

# Take Charge of Charging

## Objective

Students identify sources of power for electric vehicle charging stations and the present day EV charging station infrastructure.

Students will create a persuasive essay and present it in an oral debate.

## Curriculum Focus

Science  
English Language Arts  
Social Studies

## Materials

- Access to research materials (books, magazines, internet)
- Copies of "Take Charge of Charging"

## Key Vocabulary

Availability  
Charging stations  
Electric vehicle (EV)  
Infrastructure  
Natural resources  
Net-zero home  
Nonrenewable resources  
Position paper  
Renewable resources  
Residential

## Correlations

### Next Generation Science

4-ESS3 - 1  
4-ESS3 - 2  
4-ETS1 - 1  
4-ETS1 - 2  
5-ESS3.C  
5-ETS1 - 1  
5-ETS1 - 2  
MS-PS1 - 3  
MS-ESS3 - 3  
MS-ETS1 - 1



## Introduction

This activity has two parts involving research and role-playing scenarios to challenge students to think critically about how power is supplied to charge electric vehicles. In Part A, students research the present infrastructure to supply electricity to charging stations. In Part B, students adopt a role to present an oral position paper or presentation on the impact of EV charging stations in their fictional town.



## Procedure

### PART A: RESEARCH EV CHARGING STATIONS AND THE ENERGY SOURCES SUPPLYING ELECTRICITY

1. Have students read the background material provided at the beginning of this unit and then choose a topic from the list below to research.
2. As students research their information, instruct them to look critically at the resources used for electricity generation (ie. which natural resources, renewable or nonrenewable, are used as the energy source) and locations (home, business, parking lots) of current charging stations for EVs.
3. After students have taken some time to research their topic, have them summarize their findings (paper or presentation format) for the class. This information will help them with Part B of the activity, the infrastructure planning simulation.

#### Possible Research Topics:

- **Charging Stations:** What types of charging stations are available? How long does it take to charge an EV per kilowatt and what is the average cost per kilowatt? How many EVs could a single charging station supply with charging in a day? Consider what regulations the city will need for the maintenance and security of public charging stations.
- **Home Charging and the Grid:** Most EV owners invest in a home charging outlet to charge their EV overnight. How do you think this increased use of electricity when people typically are asleep will impact the source of energy supplying their home with electricity? (Some students should find time of use plans in their research and others may research off the grid energy sources and net-zero homes.)
- **Charging and Safety:** How far can different models of EVs travel before needing to be charged at a station? What happens if an EV runs out of charge away from a charging station? Students should have the option to include the practicalities of charging safely. Should they remain inside the EV while it is charging? Should they charge in the rain? Should they charge during a lightning storm or while it is snowing?
- **Off Grid Charging:** What off the grid sources of power are available to charge an EV at a home, on the road or in a remote location? Which charging sources are portable or attached to the EV? (In their research, students should find solar panels are not the only option. Some may realize that a portable charging service can be hired to come charge an EV and not necessarily always as an emergency roadside assistance service.)
- **Utility Fuel Mix and Expansion:** Ask students to think about the cost of supplying electricity in their state. Is it different in other states? Are these power utilities renewable or nonrenewable? How easy or how difficult would it be to expand them to supply more power? If utility power is disrupted in part of a town what strain will that place on the charging stations still operational or those powered independently off the grid? (Students should look up making a home net-zero and government tax breaks for owning EVs or installing public charging stations at businesses.)

## PART B: CHARGING STATIONS INFRASTRUCTURE DEVELOPMENT SIMULATION

This portion of the activity has students adopting the role of residents of an area considering the growing need for EV charging stations. Students will draft a position paper or presentation on the effect of the increased need for electricity in their town and personal lives.

1. Before beginning this portion of the activity, have a brainstorming session to decide what type(s) of energy sources supply the town with electricity. Students decide the present percentage of electric vehicle ownership in their fictional town. (Students can choose real-world nonrenewable and renewable energy suppliers but emphasis should be on how EV charging stations impact the power infrastructure.)

Possible factors which need to be addressed:

- Number of public charging stations needed for out-of-town travelers (deliveries, commuters, tourists and residents who only use public charging stations)
- Locations of public charging stations (parking garages and lots, schools, hospital, sports arena, stores/businesses, etc.)
- Should certain businesses be offered an incentive (tax break) or be required to install charging stations onsite for their employees or customers?
- Should price per kilowatt be the same as a residential charging outlet or should businesses be allowed to make a profit?
- Does the town want to encourage residential charging or public charging?
- Residential charging outlets may not always be an option (consider more than the cost to install, such as rental contracts of homes can disallow or make the install prohibitive for the renter or homeowner associations may limit placement or type of installations).
- Consider security and maintenance of public charging stations.
- How will the increased use of electricity impact the town's current supply of electricity in the short term and for years in the future?
- Consider power supply and construction of the sites.
- Evaluate geologic features of the area.

2. Assign student roles or allow them to pick from a list you have developed during the brainstorming session.

- Roles that you may want to assign students include:
  - representatives from the local utility
  - trucking company owner
  - director of the local hospital
  - school superintendent
  - mayor/city manager
  - tourism director
  - governor
  - sheriff
  - environmentalists
  - local business owners of hotels or restaurants
- The topics that students researched for Part A of this activity should be considered when assigning roles. For example, a student who researched portable charging could include a concierge charging business owner and a student who researched how many charging stations a school might need could include the school superintendent.

3. After students have had time to formulate their position and supporting arguments, hold the panel discussion. You should serve as the director of the panel but you may want to invite administrators, other faculty members or community members to serve on the panel with you.



## To Know and Do More

1. Ask students to research electric vehicle batteries and how the charging station outlet is designed to charge it.
2. Look into super chargers and how improvements to batteries could decrease the time and power needed to charge an EV.
3. Consider the pollution caused by the production of EV batteries with the lack of emissions over the life of the EV and compare it to the current production of gasoline fuel and its use over the life of a car.
4. What challenges do you see in properly disposing of EV batteries?
5. Can you think of ways to improve on the current EV batteries?

U.S. Department of Energy: [energy.gov/eere/vehicles/batteries](https://energy.gov/eere/vehicles/batteries)

Vehicle Cost Calculator: [afdc.energy.gov/calc/](https://afdc.energy.gov/calc/)

# Student Sheet: Take Charge of Charging

## Objective

This activity has two parts involving research and a role-playing scenario that will challenge you to think critically about the issues involving an electric vehicle charging infrastructure and how that electricity is supplied.

In Part A, you will research a selected topic about electric vehicle charging stations, where they are needed and how much electricity is required to keep EVs on the road.

In Part B, you will adopt a role and take a stand on a proposed development of charging stations in your fictional town.



## Background

Our consumption of energy and concern about its continued availability has encouraged the production of electric vehicles. Whether your car runs on fossil fuels or a rechargeable battery, that energy must come from somewhere. Your local power utility could be natural gas, coal burning, nuclear, solar, wind, water or geothermal or a combination to supply your town with electricity.

What happens when more people need electricity for transportation? All types of vehicles have a limited range, even the early automobiles could not travel far until more gas stations were built, but charging an EV is not as quick as filling up a fuel tank. Therefore, the locations and quantity of charging stations must be planned accordingly to keep EVs on the road.



## Procedure

### PART A: RESEARCH EV CHARGING STATIONS AND THE ENERGY SOURCES SUPPLYING ELECTRICITY

1. Research the topic you have picked or been assigned by your instructor. Be sure to take notes on your sources!
  - U.S. Energy Information Administration (EIA): [eia.gov](http://eia.gov)
  - National Energy Foundation, Electrical Generation Video: [vimeo.com/514357652](https://vimeo.com/514357652)
  - National Energy Foundation, Smart Grid Video: [vimeo.com/513944601](https://vimeo.com/513944601)
  - Vehicle Cost Calculator: [afdc.energy.gov/calc/](http://afdc.energy.gov/calc/)
2. As you research, look closely at the source of the information.
  - Is it a government source, an environmental group, an electric vehicle sales organization or scientific development of EV technology?
  - Consider the motivation of the group as you look at the information presented.
  - What bias might be present in the information? Look at both sides of the issue, each side can present the same information in a radically different light or include speculation about future improvements to EVs that has not occurred yet.
  - Also, is your source a primary or secondary source of information? Use primary sources whenever possible!
3. After you have taken some time to research your topic, summarize your findings (using paper or a presentation) for the class. You will serve as the expert on your topic for Part B of the activity, the charging station infrastructure development simulation.



## PART B: CHARGING STATIONS INFRASTRUCTURE DEVELOPMENT SIMULATION

You are a resident of a small town which needs more charging stations to satisfy an increase in electric vehicle use. The government has created a panel to study how many charging stations the town needs and whether the town's electricity supply can fill the growing demand.

1. You will need to create a position statement (on paper or a presentation) to present to the panel. You will choose or be assigned a role to play during the mock panel discussion. This role should be related to the research you did earlier. Be prepared to answer any questions the panel may have for you on your position or the sources of your information.
2. As you create your position statement (on paper or a presentation), try to stay in the mindset of your role and imagine what would that person feel? What would be their primary motivation?
3. You may want to dress in costume for your role when your class holds the mock panel discussion. This will make you feel more in tune with your character and more confident.
4. Participate with your class in the panel discussion in your assigned role.