation; e.g. [Autopilot](#).
- **Level 3:** The car can manage all safety-critical functions under certain conditions, but the driver is expected to take over when alerted.
- **Level 4:** The car is fully-autonomous in some driving scenarios, though not all.
- **Level 5:** The car is completely capable of self-driving in every situation.

Auto Charging Autonomous Cars

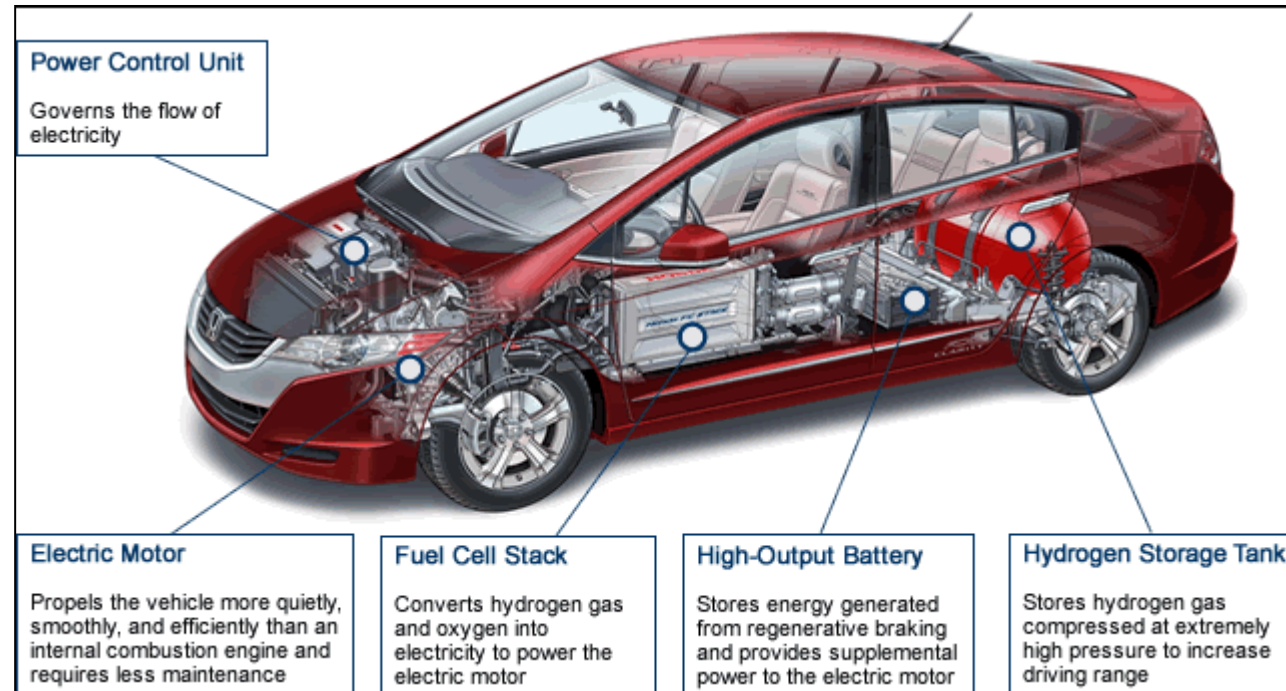
Volkswagen concept; click to see movie.



MORE VIDEOS

Why Not Fuel-Cell Cars?

- They are very complicated:



- Requires a lithium-ion or NiMH battery similar to a PHEV!
- Hydrogen fuel is not easy to obtain. Most is made from methane and water, which produces carbon dioxide with the hydrogen! Should be made by solar!
- Better for heavy-duty vehicles, such as trucks.

Why Not Solar Cars?

- Lightyear One

- Extremely efficient: 253 MPGe (?)
- 450-miles range (?)
- Aluminum and carbon fiber body for low weight
- 1-kW high-efficiency solar panels



- Sion (Sono Motors)

- Totally covered with solar panels
- 140 miles range
- 118 MPGe



Conclusion

- If disasters due to global warming are to be mitigated we must **reduce carbon emissions!**
- All must do their part with their **influence** and **wealth** beyond necessities:
- Install **solar energy** on homes and businesses.
- Use **zero-carbon public transport** or **drive electric cars**.
- **Consume** food and materials that involve **low carbon emissions**.
- **Invest** only in companies that are committed to **low-carbon emissions**.
- **Vote** for politicians that will institute **mitigation programs**.

Quotes about BEVs

- “After driving a BEV for 100 miles you will never want to drive an ICEV again.”
- “After driving a BEV for 100 miles with 1-pedal driving option, you will not want to go back to driving without it.”
- “Driving with Tesla’s driving options on a large screen makes ICEVs with multiple buttons and switches seem 20th century.”
- “Driving with Tesla’s Autopilot makes long-distance driving much easier.”

References to Follow EV Future

- Insideevs.com
- Electrek.co
- Cleantechnica.com (also renewable energy)
- Teslarati.com (also SpaceX)
- pluginamerica.org
- plugstar.com
- greencarreports.com (also HEVs)