Electric Vehicle Roadtripping

July 12, 2018

Kennewick Sustainability Forum

Garrett Brown, EV Enthusiast

I used to think that I was cool,
running around on fossil fuel,
until I saw what I was doing,
was driving down the road to ruin.

James Taylor, JT, 1977

Your world upside down with Electric Vehicles

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JANUARY 16, 1915

Electric Vehicle FUD

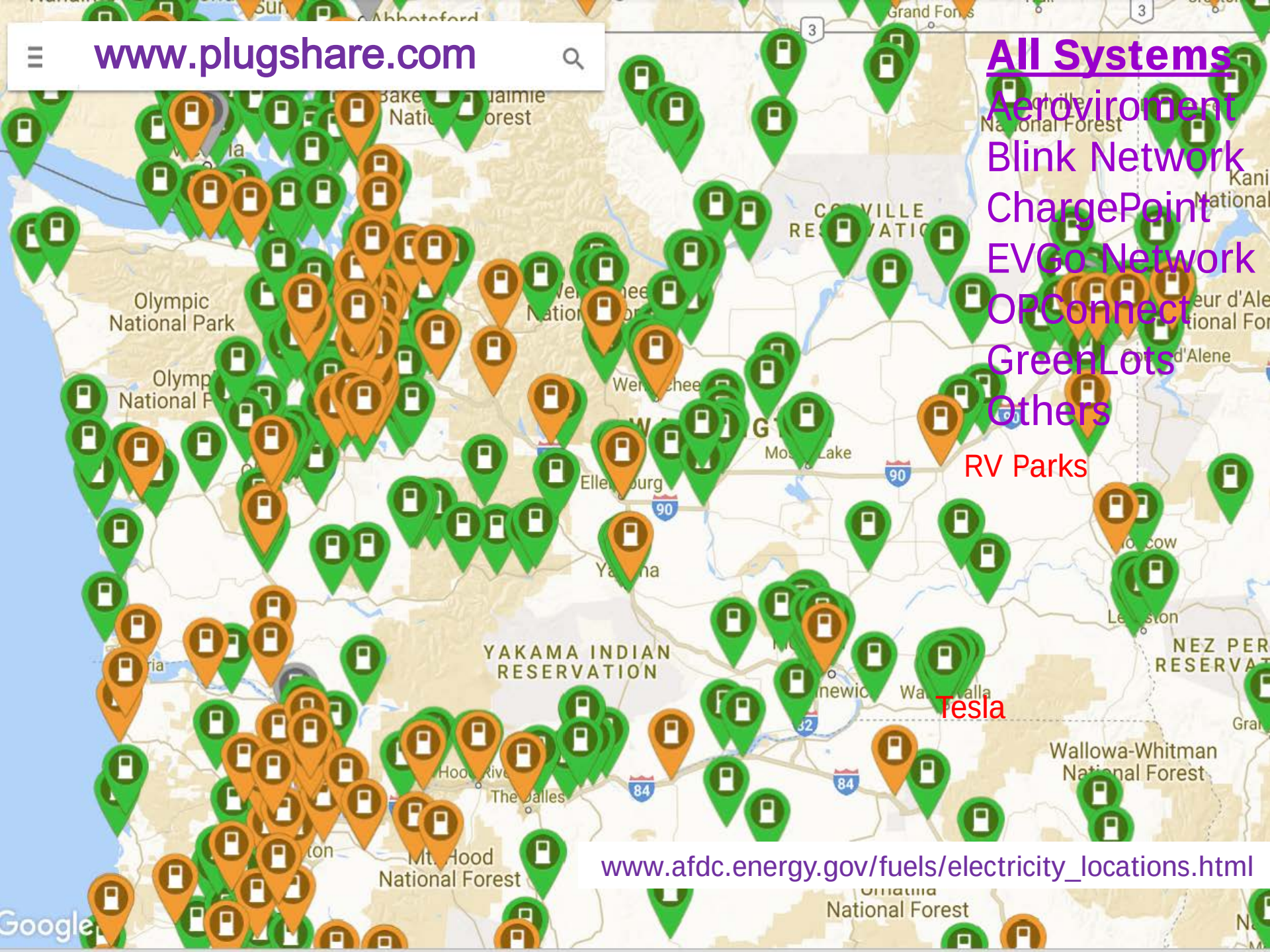
FUD: Fear, Uncertainty, Doubt

1) Not “Green” – Coal Powered (Not!)
2) Crash Grid (actually helps grid)
3) Expensive (Lowest TCO)
4) Not enough range (40 mi/day avg)
5) Slow charging (8 hr home, work)
6) No charging stations (99% home)
7) Batteries won’t last (6+ years)
8) Rare Earths Materials (not all EVs)
9) Cannot drive across country (Not!)

- 2014 summer vacation….
  - 2011 Nissan Leaf (72 mi)
  - 1200 mi, 8 days
  - $20.76 in e-fuel, zero gas
  - $854.89 spent in OR at local, small businesses

04.17.2016 15:06

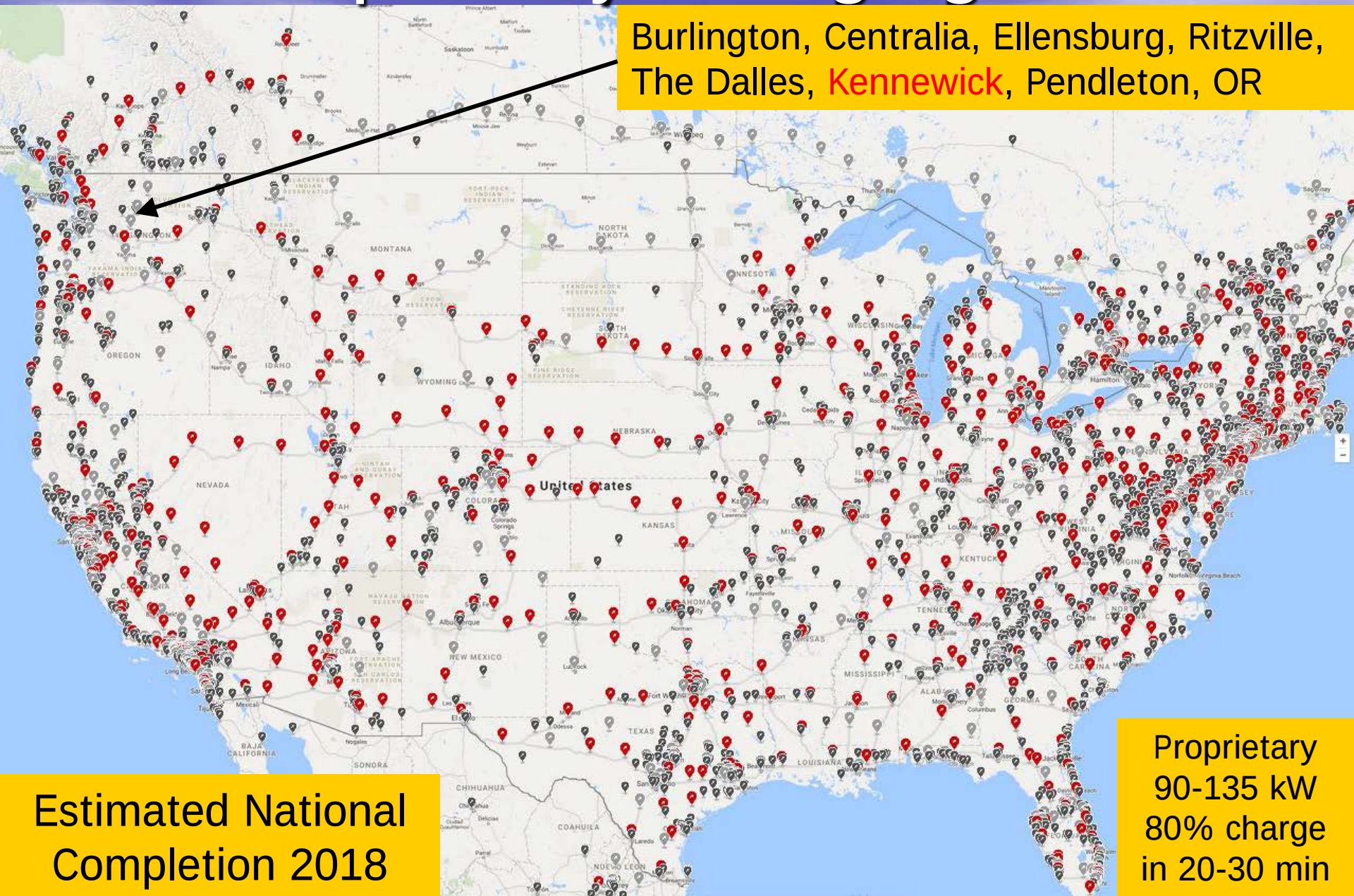
“Driving on Sunshine”



www.afdc.energy.gov/fuels/electricity_locations.html

Reddyice
01.18.2016 15:52

Tesla Proprietary Charging Stations



05.11.2017 09:03

TESLA
TESLA
TESLA
WASHINGTON
AWB8830
EVERGREEN STATE
01.20.2016 14:3

EARTHQUAKE LAKE
VISITOR CENTER

Example Installation

Support Local Businesses

CHEMAINUS VALLEY MUSEUM
Public Washrooms
EV ONLY
LEVITON
MUSEUM OPEN
WASHINGTON
AWB8830
EVERGREEN STATE
08.31.2015 11:28

Tesla Model 3
All three models today (availability varies) ~$30-50k
2018 “The Affordable ~200 mi EV”

Chevy Bolt

Copyright Carscoops.com
Nissan Leaf 2

BEV Charging Summary

* Currently available in the Tri-Cities

Vehicle Name	MSRP	Type	kWh	Range	L1	L2-16A	L2-32A	DCQC
BMW i3 ≤2016 *	43,300	Either	22	81 mi	21 hr	7 hr	4 hr	30 min
BMW i3 >2017 *	43,300	Either	33	97 mi	25 hr	7 hr	4 hr	30 min
Chevrolet Spark	26,000	BEV	20	82 mi	20 hr	6-7 hr	4 hr	30 min
Fiat 500e EV	32,600	BEV	24	84 mi	21 hr	7 hr	4 hr	NA
Ford Focus EV *	29,200	BEV	23	76 mi	21 hr	7 hr	4 hr	NA
Honda Fit/Clarity EV	Lease	BEV	20	82 mi	18 hr	6 hr	3 hr	NA
Kia Soul EV	34,500	BEV	27	93 mi	24 hr	7 hr	4 hr	30 min
Mercedes B-CL ED	42,400	BEV	28	85 mi	24 hr	7 hr	3 hr	NA
Mitsubishi MiEV *	23,800	BEV	16	62 mi	12 hr	4 hr	4 hr	30 min
Nissan LEAF *	29,000	BEV	30	105 mi	28 hr	8 hr	4 hr	30 min
Smart ForTwo ED	25,000	BEV	17.6	68 mi	13 hr	6 hr	6 hr	NA
Toyota RAV4 EV	45,000	BEV	41.8	103 mi	40 hr	13 hr	7 hr	NA
Tesla Model S & X	71,000+	BEV	60+	265 mi	70 hr	25 hr	8 hr	45 min
VW e-Golf	29,000	BEV	24	83 mi	21 hr	7 hr	3 hr	30 min
@2018 Chevy Bolt*	37,500+	BEV	60	238 mi	70 hr	25 hr	9 hr	60 min
@2018 Nissan Leaf*	30,000+	BEV	40	151 mi	70 hr	12 hr	7 hr	60 min
@2018 Tesla 3	35,000+	BEV	60+	310 mi	70 hr	25 hr	9 hr	60 min

PHEV Charging Summary

* Currently available in the Tri-Cities

Vehicle Name	MSRP	Type	kWh	Range	L1	L2-16A	L2-32A	QC
Chevrolet Volt *	33,170	PHEV	16.5	53 mi	12 hr	5 hr	5 hr	NA
Ford C-Max Energi *	32,600	PHEV	8	19 mi	6 hr	3 hr	3 hr	NA
Ford Fusion Energi *	33,900	PHEV	7	19 mi	6 hr	3 hr	3 hr	NA
Honda Accord Plug-In	40,570	PHEV	6.7	13 mi	4 hr	2 hr	2 hr	NA
Toyota Plug-In Prius*	30,000	PHEV	5.2	11 mi	3 hr	2 hr	2 hr	NA
Cadillac ELR/CT6 *	75,000	PHEV	17	35 mi	13 hr	4 hr	4 hr	NA
Mitsubishi Outlander *	34,600	PHEV	12	22 mi	10 hr	4 hr	4 hr	25 min
Mercedes C350 PHV	46,400	PHEV	6	20 mi	7 hr	3 hr	3 hr	NA
Mercedes S550 PHV	95,650	PHEV	8	20 mi	7 hr	3 hr	3 hr	NA
Mercedes GLE550e	67,000	PHEV	9	12 mi	8 hr	4 hr	4 hr	Na
Audi A3 e-tron	37,900	PHEV	9	16 mi	8 hr	4 hr	4 hr	NA
Porshe Cayenne SE	78,000	PHEV	11	14 mi	10 hr	5 hr	5 hr	NA
Porsche Panamera SE	93,000	PHEV	9	16 mi	8 hr	4 hr	4 hr	NA
Hyundai Sonata PHV	35,400	PHEV	10	27 mi	9 hr	3 hr	3 hr	NA
Volvo XC90 T8	69,000	PHEV	9	17 mi	7 hr	3 hr	3 hr	NA
BMW 330e PHV	43,700	PHEV	7	14 mi	6 hr	3 hr	3 hr	NA
BMW X5 XDrive40e	64,000	PHEV	9	13	7 hr	3 hr	3 hr	NA
BMW i8 Coupe	137,000	PHEV	7	25 mi	6 hr	3 hr	3 hr	NA

Where to Charge?

- Home (>95% of the time)
  - While you sleep, inside or outside, rain/snow
  - Top up every night, at work, shopping, lunch
- Dealerships (<5%)
  - BMW, Ford, GM, Leskovar, Nissan (L2)
- Commercial Business (<5%)
  - Hotels: Homewood, Hampton, Red Lion
  - Wineries: Hamilton & Badger Mnt, WW
  - WSU-TC, CBC, Kadlec, Some Gov't
  - ZPizza, Perfection Tire, RV Parks,
  - Plentiful throughout Western WA-OR Electric Highway System

Nomenclature & Standards

- Level 1 (L1) AC Charging

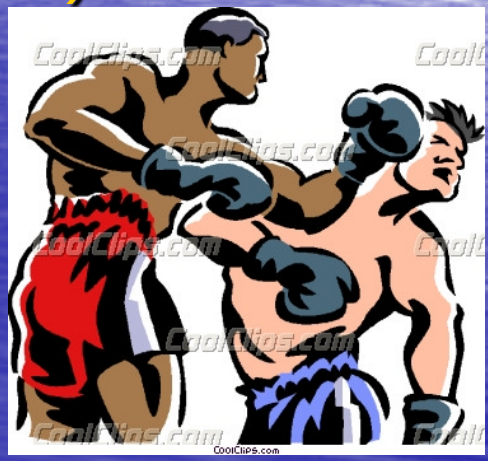
  - Advantages:
    - Standard household plug
    - Ubiquitous throughout US
    - Simple operation, no modifications
    - Simple and inexpensive to install
    - Slow charging for airports, work place
  - Disadvantages:
    - Slow charging only (>>8 hr, 4 mi/hr)
    - Requires dedicated circuit (15 A)
    - Potential for over-use (fire)
  - Mathematics:
    - 120 V x 12 A = 1440 W, 1.44 kW

Nomenclature & Standards

- Level 2 (L2) AC Charging
  - Advantages:
    - SAE Standard J1772 fits "all" EVs
    - Standard at nearly all stations
    - Simple, safe and faster (10-60 mi/hr)
  - Disadvantages:
    - More costly than L1 to install
    - Requires dedicated circuit (20-100 A)
    - Potential for misuse (blocking)
    - Enticing target for copper thieves
  - Mathematics:
    - 240 V x 16 A = 3840 W, 3.83 kW
    - 240 V x 32 A = 7680 W, 7.68 kW
    - 240 V x 80 A = 19200 W, 19.2 kW

Nomenclature & Standards

- Quick DC Charging (15-45 min)
  - Advantages:
    - Simple, safe and VERY fast charging
    - Charger is at station, not in EV
  - Disadvantages:
    - Very costly to install, >$50k
    - Requires industrial power (limited areas)
    - Potential for misuse (blocking)
    - Enticing target for copper thieves
    - Competing standards----------→
  - Mathematics:
    - 500 V x 125 A = 62 kW (Chademo)
    - 500 V x 200 A = 100 kW (ASME CCS)
    - 600 V x 200 A = 120 kW (Tesla Supercharger)



DCQC – 200+ mi/hr

480+ VDC
Industrial
Power

CHAdeMO (Below)

Why Drive Electric?

- You: Perfect short trip vehicle (commuter, town)
  - Fast & Fun! Road trips are a blast!
  - Quiet, smooth, instant torque, no exhaust
  - Lower total ownership (TCO) and per mile costs
  - Nightly charge/pre-warm at home, no gas station
- US: Locally-sourced power
  - $16B annually leaves WA State for motor fuels
  - >$0.5 T (??) annually spent in USA for motor fuels
  - Improves national security and electric grid
- World: Lower total environmental footprint
  - Better than 80 mpg gas vehicle (improving every year)
  - Essentially zero emission in Richland & WA & PNW
  - Recycling for batteries, but not gasoline

How to Choose an Battery Electric Vehicle?

- Match Average Daily Drive with ½ EV Range
  - Record/consider daily use (in miles, NOT minutes)
  - Number of trips, times, driving pattern (road trips)
  - Consider charging frequency/time(s)/location(s)
- Don't Over-Extend (Range or Cost)
  - Used EVs are now available for less than $10,000
  - New EVs can cost $20,000 to $150,000+
  - Electric range from 15 mi (PHEV) to 350 mi (BEV)
- Consider Alternatives and Additional Details
  - Cold weather requires more energy (2x worst case)
  - TMS: Degradation. Assume worst -30% in 7 yr
  - BEV vs PHEV vs 2nd Gasser vs Airplane vs Bicycle
  - Lease vs Purchase: Upgrade technology vs ownership

Electric Vehicle FUD

FUD: Fear, Uncertainty, Doubt

1) Not “Green” – Coal Powered (Not!)
2) Crash Grid (actually helps grid)
3) Expensive (Lowest TCO)
4) Not enough range (40 mi/day avg)
5) Slow charging (8 hr home, work)
6) No charging stations (99% home)
7) Batteries won’t last (6+ years)
8) Rare Earths Materials (not all EVs)
9) Cannot drive across country (Not!)