

# Electric vehicles and infrastructure guidebook

Kentucky Clean Fuels Coalition







The Kentucky Clean Fuels Coalition was established in 1993 to provide the first alternative fuels resource for Kentucky educators, consumers and providers of alternative fuels/vehicles.

It is now a successful non-profit 501C3 self-supporting organization and a national leader in the clean fuels market.

The mission of the Kentucky Clean Fuels Coalition (KCFC) is to connect providers and consumers of fuels across Kentucky with the best information and education available about clean transportation technologies.

## Operating Strategies and Objectives

- Build partnerships between providers and consumers of fuel.
- Raise awareness about the opportunities and benefits of using alternative fuels and advanced transportation technologies.
- Focus on incorporating alternative fuels and advanced transportation technologies
- Provide members and stakeholders with continuing education opportunities and reliable informational resources upon which they can base decisions.
- Commit to air quality and environmental stewardship.
- Provide a balanced source of information for developing partnerships and a realistic market approach to project implementation.
- Focus on incorporating alternative fuels and advanced transportation technologies into technician education.

## KCFC Vision

Transforming Kentucky into a model area for the development and implementation of public policy that supports and encourages the development and use of alternative fuels and technologies for transportation purposes and to improve air quality, diminish dependence on foreign oil, and enrich the state economy by creating alternative fuel options that make it inviting for commercial carriers to conduct interstate commerce.

In addition, this guidebook supports and ties into our efforts for Plug-In Kentucky.





# Electric Vehicles

## Introduction

Electric vehicle production and charging infrastructure installation have been increasing at a dramatic rate as major automakers begin to view electricity, an alternative fuel to the conventional propane, as the fuel of the future.

Electricity is considered an alternative fuel under the Energy Policy Act of 1992, and can be produced from a variety of energy sources, including natural gas, coal, nuclear energy, wind energy, hydropower, and solar energy.

Different types of electric vehicles are powered by and use electricity in different ways. **Plug-in electric vehicles** (PHEVs) and **all-electric vehicles** (EVs) draw electricity from the grid and store it in batteries, while **hybrid electric vehicles** (HEVs) produce electricity through regenerative braking and use it to boost fuel efficiency.

This guidebook will answer your basic questions about electric vehicles and charging infrastructure and guide you to other available information.

## Types of Electric Vehicles

**All-Electric Vehicles (EVs):** EVs are powered only by an electric motor. The batteries are charged by plugging into an electrical power source. They do not use any conventional fuel while driving and produce no tailpipe emissions.

**Plug-In Hybrid Electric Vehicles (PHEVs):** PHEVs are powered by an internal combustion engine, fueled by gasoline, and an electric motor that can be plugged into a power source to charge. PHEVs are able to operate in all-electric mode.

**Hybrid Electric Vehicles (HEVs):** HEVs are powered by an internal combustion engine, fueled by gasoline, and an electric motor. The battery is charged through regenerative braking, *not* by plugging in. They cannot operate in all-electric mode.

## Benefits of Driving Electric

- **Requires significantly less maintenance** than conventional vehicles, HEVs, and PHEVs because there is no engine and associated components.
- **Reduces greenhouse gases** because EVs and PHEVs in all-electric mode produce no tailpipe emissions.
- **Improves fuel economy** - HEVs typically achieve better fuel economy than comparable conventional vehicles, and all-electric vehicles have the lowest fuel cost range of all light-duty vehicles (followed by PHEVs and HEVs).
- **Federal tax credits are available** up to \$7,500 depending on the type, make, and model of electric vehicle, and the state you reside in.



# Charging Basics

## Residential Charging

Multiple charging models are available for at-home charging units with two different levels (AC Level 1 and AC Level 2).

**AC Level 1:** Electric vehicles come with Level 1 charging cords, so this charger requires no additional cost or installation, and it can be plugged into a standard 120-volt outlet. One hour of charging can provide 2 to 5 miles of range.

**AC Level 2:** Level 2 charging units require a 240-volt outlet. Families can consult with an installation contractor to install one if there are none available. One hour of charging can provide 10 to 20 miles of electric range.

**Wireless:** Also known as inductive charging, this unit can be used for residential or commercial purposes. One hour of charging can provide 10 to 20 miles of electric range.



*This AC Level 2 cordset (above) requires installing charging equipment and a dedicated 20A-100A circuit.*

**DID YOU KNOW?**

**In 2020, the median range of an electric vehicle topped 250 miles!**

## Public Charging

Building public EV charging infrastructure is a necessary component of a successful EV market. While more than 70% of EV owners primarily charge their vehicles at home, public stations can act as a type of insurance against what is known as 'range anxiety', along with offering many other benefits to businesses, consumers, the environment, and the general public.

Charging time depends on the type of charger installed. Fully charging a vehicle can take 4-8 hours, with a Level 1 or 2 charging unit, but a "fast charge" to 80% capacity can take 20-30 minutes.

**Direct Current (DC) Fast Chargers:** DC charging units are often used for public charging stations, and it is the fastest charging technology available on the market today. This type of unit is ideal for placement along heavily trafficked corridors where drivers are traveling extended distances and need to make short recharge stops. Just 20 minutes of charging can provide 60 to 80 miles of range.

## Benefits of Public Charging Infrastructure

- **May help bolster market acceptance** of electric vehicles.
- **Essential for high mileage/long distance driving.** The average range of an EV is about 200 miles - and older vehicles may not be able to drive more than 100 miles on a single charge.
- **Displays commitment to sustainability,** helping the community to achieve climate goals and attracting eco-conscious customers to businesses.



# Charging Stations

## AC Level 1



**Voltage**  
120V 1-Phase AC

**Amps**  
12 – 16 Amps

**Charging Loads**  
1.4 to 1.9 kW

**Charge time for vehicle**  
3 – 5 miles of range per hour

## AC Level 2



**Voltage**  
208V or 240V 1-Phase AC

**Amps**  
12 – 80 Amps (Typ. 32 Amps)

**Charging Loads**  
2.5 to 19.2 kW (Typ. 7kW)

**Charge time for vehicle**  
10 – 20 miles of Range per hour

## Charging Connections

EV charging connectors vary by country and model, but adapters can allow owners to charge their vehicles at different types of stations.

## AC Charging

AC charging is the most common method of charging electric vehicles, with many owners choosing to slow-charge their vehicles at home overnight.

In North America, the standard Level 1 and Level 2 charging connector is the **SAEJ1772**, which can be plugged into a standard 120- or 240-volt outlet.

Some Level 2 units will require installing a dedicated circuit and outlet if none are available.

## DC Fast Charge



**Voltage**  
208V or 480V 3-Phase AC

**Amps**  
<125 Amps (Typ. 60 Amps)

**Charging Loads**  
<90 kW (Typ. 50kW)

**Charge time for vehicle**  
80% Charge in 20 – 30 minutes

## DC Charging

There are three types of DC fast charging with their own unique port connectors: **CHAdEMO**, **Combined Charging System (CCS)** and **Tesla Supercharger**.

Tesla Superchargers are only compatible with Tesla vehicles, but Tesla vehicles can use CCS or CHAdEMO stations with an adapter.



Photograph by Joenomias on Pixabay



# Installation Costs

Cost factors are influenced by required electrical work, trenching or boring, permitting, inspection, labor rates, and ADA requirements. These factors lead to highly variable costs associated with installing EVSE. Utilizing best practices for choosing EVSE types, quantities, and locations will help minimize the financial impact of buying and installing EVSE. Ballpark cost ranges for EVSE units and installation are shown below.

Ballpark EVSE Unit and Installation Costs			
EVSE Type	EVSE Unit* Cost Range (single port)	Average Installation Cost (per unit)	Installation Cost Range (per unit)
Level 1	\$300-\$1,500	not available	\$0-\$3,000** <i>Source: Industry Interviews</i>
Level 2	\$400-\$6,500	-\$3,000 <i>EV Project (INL 2015b)</i>	\$600-\$12,700 <i>EV Project (INL 2015b)</i>
DCFC	\$10,000-\$40,000	-\$21,000 <i>EV Project (INL 2015d)</i>	\$4,000-\$51,000 <i>EV Project (INL 2015d) and (OUC 2014)</i>

## Level 1 Chargers

Level 1 units can range in cost from **\$300-\$1,500**. The lowest priced unit is a simple plug-in cordset A hardwired Level 1 pedestal unit with access control and cable management could cost closer to \$1,500.



Every EV comes with a **free** Level 1 charging cord that can be plugged into a standard 120-volt outlet. (right)

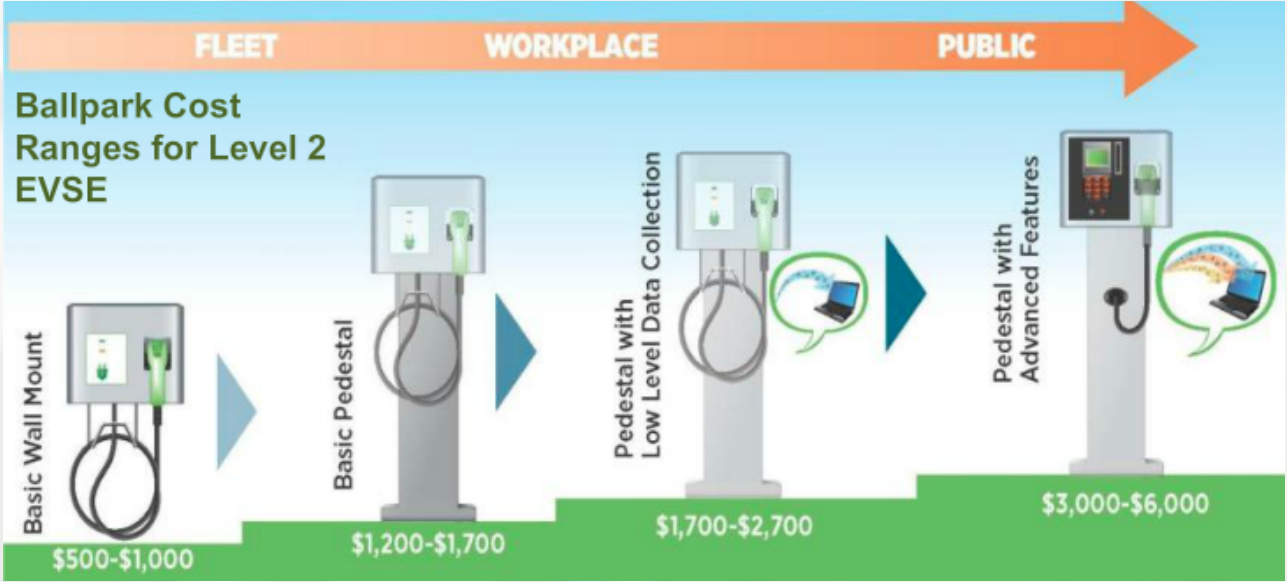
This wall-mounted Level 1 charger might cost around ---- (left).



## Level 2 Chargers

Single-port Level 2 units are available spanning a **\$400-\$6,500** cost range depending on included features. While there is no standard EVSE unit for the fleet, workplace, or public sites, the graphic below illustrates potential costs for Level 2 EVSE units with different tiers of additional features.

The pictured example is meant only to show how the cost of an EVSE unit may change based on the mounting system and selected features.



## DC Chargers

DC charging units can range in cost from **\$10,000** for a low-power, low-amperage, single-port unit with no display or networking components to **\$40,000** for a high-power, high-amperage system that enables multiple vehicles to charge at once along with various special features.







## Resources for Hosting a Charging Station

One of the highest impact strategies for reducing emissions is transportation electrification through EV charging infrastructure. Installing charging stations are simple and less expensive than you may think. If you are interested in hosting a charging station, please check out the following resources below.

- **LG&E and KU Electric Vehicle Charging Station Program:** LG&E and KU offer business customers the opportunity to host charging stations publicly or privately accessible. For more information: <https://lge-ku.com/environmental/environment/alternate-fuels-road/ev/hosting>
- **Evolve KY Adopt a Charger Program:** The Adopt a Charger program is a simple way for businesses, foundations and individuals to have a hand in creating electric car charging infrastructure in the Kentuckiana region. Please visit <https://www.evolveky.org/adopt> for more information.
- **Kentucky Power:** Kentucky Power offers support throughout the transformation process if you are wanting to host a charging station. For more information: <https://www.kentuckypower.com/clean-energy/electric-cars/>
- **U.S. Department of Energy:** Find more Federal and State Incentives in the Alternative Fuels Data Center at <https://afdc.energy.gov/>
- **KCFC's EV Charging Champions Program:** The voluntary workplace sustainability program recognizes businesses that have been champions of EV technology in addition to empower business in Kentucky to become sustainability leaders by adopting work place charging units while providing education and resources for other businesses interested in hosting a charging station. For more information: <https://kentuckycleanfuels.org/projects/ev-charging-champions/>



### For More Information:

-  [www.kentuckycleanfuels.org/](http://www.kentuckycleanfuels.org/)
-  [facebook.com/kycleanfuels/](https://facebook.com/kycleanfuels/)
-  [twitter.com/kycleanfuels](https://twitter.com/kycleanfuels)