

Tech-10
July, 2016

Electric Vehicles

Field Day

Question: What class is a station powered from the Accessory outlet of an Electric Car?

Answer: It depends

Question: Why do we care?

Answer:

First, Some Background

- 3 Kinds of electric vehicles
 - Hybrids (Toyota Prius)
 - Range-extended or Plug-in Hybrid (Chevy Volt)
 - Battery-only / BEV (Tesla)
- Range-extended and BEVs can run on battery alone
- Battery size varies from 1kwh to nearly 100kwh

EVs Come In All Sizes



Tesla Model S

Tesla Roadster

Smart Ev

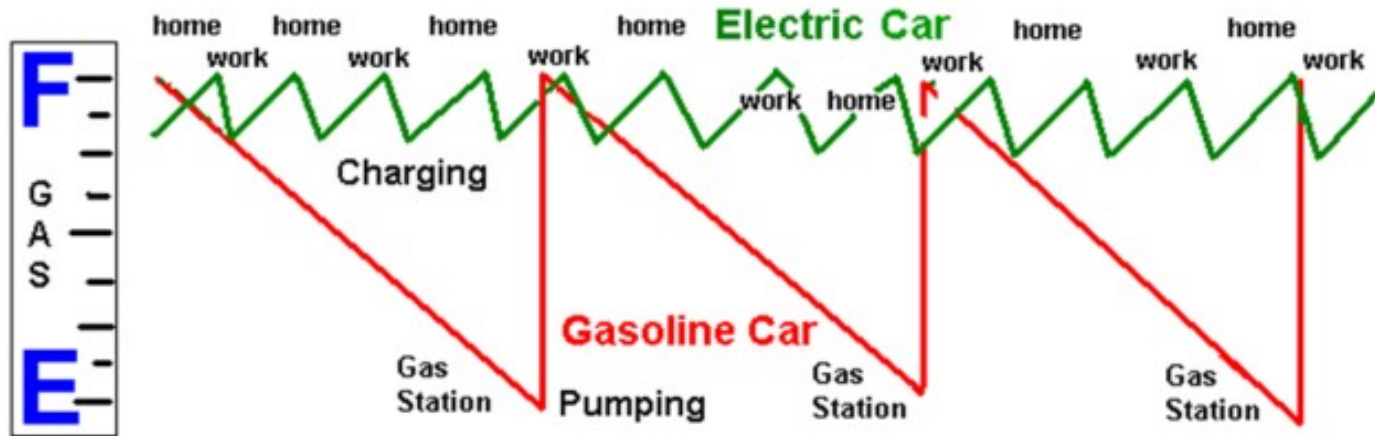
My “Green Commercial”

- Round numbers:
 - “Plug to Road” efficiency of an EV is about 70%
 - “Pump to Road” efficiency of an ICE is about 16%
- Round numbers:
 - 1 gallon of gas = 33.7 kwh of energy
 - So, my car has the equivalent of a 1.6 gallon “tank”
 - On that 1.6 gallons, I can go 244 miles
 - At 20 cents/kwh, a *full tank* costs me about \$11
 - An SUV's 15 gallon tank has about 500kwh of energy
 - That should be enough energy to go over 2,200 miles
 - *What is your car's range?*
 - *How much does a fill-up cost?*

Electric Car Myths

- It takes hours to charge an electric car
 - No, it takes seconds to plug it in
- Electric cars are slow and short range
 - No, a Tesla sedan will beat most super cars in the $\frac{1}{4}$ mi.
 - The Roadster 3.0 can go 340 miles on a charge
- Charging will kill my electric bill
 - A day's travels (50 miles?) costs about \$3.
 - Some businesses provide charging for free
- EVs pollute more (gas / coal-fired power)
 - No, and EVs are the only cars that get cleaner with time

A Battery is not a TANK!



The Complete Paradigm Shift:

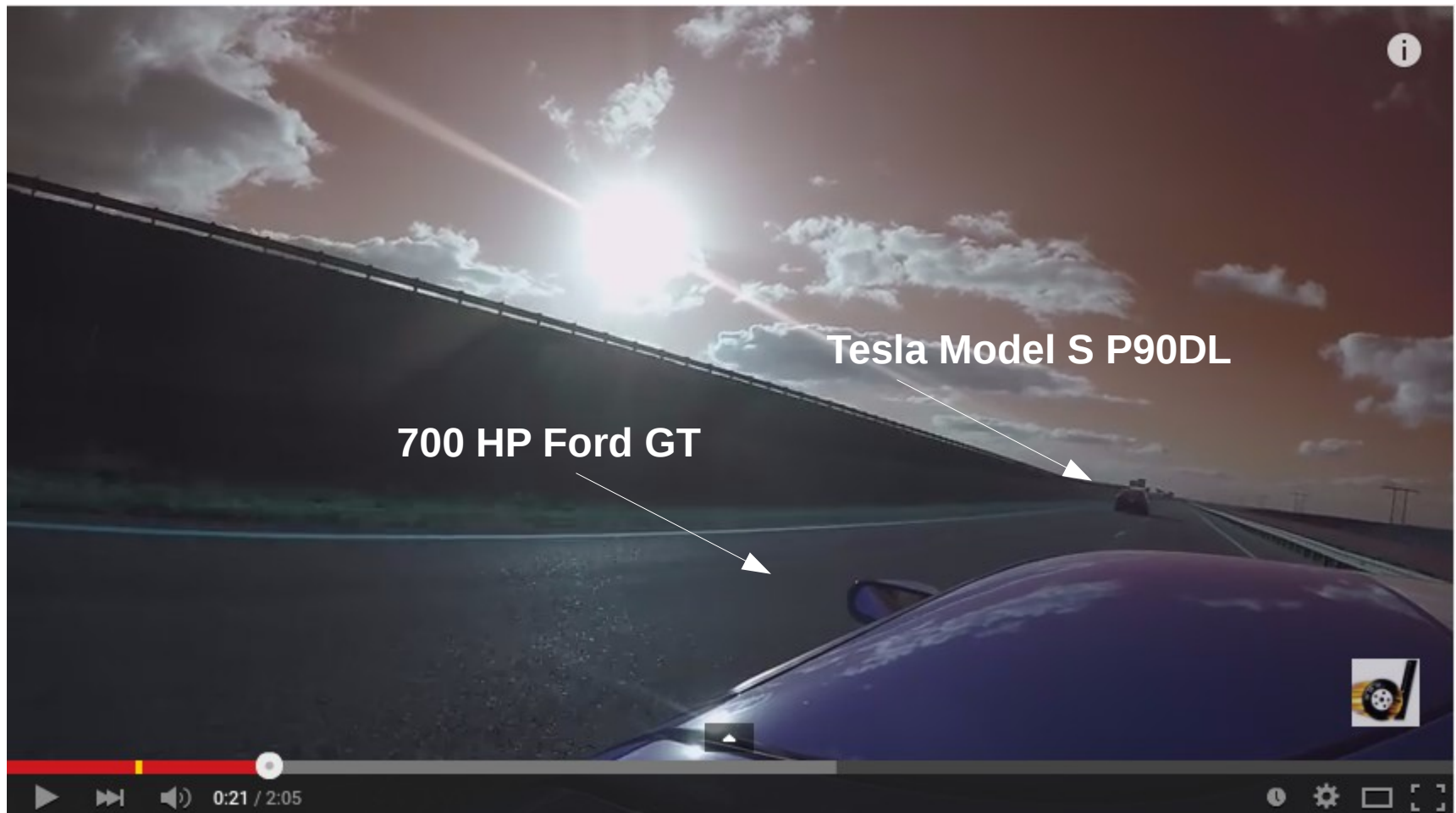
Gas cars drive-to-empty, then fill-to-full at Public Stations

EV's charge daily at home and at work while parked



Also a lot of fun to drive

YouTube Drag Strip of Tesla vs <you name it>



Besides Transportation...

- What good is an electric car, anyway?
 - Flexible charging, no gas lines!
 - Carpool lane access (some places)
 - Quiet
 - No smog
 - Cheaper to run than gas / diesel
 - Lower maintenance costs
 - Mobile *source* of electric power

Good in Emergencies

- After a disaster, the electric grid is often the first service to be restored, at least in patches
 - A gas station without power is useless.
 - An EV can travel to where there is power, and charge there
- Proven in real life
 - 2011 Japan Earthquake and Tsunami
 - 2012 Hurricane Sandy



“PriUPS”

<http://www.priups.com>

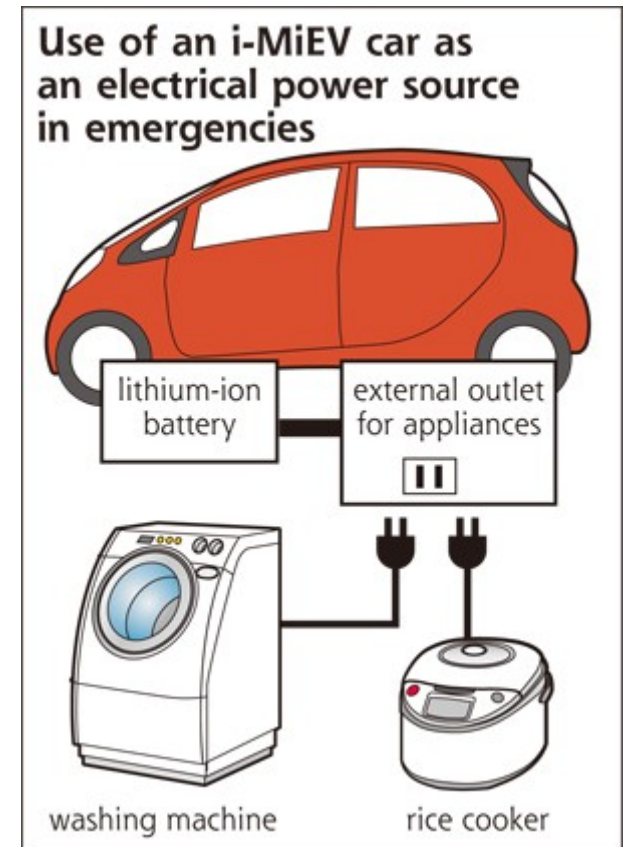
- Toyota Prius as a drivable UPS
- 1.4kw 230v battery (larger versions coming)
- Automatic recharging with on-board 50kw generator (aka the car's engine!)
- Add an inverter
 - 230v DC to 120v / 240v AC
 - Or use the 12v Accessory outlet
- 3kw of continuous power available!
 - Can do this for days

Plug-in and BEVs

- A pure EV's battery is usually more than 20kwh
 - Fiat 500e: 24kwh
 - Nissan Leaf: 30-48kwh
 - Tesla Model S: 60-90kwh
- Most BEVs use 300v - 500v batteries (don't touch!)
- Some math...
 - 12v Accessory outlet ~100 watts (0.1kw)
 - So 10 hours use is about 1kwh
 - ... you can do the rest of the math
- Also: CHAdeMO and other HV *export* standards
 - Nissan Leaf reported to support this, with external equipment

EVs for Emergencies

- Mitsubishi I-MiEV
 - 16kwh battery pack
 - Can come with its own 120v outlet!
 - 1,500 watts output
 - 5-6 hours of emergency power
 - This is an optional add-on that was the result of the 2011 earthquake and tsunami



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Question: Why do we care?

Answer: Disasters and emergencies!

2010 Tesla Roadster

Performance: 0 – 60 mph in 3.9 seconds (*this is the slow model*)

Top speed: 125 mi/hr.

Economy: Equivalent to about 70mpg by price; 155mpg by energy

(Electricity is expensive way to buy energy, but the EV is so much more efficient)

Drive train: 248 hp motor, 200 lb-ft torque, all electric.

Single speed transmission (no clutch, no shifting)

Battery: 57kw (53kw usable) Lithium Ion (160AH, 375v), liquid cooled

Built from 6,831 individual cells. Weight 992 lbs.

Range: EPA estimate 244 mi

Full recharge in 3.5 hrs @ 70 A / 240v

Misc: Integrated NAV system, Satellite radio, A/C, Seat Warmers, One cup holder.

Resources

- Websites

- http://www.greencarreports.com/news/1080256_assessing-sandy-are-electric-cars-a-better-bet-in-emergencies
- https://en.wikipedia.org/wiki/Tesla_Roadster