

Electric Vehicles and Economic Opportunity

Why EVs?

**EVs and Charging EV Batteries
Support for EVs**

**Anne Fritzel, Senior Planner
Growth Management Services**



Department of Commerce
Innovation is in our nature.





circa 1919

2SHB 1481 (2009) Electric Vehicle Bill

Why Support Electric Vehicles?

- **Electricity prices are stable**
- **Locally produced clean power**
- **Transportation sector largest source of emissions**
- **Create green jobs, support green economy tourism, local EV industry**

2SHB 1481 (2009)

Regarding Electric Vehicles

By July 1, 2011, all cities and counties in Washington must allow **electric vehicle battery charging facilities as a use in all areas. . . Except for residential or resource zones or critical areas.**

RCW 36.70A.695 and other statutes

Types of Electric Vehicles



Nissan LEAF

- All Electric
- Range: 100 miles
- Battery: 24 kwh
- Priced at \$32,780
- Target markets:
 - Urban Commuters
 - Eventually: all-purpose



Chevy Volt

- Battery Electric plus ICE range extender
- Range: 10-40 miles all-electric, 200-300 miles gas
- Battery: 16 kwh
- Priced at \$41,000
- Target Market: all auto applications

Types of Electric Vehicles



Toyota Prius Plug-in Hybrid

- Electric plus gas
- 13 miles electric only
- Price TBD - Available in 2012
- Target Market: all auto applications



Tesla Roadster

- All Electric
- 245 miles per charge
- Priced at \$109,000
- Luxury, but Model "S" coming, priced at \$50,000.

Types of Electric Vehicles



Mitsubishi i-MiEV

- All Electric
- Range: 45 - 85 miles,
- Priced at \$30,000
- Target markets:
 - Urban Commuters
 - Second Car in Every Home



Ford Transit Connect Electric

- All Electric
- Range: 50 - 80 miles
- Priced at \$50,000
- Target markets:
 - Commercial uses for delivery or passenger van

Nissan LEAF Range and Vehicle Efficiency

Speed and Driving Conditions	Outside Temp (F)	Accessories	Estimated Range (mi)	Vehicle Efficiency (mi/kWh)*
Cruising 38 mph	68°	None	138	5.75
Fairly steady 24 mph City traffic	77°	None	105	4.38
Steady 55 mph Highway	95°	A/C on	70	2.91
Crawling 15 mph Stop-and-go	14°	Heater on	62	2.60
Average 6 mph Heavy stop-and-go	86°	A/C on	47	1.96

Nissan LEAF has a 24 kWh battery Source: "Nissan Agrees - EV Mileage Will Vary; Leaf Tests Show 91-Mile Variation."
Green Car Advisor – edmunds.com. 6-15-10.

EV Fleet Economics

	Chevy Impala	Nissan Leaf	Chevy Volt
Purchase Price	\$22,000	\$32,000	\$ 41,000
Federal Tax incentive		\$7,500	\$ 7,500
Sales proceeds	\$6,500	\$10,000	\$ 12,500
Net Cost (4 years)	\$15,500	\$14,500	\$ 21,000
Car Charger		\$1,000	\$1,000
Maintenance (\$500/year)	\$ 2,000	\$ 2,000	\$ 2,000
Fuel for 4 years - gasoline	\$ 12,000	\$ -	\$ 4,140
Fuel for 4 years - electricity	\$ -	\$ 1,408	\$ 1,126
	80 miles/day all gasoline	80 miles/day all electric	First 40 miles /day electric 40 miles/day gas
NET COST			
4 years @ 18,000 miles /year	\$ 29,500	\$ 18,908	\$ 29,266
4 years @12,000 miles/year	\$ 25,500	\$ 18,439	\$ 27,511
10 years @12,000 miles/year	\$ 49,347	\$ 32,377	\$ 46,400
10 years @ 18,000 miles/year	\$ 57,000	\$ 32,020	\$ 52,666

Assumptions

18000 miles/year
80 miles/220 days

24 miles/gallon

\$4/ gallon gasoline

\$.08 kWh electricity

12000 Miles /year
60 miles/220 days

Does not include
charger costs.

2SHB 1481 Laws of 2009 **Regarding Electric Vehicles**

By July 1, 2011, all cities and counties must allow electric vehicle **battery charging facilities as a use in all areas . . .**

- **Three levels of battery charging facilities.**
 - **Level 1 - 120 volts**
 - **Level 2 - 240 volts**
 - **Level 3 – 480 volts**

Charging EV Batteries

Level 1

- 120 V is like any normal GFI outlet
- Cost: \$12 plus installation
- Normally allowed everywhere with electrical permit.
- Typical charging time: 16-24 hours
- Typical location: home, office.



Charging EV Batteries

Level 2

- 240V like an electric oven or dryer
- Requires dedicated circuit.
- J1772 Plug
- \$2000 plus installation, more for credit enabled.
- 30% tax credit extended to 2011.
- Normally allowed in all zones with an electrical permit.
- Typical charging time: 4-6 hours
- Typical installation: home restaurant, hotel, recreation facility.



EV Charging Rates

Source: www.leviton.com

Charge-Time Calculator

Level 1 Charging

		Example	
Vehicle Info	Your Vehicle	Chevy Volt	Nissan Leaf
EV Range (miles)	<input type="text" value="13"/>	40	100
Battery Capacity (kW)	<input type="text" value="5.2"/>	8	24
Charge Specifications			
Energy Info			
Average Energy Price (\$/kWh)	\$ <input type="text" value=".08"/>		
Charger Info			
Charge Voltage	<input type="text" value="120"/>		
Charge Current	<input type="text" value="15"/>		
Assumed Charging Efficiency	<input type="text" value="100"/> %		
Calculations			
Total Charge	5 kW	8 kW	24 kW
Time To Fully Charge	2.8 hours	4.4 hours	13.3 hours
Range per Hour of Charge	4.64 miles	9.09 miles	7.52 miles
Cost to Charge	\$0.40	\$0.64	\$1.92
Dollars per Mile	\$0.03	\$0.02	\$0.02

Calculate

Charge-Time Calculator

Level 2 Charging

		Example	
Vehicle Info	Your Vehicle	Chevy Volt	Nissan Leaf
EV Range (miles)	<input type="text" value="13"/>	40	100
Battery Capacity (kW)	<input type="text" value="5.2"/>	8	24
Charge Specifications			
Energy Info			
Average Energy Price (\$/kWh)	\$ <input type="text" value=".08"/>		
Charger Info			
Charge Voltage	<input type="text" value="240"/>		
Charge Current	<input type="text" value="30"/>		
Assumed Charging Efficiency	<input type="text" value="100"/> %		
Calculations			
Total Charge	5 kW	8 kW	24 kW
Time To Fully Charge	0.7 hours	1.1 hours	3.3 hours
Range per Hour of Charge	18.57 miles	36.36 miles	30.3 miles
Cost to Charge	\$0.40	\$0.64	\$1.92
Dollars per Mile	\$0.03	\$0.02	\$0.02

Calculate

Charging EV Batteries

Level 3

- 480V like a welder or commercial refrigeration unit
- Typical charging time: 15-30 minutes
- Cost: \$50,000 plus installation, ensure adequate power from the utility
- Normally allowed in commercial and industrial zones with a higher level of review.
- Typical locations might be gas stations, high visibility, maximum access



Battery Exchange Stations

- **Must be allowed along I-5, I-405, I-90, and SR-520.**
 - citywide for cities adjacent to these highways
 - within 1 mile for counties adjacent to these highways (RCW 36.70.695)
- **Batteries stored for exchange (like propane canisters)**
- **\$1 million facility**
- **Not currently in the US**



2SHB 1481 Laws of 2009

By July 1, 2011, all cities and counties must allow electric vehicle battery charging facilities as a use in all areas, except for residential, resource, and critical areas.

(RCW 36.70A.695 and other statutes)



Electric Vehicle Infrastructure

www.ElectricDrive.wa.gov

Zoning

City of Auburn
Ordinance No. 6365, June 20, 2011

18.47.020 Permitted locations

EVI Type	Zoning District						
	PUD, RC, R1, R5	R7, R10, R16, R20	CN, RO	DUC	CI, C2, C3,	M1, M2, BO, EP	I, P-1
EV Charging Station ^{1, 2}	P ₃	P ₃	P	P	P	P	P
Rapid Charging Station ⁴	P ₅	P ₅	P	P	P	P	P
Battery Exchange Station	X	X	X	X	P	P	P

P: Use is permitted.

X: Use is not allowed in the given zoning district.

Development Standards

1. Level 1 and Level 2 charging only.
2. Level 1 and Level 2 charging are permitted in aquifer recharge areas and in other critical areas when serving an existing use.
3. Allowed only as accessory to a principal outright permitted use or permitted conditional use.
4. The term "Rapid" is used interchangeably with Level 3 and Fast Charging.
5. Only "electric vehicle charging stations - restricted" as defined in 18.47.354.

EV Sign Standards



Roadways



12" X 12"



12" X 6"

Encourage property owners to use these signs



12" X 12"



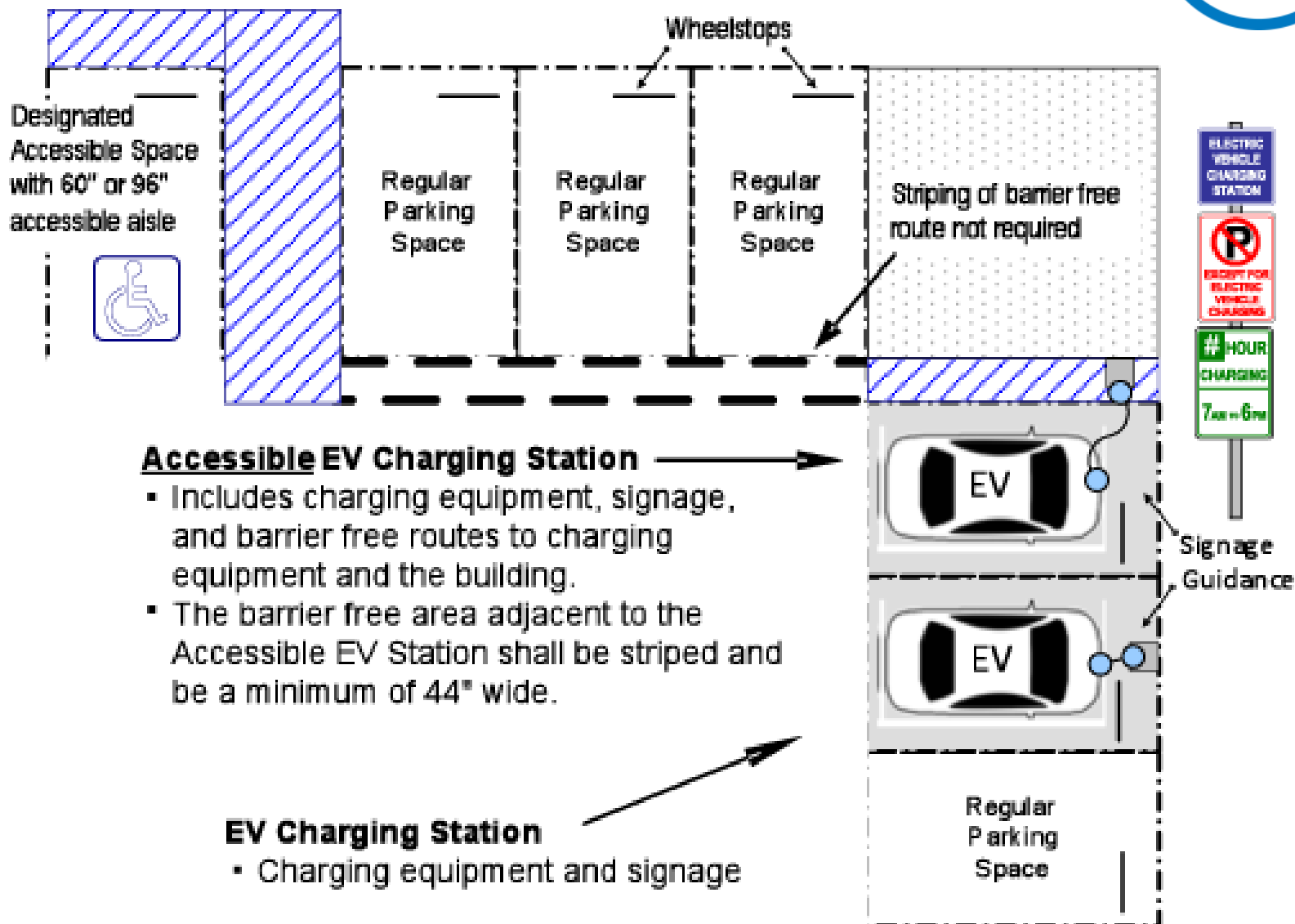
12" X 18"



12" X 18"

Design Standards

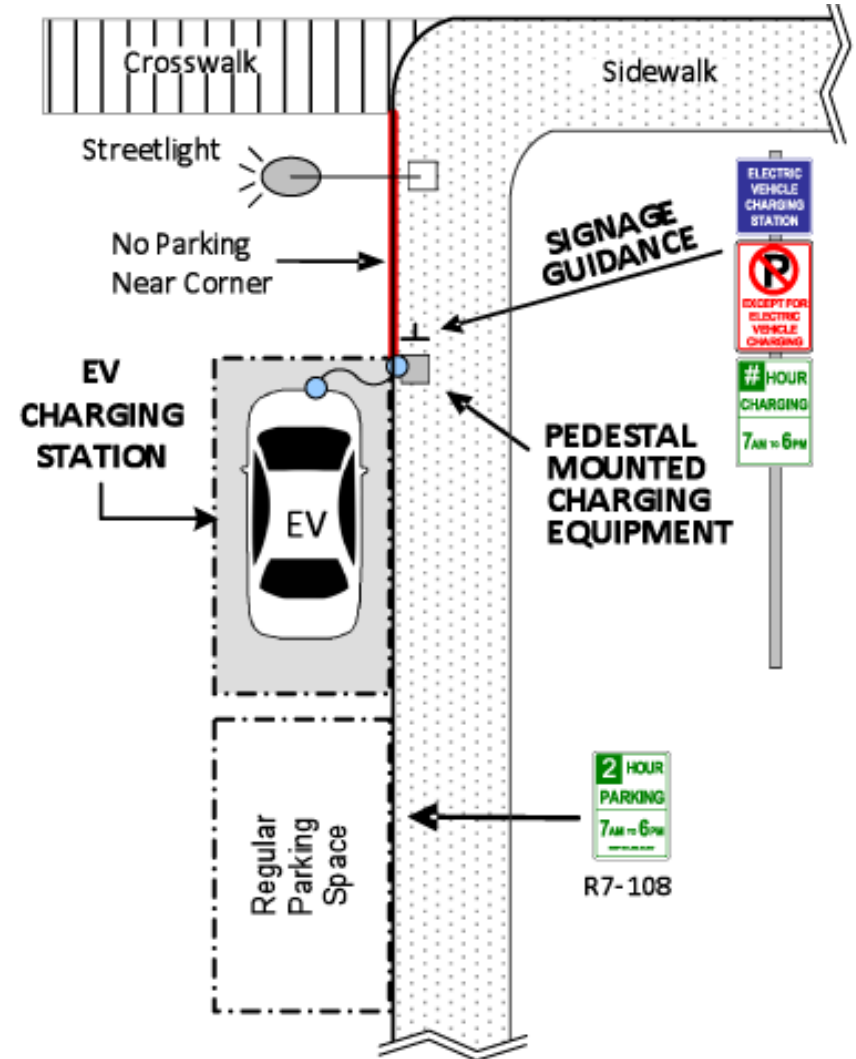
City of East Wenatchee
Ordinance No. 2011-02



On-Street Charging Stations

City of Tukwila,
Ordinance 9.28.037

- **Public Parking**
 - Station location
 - Parking enforcement



Bookmarks

- Cover
- Table of Contents
- Appendix A. House Bill 1481 as Codified in the Revised Code of Washington
- Appendix B. Model Guides for Charging Stations
 - Installation Guide: Single-Family Residence
 - Installation Guide: Commercial or Employee Parking Lot
- Appendix C. Model Electric Vehicle Charging Station Installation Checklist
- Appendix D. Research Memorandum
 - App.D.1. Code Compilation
 - App.D.2. Agency Interviews
 - App.D.3. Battery Research
 - App.D.4. EV Driver Survey
 - App.D.5. Data Collection Subcommittee

Appendices to Model

Installation Guide for Charging Stations

Electric Vehicle Charging at a Single-Family Residence

Congratulations on joining the exciting transition to electric vehicles! As a current or future electric vehicle owner, you can look forward to convenient overnight "fueling" by plugging your car in at home. This guide provides important information to help you plan and install necessary charging equipment.

1. Charging times and specifications. – *Charging times vary by battery capacity and voltage.*

The time and equipment required to charge an Electric Vehicle (EV) varies based on the capacity of the vehicle's battery and the level of electric power available. Most future EV drivers will choose to drive one of the two major categories of electric vehicles: a battery electric vehicle or a plug-in hybrid electric vehicle. These two types of EVs are described below. Generally, battery electric vehicles contain batteries with more capacity and require heavier duty charging equipment than plug-in hybrid electric vehicles. See Table 1 on Page 2 for more information on charging levels.

Battery Electric Vehicle (BEV). BEVs are zero-emission vehicles that run exclusively on a powerful, large capacity battery that pulls energy from the electric grid. Because electricity is the only source of energy for BEVs, for normal daily driving you will likely need to install a Level 2 charging station (see Figure 1 and Figure 3). Level 2 is likely to be the best option given the reduced charging times.

Plug-In Hybrid Electric Vehicle (PHEV). PHEVs are vehicles that run on both electricity from the grid and an internal combustion engine. Depending on its design, the internal combustion engine either shares in powering the EV by alternating back and forth with the electric motor, or it is used to recharge the battery once the all-electric range has expired. The latter type is often referred to as an extended-range electric vehicle or "EREV." The battery in a PHEV generally has less capacity than the battery in a BEV, and depending upon your daily



Figure 1. A typical wall-mounted Level 2 home charging station inside a garage. Photo courtesy of Clean Fuel Connection, Inc.

driving needs, a dedicated circuit for a Level 1 charging system will take longer but may be adequate.

A third category of EV, **Electric Scooters and Motorcycles**, is made up of two-wheeled lightweight vehicles. This category of EVs is similar to BEVs, because they are powered completely by an electric battery. However, their light weight allows for a less powerful battery. Currently, electric scooters and motorcycles only accept Level 1 charging equipment.

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State Support for EVs

2SHB 1481 Laws of 2009

- **RCW 82.08.816 – Electric vehicle batteries and infrastructure exempt from retail sales and use tax.**
- **RCW 43.21C.410 – EV Battery charging station installation exempt from SEPA.**
- **RCW 82.29A.125 – State and local governments may lease land for electric vehicle infrastructure, exempt from leasehold tax.**
- **Cities may adopt incentive programs to encourage EVI.**
- **2018 all cities, 100% of fuel from renewable sources**
(RCW 43.19.648 - revised from 2015 by HB 1478 - laws of 2011)

Federal Support for EVs

Federal Investment in Electric Vehicle Charging Infrastructure

The EV Project

- ECoality awarded \$20M in U.S. DOE funds to install charging infrastructure in Puget Sound
- 1,200 public and fleet charging stations, including 22 fast-chargers
- 1,000 private charging stations for Nissan LEAF owners

Charge America

- Charge Northwest/Coloumb awarded \$37M to install 5,000 charging stations in 37 regions, including eastern King County (Bellevue).

Cities and Counties

- Puget Sound Clean Cities Coalition awarded \$15M to install charging stations and purchase fleet vehicles. Other cities used EECBG funds to purchase and install EV chargers.





WEST COAST GREEN HIGHWAY

- Public/private partnerships to promote sustainable transportation solutions in the I-5 corridor
- Provide travelers with alternative fuels, “BC to Baja”
- Tri-State initiative (Washington, Oregon, and California) with agreement with BC Province
- Partnership with state DOTs, existing businesses and fuel providers, emerging technologies, and travelers
- Collaborate with Oregon and California on joint EV infrastructure development, signage, and funding
- Components: alliance, business and marketing assistance, branding, fueling and charging stations.

WA Electric Highways

- WSDOT/Commerce Project funded with \$1.32M through State Energy Program, US Department of Energy
- Goal: Develop safety net of EV Fast-Charging stations throughout un-served locations along I-5 with additional stations along US 2
- Contract with provider of level 3 chargers. Seek partnerships with retail businesses located in critical recharge zones
- Coordinate EV infrastructure investments with other planned investments in Puget Sound Region



Washington Electric Highways

Host Sites and Retail Partnerships

- Selected contractor through competitive process
- Identified recharge zones due to distance, etc.
- Finalizing locations
- Installing EV fast chargers by December 2011



Fast-Charge Site Criteria:

- Within ½ mile of highway interchange
- Safe and convenient access
- Restrooms and drinking water
- Parking space
- Shelter and lighting
- 480V 3-phase electric power supply
- Customer amenities (food, traveler info)
- Financial and non-financial contributions



Electric Vehicle Contacts

State Planning Assistance for Cities and Counties

Anne Fritzel, Senior Planner
Growth Management Services
Washington State Department of Commerce
360-725-3064, anne.fritzel@commerce.wa.gov
www.ElectricDrive.wa.gov

West Coast Green Highway

Tonia Buell, Project Development
and Communications Manager
Public-Private Partnerships Office
Washington State Department of Transportation
360-705-7439, buellt@wsdot.wa.gov
www.westcoastgreenhighway.com/electrichighways.htm

Consumer Resources

www.AmericanGarageMagazine.com

www.PlugInAmerica.org

www.leviton.com



Stop, Shop and Recharge

Car Charging	Level 1	Level 2
Cost of Charger	\$12	\$1,500
"EV Charging Sign"	\$40	\$40
Installation	\$120	\$200
Tax Credit	30% of purchase and installation	30% of purchase and installation
Estimated distance per 2 hour charge	10 miles	40 miles
Estimate of cost per 2 hours charge	\$0.30	\$1.20
		\$0 for Kiosk
Cost per year 3 charges/day/ 250 days/year Assuming 8 cents /kWh	\$ 225.00	\$ 900.00

Summary: Types of Electric Vehicles

Make	Price	Battery Type	Electric Range	Charge Time 240 V (120 V)	Charge Time 480 V
Nissan Leaf	\$32,780	24kWh Lithium-ion	100 miles	8 hours (24 hours)	30 min
Chevy Volt	\$41,000	16kWh Lithium-ion	40 miles	4 hours (10 hours)	N/A
Mitsubishi i-MiEV	\$30,000	16kWh Lithium-ion	45-75 miles	7 hours (16 hours)	30 min
Ford Transit Connect	\$50,000	28kWh Lithium-ion	80 miles	6-8 hours (24 hours)	N/A
Toyota Prius Pl=H	TBD	5.2kWh Lithium-ion	13 miles	1.5 hours (5hours)	N/A
Tesla Roadster	\$109,000	56kWh Lithium-ion	245 miles	6 hours	N/A

Charging EV Batteries Summary

Level	Input Voltage	Typical Charging Time	Breaker Size (A)	Electrical Loads (kW)	Typical Locations
I	120 V	8 – 12 hours	15-20	2	Standard 120 volt plug; NEV/Motorcycle charging, Emergency charging
II	240 V	2 – 4 hours	40 amp Typical	3-6	Residential garages, parking lots, public garages, transit centers
DC Quick Charge	480 V 3 phase	20 – 40 minutes	various	30-60	Rapid charging facility near high traffic volume arterials