SEMPO Plug-In Electric Vehicle Readiness Plan

Southeast Metropolitan Planning Organization (SEMPO)

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SEMPO
SOUTHEAST METROPOLITAN PLANNING ORGANIZATION

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SEMPO
SOUTHEAST METROPOLITAN PLANNING ORGANIZATION

Purpose Statement from SEMPO

The Southeast Metropolitan Planning Organization (SEMPO) undertook the development of an Electric Vehicle Readiness Plan (EVRP) to inform the general public, transportation agencies, electric vehicle stakeholders, private businesses, and local government entities of the advent of increased electric vehicle ownership and electric vehicle infrastructure deployment within the SEMPO Metropolitan Planning Area. The rapidly evolving technologies driving electric vehicles and electric vehicle infrastructure require preplanning and local efforts toward understanding the potential benefits, equitable deployment and access, future implications, potential barriers, and best practices. It is also imperative that the proliferation of electric vehicles and electric vehicle infrastructure be coupled with deliberate planning and appropriate policies to ensure equity of distribution and deployment so the disadvantaged and traditionally underserved members of the community are able to participate and benefit from these advancements.

Recent public and private sector investments into electric vehicles and charging infrastructure aided SEMPO's decision to prioritize the development of this plan. At the federal level, we have seen efforts focus on sustainable transportation through legislative actions such as the Bipartisan Infrastructure Law which has dedicated $5 billion over the next five years to help states create a network of electric vehicle charging stations. In the private sector, automakers have communicated detailed plans to electrify large portions of their fleets over the next decade, with some announcing goals for fully electrified lineups within five years. These significant investments will undoubtedly have an impact on the number of individuals interested in electric vehicle adoption.

The implications of increased electric vehicle adoption and corresponding infrastructure buildout could be significant for the SEMPO region and may provide opportunities to gain a competitive edge. As more electric vehicles are introduced into the market so too will the demand for charging options. Planning for this demand could further attract electric vehicle users to the SEMPO area enhancing the region's appeal as a regional hub for commerce, retail, education, and heath care services.

Advancements in technology have continually evolved transportation throughout history. Therefore, transportation planning must remain future-oriented to account for these advancements. It is SEMPO's intent that this planning document serve as a valuable resource to any and all interested in the emerging technology of electric vehicles, related charging infrastructure, and the potential decision to invest.

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COMMONLY USED TERMS & SEMPO ACRONYMS

Alternating Current (AC) - An electric current that reverses direction multiple times per second, used to offer fast charging.

Americans with Disabilities Act (ADA) - A civil rights law that prohibits discrimination against individuals with disabilities in all areas of public life, including jobs, schools, transportation, and all public and private places that are open to the general public.

Ampere (Amps) - The fundamental base unit of electrical current.

Battery Electric Vehicle (BEV) - A vehicle that receives all its power from batteries and one or more electric motors.

Combined Charging System (CCS) - A standard for charging electric vehicles providing power up to 350 kilowatts. These connectors are extensions of the IEC 62196 Type 1 and Type 2 connectors, with two additional direct current (DC) contacts to allow high-power DC fast charging.

Charge de Move (CHAdeMO) - A charging standard for fast-charging stations.

Disadvantaged Communities (DACs) - The areas which most suffer from a combination of economic, health, and environmental burdens.

Direct Current (DC) - An electric current flowing in one direction only, used for fast charging electric vehicles, regardless of which charging port is used (Tesla, CCS, or CHAdeMO).

Direct Current Fast Charger (DCFC) - Chargers that convert AC power to DC power to provide DC power straight to your EV's battery; the AC-to-DC conversion happens in the charging station before the electrons enter your vehicle.

Electric Vehicle (EV) - A vehicle propelled by one or more electric motors using energy stored in rechargeable batteries.

European Union (EU) - An international organization comprising 27 European countries and governing common economic, social, and security policies.

Federal Highway Administration (FHWA) - A federal organization that provides stewardship over the construction, maintenance and preservation of the nation's highways, bridges and tunnels.

Fuel Cell Electric Vehicle (FCEV) - A vehicle fueled with pure hydrogen gas stored in a tank on the vehicle. Similar to conventional internal combustion engine vehicles, FCEVs can fuel in less than 4 minutes and have a driving range over 300 miles.

Greenhouse Gas (GHG) - A gas that contributes to the greenhouse effect by absorbing infrared radiation, such as carbon dioxide (CO^2).

Hybrid Electric Vehicle (HEV) - A vehicle powered by an internal combustion engine in combination with one or more electric motors that use energy stored in batteries.

Horsepower (HP) - A unit of measurement of power, or the rate at which work is done, usually in reference to the output of engines or motors.

COMMONLY USED TERMS & SEMPO ACRONYMS

Homeowners Association (HOA) - An organization designed to manage common or shared property, protect owners' property values, provide services to residents, and develop a sense of community through social activities and amenities.

International Brotherhood of Electrical Workers (IBEW) - An organization that represents active members and retirees who work in a wide variety of fields, including utilities, construction, telecommunications, broadcasting, manufacturing, railroads and government.

International Building Code (IBC) - The International Building Code is a model building code developed by the International Code Council (ICC). It has been adopted for use as a base code standard by most jurisdictions in the United States. The IBC addresses both health and safety concerns for buildings based upon prescriptive and performance related requirements.

International Residential Code (IRC) - A model building code developed by the International Code Council (ICC) which comprises all building, plumbing, mechanical, fuel gas and electrical requirements for one- and two-family dwellings and townhouses up to three stories.

International Energy Conservation Code (IECC) - A model building code developed by the International Code Council (ICC) which establishes minimum requirements for energy-efficient buildings using prescriptive and performance-related provisions.

Kilowatt (kW) - A unit of electrical power equal to 1000 watts.

Kilowatt-hour (kWh) - A unit of energy equal to 1 kilowatt of power sustained for one hour and is commonly used as a measure of electrical energy.

Manual on Uniform Traffic Control Devices (MUTCD) - The standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bike-ways, and private roads open to public travel.

Megawatt (MW) - A unit of electrical power equal to 1 million watts.

Metropolitan Planning Area (MPA) - The boundary in which the transportation planning process must be carried out. The MPA is made up of the census-defined Urbanized Area (UA), plus the contiguous area expected to become urbanized within the next 20 to 25 years.

Metropolitan Planning Organization (MPO) - An organization created and designated to carry out the metropolitan transportation planning process. MPOs are required to represent localities in all urbanized areas (UAs) with populations over 50,000, as determined by the U.S. Census.

Multi-unit Dwelling (MUD) - A dwelling unit consisting of five or more self- contained suites or apartments having sleeping, cooking and bathroom facilities.

National Electrical Code (NEC) - The benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.

COMMONLY USED TERMS & SEMPO ACRONYMS

National Electrical Manufacturers Association (NEMA) - An organization that forms the standards for the manufacturing of medical imaging equipment and electrical equipment.

National Electric Vehicle Infrastructure (NEVI) Funding Program - Provides funding to states to strategically deploy electric vehicle (EV) charging infrastructure and to establish an interconnected network to facilitate data collection, access, and reliability.

Plug-in Electric Vehicle (PEV) - An electric vehicle containing a battery that can be recharged by plugging in to an external source of power.

Plug-in Hybrid Electric Vehicle (PHEV) - A hybrid electric vehicle containing a battery that can be recharged by plugging in to an external source of power and by the on-board engine and generator.

Request For Proposal (RFP) - A business document that announces a project, describes it, and solicits bids from qualified contractors to complete it.

System Average Interruption Duration Index (SAIDI) - A system index of average duration of interruption in the power supply indicated in minutes per customer.

System Average Interruption Frequency Index (SAIFI) - A system index of average frequency of interruptions in power supply.

Supervisory, Control, and Data Acquisition (SCADA) - A combination of hardware and software enabling the capture of data within, and automation of, industrial processes. SCADA connects the sensors that monitor equipment like motors, pumps, and valves to an on site or remote server.

Sport Utility Vehicle (SUV) - A car classification that combines elements of road-going passenger cars with features from off-road vehicles, such as raised ground clearance and four-wheel drive.

State Highway Systems (SHS) - All existing and future transportation projects constructed, operated, repaired, maintained, and administered under the jurisdiction of the department of transportation, including toll projects and highway projects.

Technical Planning Committee (TPC) - A group comprised of engineers, planners, and other professionals to analyze issues from a technical perspective and serve in an advisory capacity by providing recommendations to the board of directors based on scientific information, technical sufficiency, accuracy, and completeness of studies, plans, and programs.

Urbanized Area (UA) - A developed urban area with more than 50,000 people.

United States Department of Energy (DOE) - A federal department working to address the country's energy and environmental challenges.

United States Department of Transportation (USDOT) - A federal department responsible for planning and coordinating federal transportation projects. It also sets safety regulations for all major modes of transportation.

EXECUTIVE SUMMARY

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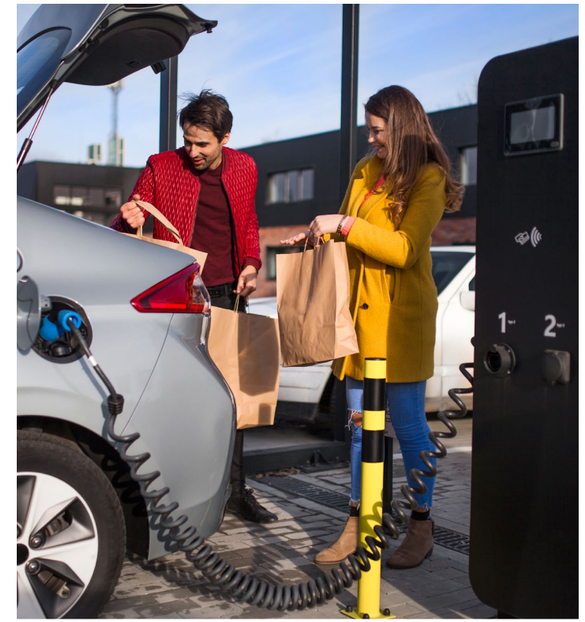

EXECUTIVE SUMMARY

SEMPO Plug-in Electric Vehicle Readiness Plan

The Southeast Metropolitan Planning Organization (SEMPO) Plug-in Electric Vehicle (PEV) Readiness Plan was developed to support the growing market of PEVs in the region by enabling municipalities and others to address immediate needs and long-term planning objectives so the SEMPO region will become an electric vehicle (EV) destination, corridor, and gateway.

The Readiness Plan delivers a comprehensive course of action to efficiently and effectively provide EV charging infrastructure and remove barriers to further EV adoption in the SEMPO region. This document serves as a starting point for both public and private entities to become familiar with the challenges and opportunities associated with EV adoption and EV charging infrastructure. It also serves as a guide for future agency-level and public engagement efforts.

The Readiness Plan supports the 2045 SEMPO Metropolitan Transportation Plan, a single overarching plan for SEMPO's transportation future, by advancing the use of EVs to improve air quality and by fostering economic development through the encouragement and expansion of the labor force to support EV infrastructure.

Emerging Needs and Opportunities

Many automakers have recently announced their commitment to EVs by diversifying their offerings and making pledges towards electrifying their fleets over the next few years. Automakers are driving the need for EV charging station infrastructure to charge the vehicles they are offering. Private sector EV infrastructure service providers deploy in areas where use is high, which leaves gaps in the network. SEMPO has an opportunity to adapt to these emerging technologies by closing EV charging infrastructure gaps and removing barriers to EV adoption. These technologies also have implications for transportation funding at the statewide and local levels. Careful consideration must be given to balance the desire to move toward electrified mobility and sustain resources for the region's long-term success.

Recommendations

The process for the development of the Readiness Plan included coordination with state, regional and local agencies and stakeholders as well as members of the public. Multiple stakeholder meetings were conducted in addition to a 90-day public survey period. The collaborative process was informed by technical analysis, which led to the development of the recommendations.

The recommendations provide a framework and strategic actions that SEMPO should consider to help achieve the goals and objectives of the Readiness Plan. These foundational concepts are steps toward expanding EV charging station networks and furthering EV adoption along multimodal transportation infrastructure and enhancing both public and private investment in charging stations.

INITIATIVES

Adapt

Adapt transportation infrastructure to advance electrified mobility.

Educate

Provide resources to share information and knowledge that enhance educational and outreach efforts to support SEMPO's goals.

Facilitate

Facilitate the transition of next-generation infrastructure through strategic investments and partnerships.

Coordinate

Engage other Metropolitan Planning Organizations (MPOs), communities, agencies, and stakeholders to coordinate best practices related to EVs.

INTRODUCTION

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INTRODUCTION

As the Electric Vehicle (EV) market expands, the Southeast Missouri region benefits in several ways: EVs help improve air quality, save consumers money, reduce greenhouse gas emissions, and foster new companies to grow and create jobs. As more Southeast Missourians purchase EVs, a robust regional charging infrastructure network will be necessary for supporting this growing market. Building this infrastructure in the Southeast Missouri region requires coordinated effort among local governments, the contractor community, businesses, residents, and local utilities.

The Southeast Metropolitan Planning Organization (SEMPO) Plug-in Electric Vehicle (PEV) Readiness Plan is part of a nationwide effort to prepare local governments for the deployment of EVs. The Readiness Plan builds on national efforts to promote regional PEV readiness, identifies barriers to the deployment of PEV charging infrastructure and includes recommendations and resources for public agencies, property owners, consumers and other stakeholders to overcome these barriers.

Southeast Metropolitan Planning Organization

SEMPO is a metropolitan planning organization (MPO), which is a federally mandated and funded policy-making organization that oversees transportation planning for an urbanized area (UA). As the MPO for the Cape Girardeau – Jackson UA, SEMPO is responsible for meeting the federal metropolitan planning regulations for the specified geographic area that includes the City of Cape Girardeau, the City of Jackson, and portions of Cape Girardeau County and Scott County, Missouri, and also portions of the Village of East Cape Girardeau and Alexander County, Illinois. SEMPO is comprised of a Board of Directors, a Technical Planning Committee (TPC), and the planning and administration staff.

The SEMPO Metropolitan Planning Area (MPA), as delineated by the SEMPO board of directors, contains the UA and portions of unincorporated, non-UA within Cape Girardeau and Scott counties in Missouri and Alexander County in Illinois. The MPA covers approximately 117 square miles; 111.7 square miles in Cape Girardeau County, 4.7 square miles in Alexander County, and 0.6 square mile in Scott County. **Figure 1** shows a map of the MPA.

SEMPO PEV Readiness Plan

The SEMPO PEV Readiness Plan was developed to support the growing market of PEVs in the region by enabling municipalities and others to address immediate needs and long-term planning objectives for the SEMPO region to become an EV destination, corridor, and gateway.

Multiple stakeholders, including public agencies, utility providers, property and business owners, charging station manufacturers, local automobile dealers, transit providers, fleet delivery services, and the public, among others, coordinated with the SEMPO TPC to help shape and inform the Readiness Plan. The Readiness Plan provides background and analysis of the SEMPO PEV market and assesses areas where local governments, businesses, workplaces, and residents can more easily adapt and better prepare for PEVs and charging infrastructure in the region. Importantly, this plan includes recommended solutions to reducing several of the following barriers identified for the SEMPO region:

The Readiness Plan identifies the complexities behind each barrier and provides guidance for municipalities to address these complexities, educate constituents and streamline permitting and other regulatory policies. Regional and statewide examples are provided throughout the document as model ways to overcome these barriers.

- Lack of EV and EV supply equipment (charging station) information
- Regional planning for public charging stations
- Charging station permitting/inspection
- Charging station at multi-unit dwellings (MUDs)
- Commercial and workplace charging stations
- Zoning and parking rules
- Building codes
- Training and education for municipal staff and electrical contractors
- On-peak charging and utility rates

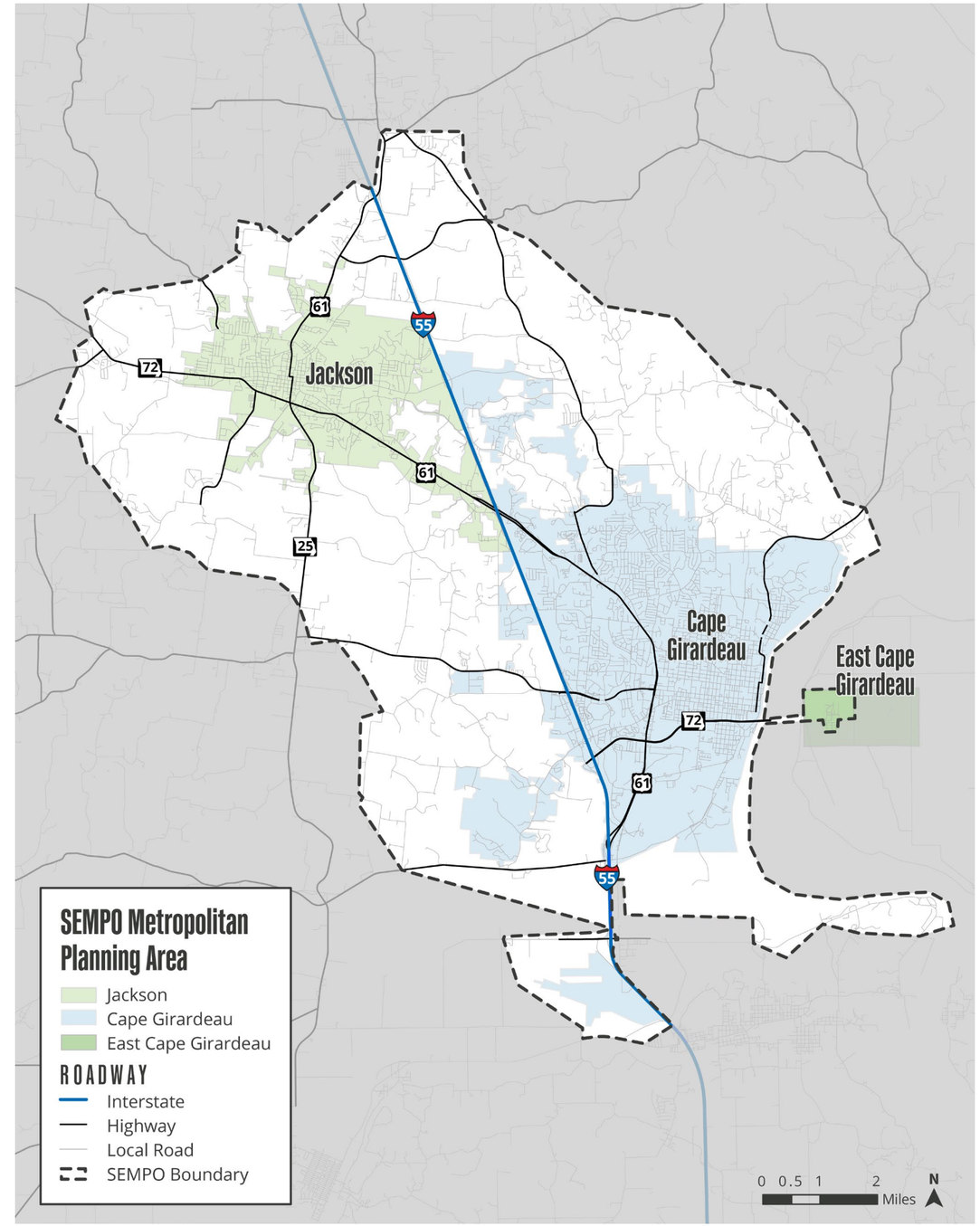


FIGURE 1 | SEMPO METROPOLITAN PLANNING AREA BOUNDARY

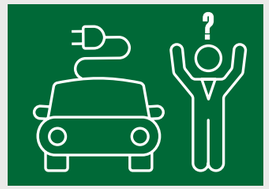
BENEFITS OF ELECTRIFIED MOBILITY

Transportation electrification provides opportunities to transform mobility by providing environmentally friendly and cost-effective travel options while promoting energy independence.

The transportation sector (automobiles) is one of the largest contributors of greenhouse gases (GHGs).

Lack of transportation energy diversity can lead to over-reliance on specific energy sources. This makes Southeast Missouri susceptible to changes (price fluctuations / availability) in the global energy market. EVs can be fueled by any power source.

One energy sector fuel source (for electricity generation) is natural gas. Natural gas is becoming more popular and is a cleaner fuel source compared with coal-based electricity. At the same time, Missouri utilities are rapidly investing in renewable energy sources, which could further reduce an EV's carbon footprint.

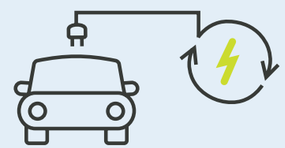


General lack of awareness / education and higher price points for new EVs has led to confusion about overall total cost of ownership. Significantly less maintenance and zero trips to the gas pump will help drive down costs of EVs over time.

THE BASICS OF PLUG-IN ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE

Types of EVs

EV technology is rapidly evolving; as batteries improve, more models become available, and the vehicles themselves become more affordable because EVs are powered by batteries rather than by gas. This section provides an overview of the types of EVs available, how EVs compare to gas-powered vehicles **(Table 1)** and what EV charging technology currently looks like **(Table 2).**

Battery Electric Vehicle (BEV)	Plug-in Hybrid Electric Vehicle (PHEV)
	
BEVs are fueled entirely by electricity stored in onboard batteries. The range of BEVs varies greatly between cars tailored for short commutes of 100 miles to luxury vehicles that can travel 500 miles or more. • Range: Up to 500 miles depending on make and model of car. The median among all models is 250 miles. • Primary user considerations: – Intercity travel	**PHEVs** are fueled in part by electricity stored in onboard batteries which have a short range. Once the battery energy is consumed the car uses a gas-powered engine. • Range: Up to 40 miles fully electric, then a combination of gas and battery power until the next charge. • Primary user considerations: – Short range commutes – Not limited in range by electricity

Gas-powered Vehicles vs. EV

When looking at EVs and gas-powered vehicles side by side, it can be difficult to spot the differences. These vehicles have many similarities; however EV's noticeably have no tailpipe for emissions. Under the hood, gas-powered vehicles have an engine made with several components fueled by the combustion of fossil fuels, typically either diesel or gasoline, and sometimes natural gas. EVs are powered directly by a battery, which has far fewer moving parts and requires significantly less maintenance over the course of ownership. No regular oil change is necessary, so other than balancing the tires, service mostly consists of refilling the windshield wiper fluid and checking the brake pads.

The range of a gas-powered vehicle depends on the fuel tank capacity in gallons, the vehicle efficiency in miles per gallon, and the availability of gasoline fueling stations. Comparatively, the range of an EV depends on the battery size in kilowatt-hours (kWh), the vehicle efficiency in miles per kWh, and the availability of charging infrastructure. In addition to these factors, cold temperatures and battery age both decrease battery capacity.

Today's EVs already produce significantly lower carbon emissions over the course of their lives than traditional gas-powered vehicles – even when accounting for all factors such as mining, manufacturing, power generation, and energy consumption. EVs have this advantage over gas-powered vehicles even though power generation and mining practices presently rely on fossil fuels in many cases. This lower carbon emissions benefit is expected to improve because these industries and utilities are setting ambitious decarbonization goals; for instance, the mining industry is adopting alternative drive trains for equipment and Ameren, a Southeast Missouri energy provider, is committed to becoming carbon-neutral by 2050.

One typically unaccounted for and often difficult to measure impact comes from the mining of the precious limited resource of rare earth metals for the batteries. Manufacturers are constantly searching for new, more efficient, and less impactful battery chemistries and methods to recycle used batteries. Globally, the battery recycling industry is quickly expanding and becoming more profitable. It currently has the capacity to recycle over 320,000 tons of material annually from spent batteries. In the future, expect hydrogen and renewable natural gas to become more prevalent in conversations regarding sustainable transportation, especially regarding medium and heavy-duty vehicles. The mining industry is currently testing fuel cell technologies for use with heavy machinery, and multiple fleets of hydrogen fuel cell electric buses are being tested in California.[1]

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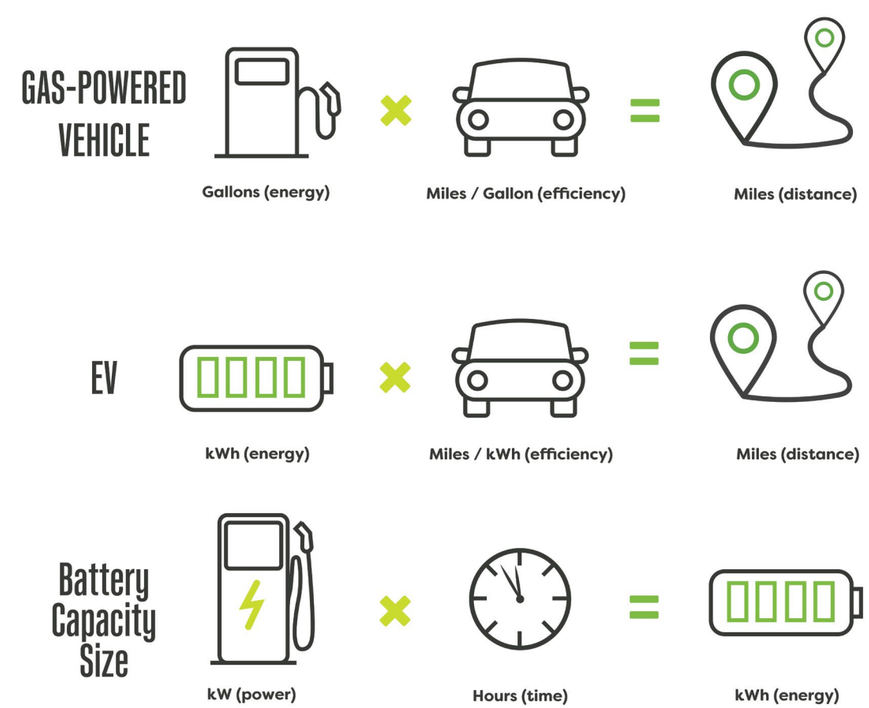
1 ***Sources:*** *Lithium-Ion battery recycling trends: https://pubs.acs.org/doi/10.1021/acsenergylett.1c02602*
Source: *Comprehensive evaluation of hydrogen fuel cell EVs: https://www.nrel.gov/hydrogen/fuel-cell-vehicle-evaluation.html*
Fuel Cell busses: *https://www.nrel.gov/docs/fy21osti/75583.pdf*

Conversions

Gas Powered Vehicle	Electric Vehicle (EV)
• Energy Type (diesel, gasoline, or natural gas)	• Energy Type (electricity)
• Efficiency (miles/gallon)	• Efficiency (miles/ kWh)
• Distance (miles)	• Distance (miles)
• Gallons (energy) * Miles / Gallon (efficiency) = Miles (distance)	• kWh (energy) * Miles/kWh (efficiency) = Miles (distance)
	• Battery Capacity Size: 30-200 kWh for Battery Electric Vehicles (BEVs) and 10 kWh for Plug-in Hybrid Electric Vehicles (PHEVs)

TABLE 1 | GAS-POWERED VEHICLE VS ELECTRIC VEHICLE (EV)



Charging Infrastructure

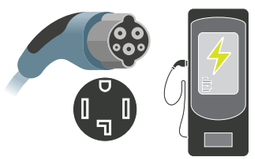
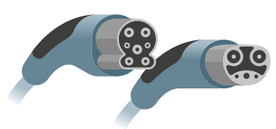
	Level 1	Level 2	Direct Current Fast Charger (DCFC)
CHARGE RATE	3-7 miles of range per hour	10- 60 miles of range per hour	175-500 miles of range per hour
CHARGING USE CASES	Overnight or emergencies	Charge overnight or while at work	Charge while shopping, going to the gym, or during interstate travel
SUPPLY VOLTAGE	120-volt outlet (toaster)	240-volt outlet (clothes dryer)	480-volt (small office building)
POWER LEVEL	15 amps	30 to 100 amps	Up to 250 amps
CHARGING CONNECTOR TYPES	Standard equipment for most battery electric vehicles (BEVs)	At home charging requires a 240-volt outlet and a charging adapter. These charging stations may also be available at work and in public spaces.	Public charging locations
CHARGER EXAMPLES			
INSTALL COST	$ Typically, the connector is included	$$ • $300-800 for a 240-volt outlet installation, if not already available. • $300-2000 for a charging adapter	$$$ Not available for residential installation
KEY TAKEAWAYS	• Access to charge in emergency situations is widely available. • Obsolete for commercial purposes.	Currently accounts for most of all charging demands.	Best used for long-range travel

TABLE 2 | CHARGING STATION TYPES

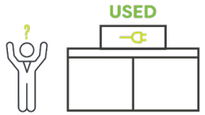
The charging ports above represent the most used technology. Some proprietary charging connectors are still used in the industry. When looking at purchasing an EV, be mindful of the compatibility between ports and connectors.

BARRIERS TO ADOPTION AND INDUSTRY TRENDS

Emerging technologies often face barriers to market acceptance. Some barriers are easily overcome through innovation and market forces while other barriers are persistent. Some major barriers are highlighted below.

EV Adoption Barriers

EV cost parity with gas powered vehicles – expected to occur short term (2025-2030)



No secondary market – limited amount of used EV inventory

Long-distance travel, multi-family housing, and lack of charging stations

Range anxiety

Lack of dealership knowledge, and willingness to suggest EVs, and lack of EVs available at dealerships

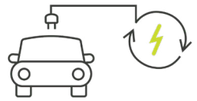
Lack of truck, SUV/ crossover EV models available on the market

Lack of current manufacturer and model options and vehicle availability. This is expected to improve 2022-2024

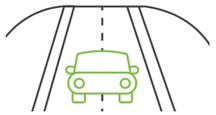
Charging Station Adoption Barriers

Low EV customer base

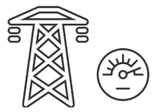
Lack of public awareness regarding charging station locations



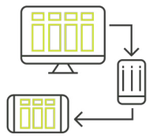
Charging station charging speed



Service providers locate charging stations where EV adoption is highest, creating gaps in under-represented communities



Utility demand charges



Lack of site-specific back-end utility infrastructure for Direct Current Fast Charger (DCFC) stations, especially in rural areas

Additional costs when providing back-up power at charging station locations for emergency evacuation

Long recharging times

EV Market Trends in the United States

A global market for EVs has been growing with a significant increase in sales starting in 2017 (see Figure 2). California has the largest annual sales percentage, with EVs accounting for over 6 percent of all vehicles sold in 2020. Several other states have reached annual EV sales percentages of 3-4 percent. The United States national average has increased slowly and is now just under 5 percent of annual vehicle sales with a goal of 50 percent by 2030.

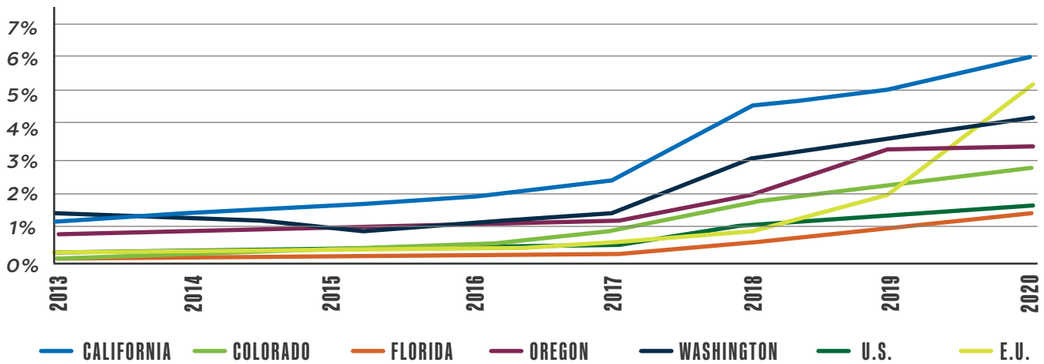


FIGURE 2 | ELECTRIC VEHICLE (EV) SALES

Cumulative Battery Electric Vehicle (BEV) Offerings by Vehicle Type

By the end of 2020, there were 17 BEV models on the market. By 2025, there will be at least 81 additional BEV models available to consumers. Because the EV market is still relatively new, a limited selection of vehicle types of EVs is available, especially sport utility vehicles (SUV), vans, and trucks. Automobile manufacturers are looking to change this, and have announced a diversified menu of electric cars, many of which are expected to be available in 2023.

Automobile Manufacturers are Going Electric

VOLVO
has pledged that 50% of its vehicle offerings will be EV by 2025.

GENERAL MOTORS
has pledged that all light-duty cars and SUVs will be EV by 2035.

FORD
expects that 40% of global sales will be EV by 2030.

VOLKSWAGEN
expects that 50% of US sales will be EV by 2030.

2021	2022	2023	2024	2025
20	38	44	46	50
3	10	13	15	18
1	9	11	13	13
24 MODELS	57 MODELS	68 MODELS	74 MODELS	81 MODELS

SEMPO EV STEERING COMMITTEE AND STAKEHOLDERS

Background and Purpose

Gathering information from the SEMPO region community allowed the Steering Committee to understand the current available resources, the performance of existing charging stations, and the need for future infrastructure. Multiple stakeholders, including public agencies, utility providers, property and business owners, charging station manufacturers, local automobile dealers, transit providers, fleet delivery services, and the public, among others, coordinated with the SEMPO Steering Committee to help shape and inform the Readiness Plan. Holding stakeholder interviews and online surveys throughout the course of this effort provided insight into the knowledge gaps, common misconceptions and potential opportunities within the SEMPO region. The full list of stakeholders is provided in *Appendix B – Engagement Results*. In general, feedback from participants showed they view EVs and the potential of transportation electrification in a positive light.

Summary of Stakeholder Engagement

Education, awareness, and community dialogue around EVs and infrastructure is paramount to the success of this Readiness Plan and will lay the groundwork to ensure widespread acceptance and approval of the recommendations crafted as part of this effort. Early in the development of the Readiness Plan, it was evident that a knowledge gap existed within the community around EVs. To jump start the number one recommendation in this Readiness Plan, to develop and implement EV education and awareness programs, the Project Team developed an engaging and thought-provoking survey.

Using an interactive online format, participants responded to specific questions about EVs, which helped the Project Team and the EV Steering Committee understand the community's current knowledge base regarding EVs. Published on the project website in November 2021, the online surveys were completed by over 50 individual stakeholders. The purpose of the survey was to gauge knowledge gaps while also gathering information about existing EV efforts in the SEMPO region that would help inform recommendations developed as a part of this Readiness Plan. See *Appendix B – Engagement Results* for the survey questions, answers, and a list of engaged stakeholders.

Key Findings from Public Survey Respondents			
Vehicle Ownership	**67%** own three or more vehicles		
Average number of miles driven on a daily basis	**35%** drive under 20 miles	**41%** drive between 20 and 50 miles	
Range of an electric vehicle (EV) on a single charge before EV purchase considered	**43%** less than 300 miles	**46%** between 300 and 500 miles	
Maximum charge time acceptable in order to consider purchasing an EV	**23%** less than 15 minutes	**31%** between 15 minutes and 1 hour	**29%** between 1 to 4 hours
Likelihood of owning an electric vehicle in the next 5-10 years	**57%** are likely to own an electric vehicle		
Age groups who completed the survey	**5%** under 25 years **24%** 25-39 years	**47%** 40-59 years **24%** over 60 years	

Key Findings from Primary Stakeholders	
Power Providers	• Ameren has a net-zero carbon goal for 2050. • Ameren has charging station incentives for workplaces, multi-unit dwellings (MUDs), and publicly accessible locations. • Citizens Electric does not currently offer charging station incentives.
Agencies and Municipalities	• City of Cape Girardeau has installed publicly accessible EV charging stations. • Jackson has not installed any EV charging stations to date.
Automobile Dealerships	• Some local dealers have sold EVs and can service EVs. • Local dealers have seen an increase in demand for EVs from their customers. • Some local dealers have expressed no interest in selling or servicing EVs.
Fleets (transit, delivery, etc.)	• Cape Girardeau County Transit Authority has six hybrid vehicles and has plans to convert its entire fleet to EVs. • Cape Girardeau County Transit Authority has plans to install EV charging infrastructure with the completion of its new facility, roughly expected in 2025.
Educational Institutions	• Southeast Missouri State University has an enrollment of 12,000 students with roughly 7,000 parking spaces. No charging stations are currently provided, though some students have inquired about them.
Businesses and Organizations (hotels, airports, hospitals, gas stations, etc)	• Local hotels, gas stations, and grocery stores have installed charging stations in recent years. • Local businesses have noticed an increase in demand for charging stations.
Electric Charging Station Providers	• Demand for charging stations has dramatically changed in the past 12 months. • Residential, commercial, and fleet providers have requested quotes for charging stations.

PEVS AND PUBLIC CHARGING INFRASTRUCTURE IN THE SEMPO REGION

PEVs in SEMPO Region

As of June 2021, there were more than 6,700 registered EVs in the state of Missouri per the National Renewable Energy Laboratory's data posted on the U.S. Department of Energy (DOE) website. EV registration data specific to the SEMPO region is currently not available.

Locations of public charging stations in the SEMPO Region

As of April 2022, there were 30 EV charging stations, 20 public Level 2 charging stations, and 12 public Direct Current Fast Chargers (DCFC) serving the SEMPO region. Locations and charging types are included in **Figure 3. Table 3** shows the location of existing EV chargers and their hours of operation, type of charger, connector type, facility type, and pricing.

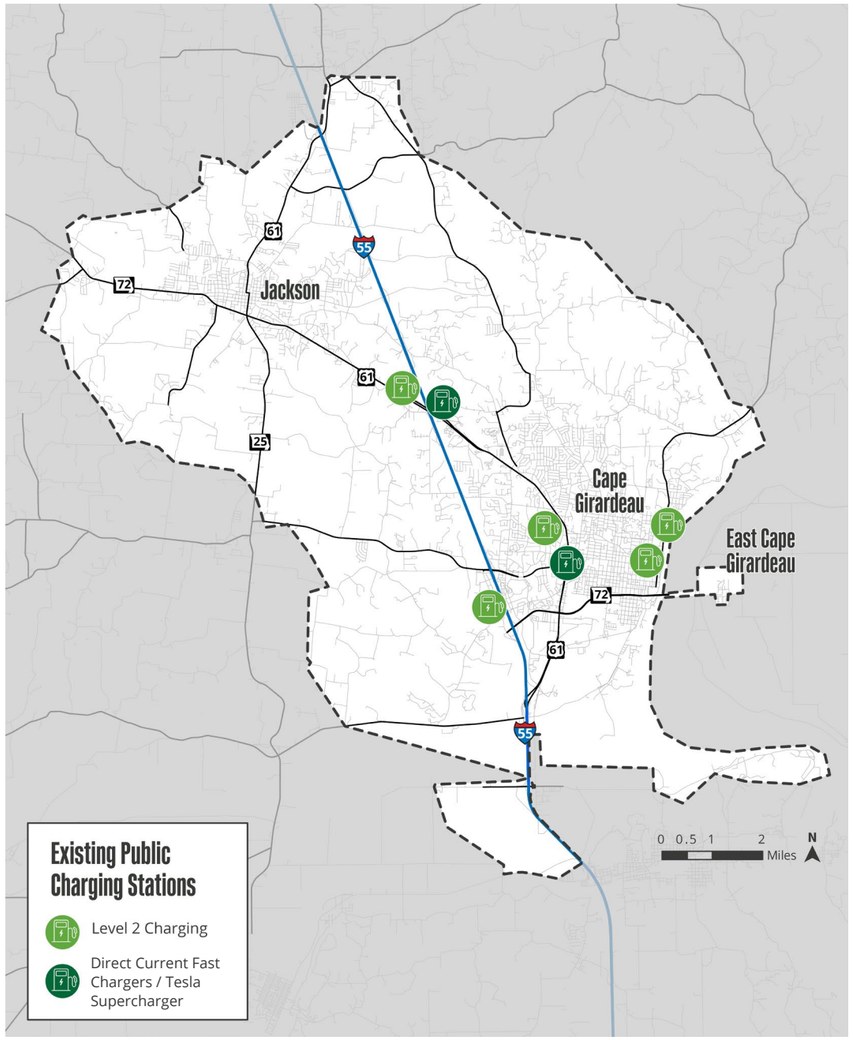


FIGURE 3 | SOUTHEAST METROPOLITAN PLANNING ORGANIZATION (SEMPO) REGION EXISTING CHARGING INFRASTRUCTURE

Station	Access	Hours	Level 1	Level 2	DCFC	Total	Network	Connector	Facility	Pricing
BEST WESTERN PLUS 3003 S Old Orchard Road, Jackson, MO 63755	Public	24 hours daily	-	2	-	2	Non-networked	J-1772	Hotel	Free
WINKS 2505 Veterans Memorial Drive, Cape Girardeau, MO 63701	Public	24 hours daily	-	-	8	8	Tesla	Telsa	Convenience Store	$0.34/ kWh
JOHN SINCLAIR NISSAN 478 Siemers Drive, Cape Girardeau, MO 63701	Public	Dealership business hours	-	2	-	2	Non-networked	J-1772, Wall Plug	Car Dealer	Free
AC BRASE ARENA 410 Kiwanis Drive, Cape Girardeau, MO 63701	Public	8am-5pm	-	8	-	8	Non-networked	NEMA 14-50, Wall Plug	City Park	$10 a day
CAPE GIRARDEAU CITY HALL 44 N Lorimier Street, Cape Girardeau, MO 63701	Public	24 hours daily	-	2	-	2	Non-networked	J-1772	City Hall	Free
SCHNUCKS 25 S Kingshighway, Cape Girardeau, MO	Public	24 hours daily	-	2	4	6	ChargePoint	CCS/SAE, CHAdeMO, J-1772	Grocery Store	$0.25/ kWh
CENTURY CASINO 777 N Main Street, Cape Girardeau, MO 63701	Public	24 hours daily	-	4	-	4	ChargePoint	J-1772	Casino	$0.25/ kWh
**Charging Infrastructure in SEMPO Region as of 04/30/2022.*			**0**	**20**	**12**	**32**				

TABLE 3 | SOUTHEAST METROPOLITAN PLANNING ORGANIZATION (SEMPO) EXISTING CHARGING INFRASTRUCTURE INVENTORY

Finding public charging infrastructure

Drivers typically use websites or mobile applications to locate public charging stations. EV drivers can find these charging locations by using several online resources. Additionally, each charging network (e.g. ChargePoint, Tesla, etc.) has its own web-based or mobile application to help its members find network-specific charging locations. Resources for locating public charging stations are provided further below in **Table 4**. Locating charging stations during regional travel is a crucial resource for EV owners, especially for the SEMPO Region given the significant amount of major metropolitan cities like Memphis, St. Louis, Louisville, and Indianapolis all within 400 miles of the SEMPO Region as shown in **Figure 4** and **Table 5**.

Charging Infrastructure Source	Description	Website
Plugshare	Available online or through a mobile application. Users can leave reviews on public chargers and have their own residential chargers displayed on the map.	https://www.plugshare.com/
Alternative Fuels Data Center Station Locator	Displays hours of availability and number of charging units per site. Allows end users to add new stations.	http://www.afdc.energy.gov/locator/stations
Open Charge Map	Displays hours of availability and number of charging units per site. Allows end users to add new stations, leave reviews, and photos.	https://openchargemap.org/site
ChargeHub	Available online or by a mobile application. Users can leave reviews on public chargers including photos.	https://chargehub.com/

TABLE 4 | FINDING PUBLIC CHARGING INFRASTRUCTURE

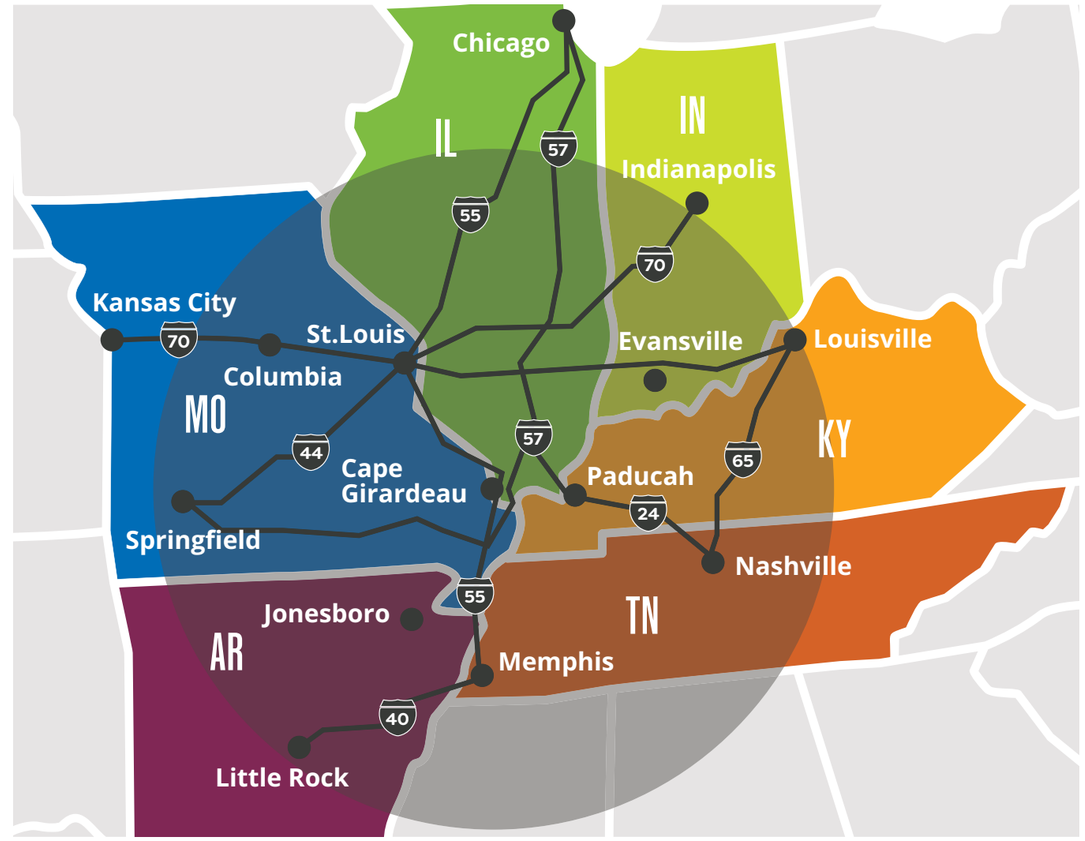


FIGURE 4 | REGIONAL CONTEXT MAP

Paducah	70 Miles	1.50 Hours	Springfield	270 Miles	4.25 Hours
St. Louis	118 Miles	2.00 Hours	Louisville	274 Miles	4.00 Hours
Evansville	141 Miles	2.75 Hours	Little Rock	289 Miles	4.00 Hours
Jonesboro	151 Miles	2.50 Hours	Indianapolis	305 Miles	4.50 Hours
Memphis	172 Miles	2.50 Hours	Kansas City	349 Miles	5.00 Hours
Nashville	202 Miles	3.25 Hours	Chicago	374 Miles	5.50 Hours
Columbia	225 Miles	3.25 Hours			

Circle Shows 250-mile Radius of Electric Vehicle on Single Charge from Cape Girardeau

TABLE 5 | DISTANCE FROM CAPE GIRARDEAU TO SURROUNDING REGIONAL CENTERS

REGIONAL PLUG-IN ELECTRIC VEHICLE INFRASTRUCTURE EXISTING CONDITIONS

PEV infrastructure in the SEMPO region is rapidly evolving with local governments, homeowners, multi-unit property managers and local businesses playing a crucial role. This section will highlight the existing conditions and what is already being done around PEV infrastructure in the SEMPO region.

Local Government

Local governments set the tone for how PEVs are adopted into communities and how infrastructure will expand to support PEVs primarily through planning efforts or regulatory compliance.

Cape Girardeau and Jackson

The City of Cape Girardeau and the City of Jackson do not yet have policies specific to EVs and PEV infrastructure. However, the SEMPO Metropolitan Transportation Plan (MTP) has identified EV readiness as a priority, which is the basis for this EV Readiness Plan.

By starting from scratch, Cape Girardeau and Jackson can implement best practices that have been successful for other communities. Much of this effort is accomplished by integrating charging station installations into streamlined building permit processes, pre-wiring for installation into public projects, and identifying limitations in zoning codes that may inhibit public charging station installations. These opportunities are further expanded in the *Regional Barriers to Charging Station Deployment and Key Recommendations* section of this document.

St. Louis City and County

Regionally, several bills and ordinances that affect the availability of PEV infrastructure have been enacted. One of these efforts is an ordinance in St. Louis and St. Louis County that requires "EV Ready" (EVR) parking spaces for all new single-family buildings. New requirements are also in place for new construction and "Level 3 Alterations" (50 percent of building areas being reconfigured) for commercial projects. These requirements mandate a certain number of EVR spaces and charging stations, depending on the size of the project and the number of required parking spaces. These are a few examples of communities around the region implementing new practices to support EVs.

Single-family Residences

Charging behavior studies clearly indicate that most PEV drivers charge their vehicles at home. Many PEV drivers who have single-family homes will find a standard household outlet (120 voltage, alternating current [VAC]) available for charging where their vehicle will be parked. However, some PEV owners install a dedicated Level 2 (240 VAC) charging station to charge their vehicle. The installation of a Level 1 or Level 2 charger does not currently require a permit from any of the local jurisdictions or utility providers in the SEMPO region.

Developing a charging station permitting and installation process for homeowners has been proven to help reduce barriers to home charging and further PEV adoption. Training and information tailored for homeowners is also essential to easing concerns and informing PEV drivers. A common way these practices have been implemented in other communities around the country is by offering a home charger station purchase incentive program that is managed by local power utility providers to help facilitate the adoption of PEVs while standardizing the permitting and installation processes.

Multi-unit Dwellings

As noted, most drivers charge their PEVs at home; however, multi-unit dwellings (MUDs) offer a unique set of challenges. Shared utilities, parking designations or restrictions, and design and infrastructure hurdles make charging station installations at MUDs more complex. To date, no local governments, developers, or property owners in the SEMPO region have conducted any educational or outreach activities. Training, education, and outreach activities with all MUD stakeholders (local governments, developers, and property owners) will play a crucial role in expanding charging options for MUD PEV drivers. Recommendations specific to MUDs will be highlighted in the *Regional Barriers to Charging Station Deployment and Key Recommendations* section of this document.

Workplace, Retail and Public Locations

PEV drivers are limited by the range of their vehicle. Although most veteran PEV drivers are aware of their vehicle's range, others experience range anxiety, which can hinder their decision to purchase a PEV or make them less likely to drive one they have purchased. Several local retailers, workplaces, and public destinations now have charging stations available to their customers, employees and the public. Expanding charging options for PEV drivers will continue to play a critical role in broadening the range and number of PEV owners.

Charging station installations at workplace, retail, and public locations will continue to expand the existing charging network and give PEV drivers options similar to those available to drivers of traditional gas-powered vehicles. Contractor and business owner training, education and outreach will be crucial to encouraging the decision to install charging stations. Permitting processes, construction, and electricity costs are also concerns for local business owners and can impede charging station installations. One-way local governments can help is to provide employees and customers EV-charging infrastructure on public property, thereby leading by example and filling gaps in the charging network.

REGIONAL BARRIERS TO CHARGING STATION DEPLOYMENT AND KEY RECOMMENDATIONS

As stated previously, barriers exist for regional charging infrastructure installations and PEV adoption. This section details the types of PEV charging stations currently available and discusses considerations, by land use type, and how the barriers can be overcome.

Regional Planning for Public Charging Stations

Overview

Collaborative planning for regional charging infrastructure is necessary to establish a cohesive and interconnected charging network. Such planning efforts include assessing priority locations, establishing optimal land use, providing access, and understanding driver behavior. Defining the needs and establishing ideal locations to support charging stations that benefit PEV drivers have to be done on a large scale to be effective and functional.

Classifying local land use statistics for PEVs

Understanding local land uses and PEV driving habits helps identify optimal locations for charging stations and the appropriate type of charging station required. **Table 6** describes the different types of charging stations and the applications for which they are best suited.

Charging Station	User Profile	Typical Venues	Charging Time	Miles/Hour Charge
Level 1	Parked for 6 to 8 hours	Streets/Meters	1 to 2 hours	3 to 7
		Parking Garages	2 to 10 hours	
		Cultural & Sports Centers	2 to 5 hours	
		Airports (long term) & Hotels	8 to 72-plus hours	
Level 2	Parked for 2 to 4 hours	Shopping Centers	0.5 to 2 hours	10 to 60*
		Airports (short term)	< 1 hour	
		Streets/Meters	1 to 2 hours	
		Parking Garages	2 to 10 hours	
		Cultural & Sports Centers	2 to 5 hours	
		Airports (long term) & Hotels	8 to 72-plus hours	
		Highways & Commuting Roads	< 0.5 hour	
Direct Current Fast Charging (DCFC)	Parked for 15 to 60 minutes	Shopping Centers	0.5 to 2 hours	175 to 500*
		Airports (short term)	< 1 hour	
		Highways & Commuting Roads	< 0.5 hour	

**Depending on vehicle onboard charger.*

TABLE 6 | CHARGING STATION TYPES AND APPLICATIONS

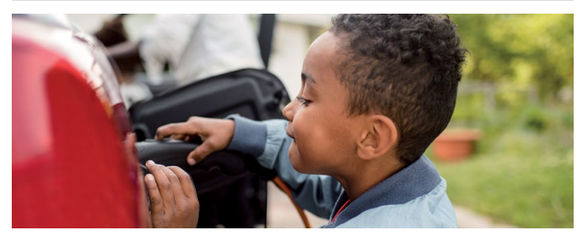
Land use/parking analysis for charging stations

Parking requirements specific to individual land uses are established by local jurisdictions and often determined through a formula relative to the use or service being provided at the site and the size of the use in conjunction with state and federal mandates, such as those addressing accessibility. All these factors are important to consider when assessing the potential parking availability for charging stations. The information in **Figure 5** is commonly referred to as industry best practices for assessing parking opportunities for consideration in PEV land use planning and was developed by UCLA Luskin Center.

STEP 1	Assessing absolute and relative number of hosting opportunities by land use classification
STEP 2	Assess number of parking spaces by land use type to adjust comparison of land use opportunities
STEP 3	Prioritize planning reforms and technical assistance programs according to local opportunities
STEP 4	Inventory parcels to identify building types offering cost-effective charging opportunities

Source: UCLA Luskin Center, Southern California PEV Readiness Plan

FIGURE 5 | STEPS IN PLUG-IN ELECTRIC VEHICLE (PEV) LAND USE ASSESSMENT

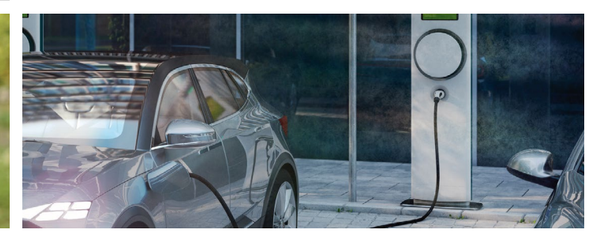


Public EV charging stations

Public charging stations and an integrated charging network are critical to regional PEV adoption. Reducing range anxiety and providing more opportunities for drivers to charge their vehicles will support increased PEV adoption rates. Local governments play a crucial role in expanding the regional charging network and in ensuring connectivity among driving corridors. Challenges to installing public charging stations include electricity costs and accessibility, operation, and maintenance needs.

To aid local governments, public agencies, and businesses with the procurement of installation and operation of EV charging stations, a standardized request for proposal (RFP) template is recommended for the SEMPO region.

By having standardized equipment specifications, contractor minimum qualifications, and a general scope of work, agencies can minimize efforts, reduce risk, and reduce liability while taking advantage of consistent text that has already been vetted through other local agencies for the installation and maintenance of public charging stations. Example RFP's and templates are provided in Appendix A.



Permitting and Charging Practices for Charging Stations

Overview

The permitting process is very influential in encouraging or hindering charging station installations. The SEMPO region does not currently have a single, regional standard permitting or installation process related to charging stations. The following section describes critical components of permitting and installation processes and identifies opportunities to expand charging station installations and best practices for specific charging stations.

Permitting charging station installations at residential locations

Permitting for installing a charging station at a residential location varies depending on the type of charger. Level 1 chargers do not currently require any notification or permit to be installed in the SEMPO region. However, installing a Level 2 or DCFC charging station requires you to notify the local power provider prior to installing. There is, however, no standard permitting process established to date.

Local jurisdictions in the region should work together to develop guidance and a streamlined permitting process to assist permit applicants with permitting, installation, and inspections for charging stations.

Table 7 contains recommended supporting documents for residential charging station permit applications. This information is based on research of best practices throughout the country.

Permitting charging station installations at commercial locations

The installation of a charging station at a commercial location is typically more complex than one at a residential location and may require additional permits or documentation. Some additional considerations for commercial charging station installations include the following:

- Zoning
- Community or Design Guidelines
- Existing Use Permits
- Electrical Source and Metering
- Parking and Signage
- Permit and Inspection Fees

A simple commercial charging station installation may have similar permitting requirements as a residential installation. However, a more complex commercial installation may require a modification to an existing use permit or a site plan addressing specific community or zoning design criteria. It is important to meet with staff from the building, and if necessary, planning departments of the permitting jurisdiction to fully understand all the necessary requirements and fees prior to applying for permits.

Supporting Documentation	Description
Plot Plan	Identify the complete layout of existing parking spaces and the proposed location of charging station parking space(s) with respect to existing buildings and structures
Electrical Load Calculations	Home electrical load calculations estimate whether an existing electrical service will handle the extra load from a residential charging station and the necessary wiring methods based on the National Electrical Code (NEC).
Electrical Plans	Single-line diagrams showing the system, point of connection to the power supply, and charging station.
Charging Station Information	The charging station manufacturer's installation instructions and charger specifications.

TABLE 7 | RECOMMENDED SUPPORTING DOCUMENTS FOR RESIDENTIAL CHARGING STATION PERMITS

Permitting Charging Station Installations at Multi-Unit Dwelling (MUD) Locations

MUD is a generic term for a variety of multi-unit residence types. These include (but are not limited to) apartment buildings, attached and detached housing units within a community, high-rise buildings, mobile home communities, and others. Installing charging stations at MUDs presents several unique challenges. **Table 8** summarizes the barriers to charging station installations at MUDs.

Barrier	Description
Cost	Installation costs can range anywhere from $2,000 to $10,000. A building that has sufficient panel capacity and existing conduit running from the panel to the Plug-in Electric Vehicle (PEV) parking space will likely only incur charging station, permit and electrician installation/assessment costs, resulting in a lower-cost installation. On the other hand, a building with limited panel capacity, no conduit, and a parking space located a significant distance from the electrical panel will likely incur higher installation costs.
Power Supply	Transformers supplying power to multifamily buildings typically have 10 percent to 15 percent excess capacity, or overhead, which is enough to sustain a few electric vehicles. However, as PEV adoption grows and vehicles are equipped with higher charging loads, these transformers may be insufficient to handle a wide-scale conversion of electric vehicles.
Proximity to Metering Equipment	Service panels for multi-unit dwellings (MUDs) can be located substantial distances from where the charging station is to be installed.
High-Rise Units	In high-rise units, meter rooms are often located on the upper floors and conduit space is limited. Challenges are faced in installing additional conduit and/or encountering physical limitations (e.g., drilling through concrete floors).
Parking	Parking is not standard across MUD building types. In some MUDs, parking is bundled into the rent or sale price of the unit. In other buildings, parking is unbundled or paid for separately. Unbundled parking spaces can be assigned on a first-come, first-served basis, or they can be unassigned. A charging station tied to a bundled parking space could be added value to a future tenant; however, a charging station on an unbundled or unassigned spot may pose challenges for assigning costs to individual owners. Choice of spaces also must address issues with proximity to metering equipment as addressed above.
Electricity Rates and Meters for Common Areas	Parking garages/lots are typically on a common meter. This means electricity provided in parking garages and other common areas is paid by the property manager or HOA and then billed to residents through HOA fees or rent. This creates a challenge in allocating charging costs to individual owners.
Homeowner Associations (HOAs)	HOAs cannot prohibit or restrict the installation of a PEV charging station. Senate Bill 880 codified this and other provisions for charging installations in common areas. However, HOA boards may still resist installations. Lack of information regarding charging station installations remains a signification barrier.

TABLE 8 | BARRIERS TO CHARGING STATION INSTALLATIONS AT MULTI-UNIT DWELLINGS

Best practices and recommendations to help address barriers to charging station installations at MUDs have been organized from similar EV readiness plans from around the country and are included below.

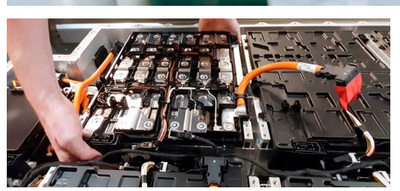
These recommendations can serve as a resource for local governments, residents, building managers, homeowner associations, and apartment associations that are assisting with the siting of charging stations at MUDs.

REACH OUT TO BUILDING MANAGEMENT OR HOA

- Because EV chargers will likely be installed in common areas, it is important to engage the building management or HOA early in the process. Identify any existing rules in the covenants, conditions and restrictions that could affect the installation of charging stations.

DETERMINE DEMAND FOR EV CHARGER INSTALLATIONS

- Survey residents to gauge their interest in purchasing a PEV. This survey will help determine the number of charging units and/or amount of conduit to install and in what layout(s). Identify demand for Level 1 versus Level 2 charging. Planning ahead by installing extra capacity for future charging units can save on costs down the road.



ALLOCATE COSTS

- It is important to establish how EV charger installation, operations, maintenance, insurance, and electricity bills will be paid. How costs are allocated will depend on how the chargers are installed. Potential options include the following:
  - Chargers in assigned spots: Individual meters installed for each charging station and the resident covers the actual charger cost, billing, insurance, and maintenance of the unit. Installation costs for the meters, panel upgrades and conduit can either be covered by management or the resident, or the cost can be shared.
  - Common area chargers for residents only: Building management installs charging stations in common areas and recoups costs from residents through a billing system in the charger.
  - Common area chargers for residents and the public: Building management installs charging stations in public common area and recoups costs from residents and the public through a billing system in the charger.

SITE EV CHARGERS

- Identify the location and type of electric metering and wiring in the parking area. Determine if the existing supply is adequate or if a meter/panel upgrade is needed. If an upgrade is required, consider the capacity needed to accommodate additional PEV chargers in the future. Contact the building/planning department to discuss any permits or requirements that should be considered when sitting chargers.

PROVIDE POWER SUPPLY FOR EV CHARGERS

- The closer the charging station is to the power supply, the lower the installation costs will be.
- Installation costs will increase if a panel meter installation upgrade is necessary. The power supply needs for Level 1 and Level 2 charging stations are as follows:
  - Level 1: Dedicated branch circuit with NEMA 5-15R or 5-20R receptacle
  - Level 2: Dedicated branch circuit hardwired to a permanently mounted charging station with 240VAC/single phase, 4-wire

Charging at Commercial and Public Sites

Though most PEV charging happens at home and work, charging stations at commercial and public locations complement a driver's daily commute needs, offer flexibility in traveling and maximize electric miles driven. As PEVs become more prevalent, the demand for diverse charging station options will increase.

Factors for consideration when providing chargers at commercial and public locations are detailed below.

DOES YOUR BUSINESS OWN OR LEASE ITS FACILITIES?

- Building owners: Commercial sites that own the facility and parking area will encounter fewer challenges when developing a plan for vehicle charging. Key stakeholders should be engaged earlier in the process, including PEV drivers, operations supervisors, building/facility managers, facility technicians, and legal counsel
- Building tenants: Commercial sites that lease their facility will likely require tenants to obtain an agreement from the building or property owner. If an agreement cannot be reached with the owner, look to partner with a neighboring parking lot owner or another business to develop a cooperative PEV charging program.

WHAT TYPE OF CHARGING IS NEEDED?

- Business owners should determine the appropriate charging levels based on the electrical capacity available at their facility, and refer to **Table 6** to determine the appropriate type of charging infrastructure based on the corresponding land use of the site.

WHO WILL PAY FOR THE CHARGING?

- Business owners can choose to cover electricity costs and allow consumers to charge their vehicles for free, or a business may want to recoup some or all the electricity costs by requiring consumers to pay for their charging.

Charging at the Workplace

The SEMPO region has a growing population of PEV drivers who are likely to require charging during the workday. Because the workplace is where these PEV drivers spend most of their time outside of home, expanding workplace charging opportunities will allow commuters more flexibility and maximize EV miles traveled.

The choice to add workplace charging is often conflicted between the value proposition of wanting to provide charging as an employee benefit and the up-front and long-term costs associated with the stations. Documenting and sharing workplace charging experiences and lessons learned with regional stakeholders can help encourage other employers to offer workplace charging. There are benefits to offering Level 1 charging stations at the workplace as a less expensive alternative to Level 2 charging stations. Providing Level 1 charging requires less electricity and is ideal for a workplace, where drivers are usually parked for longer times.

Standardized regionally recognized permit processes and procedures for commercial and workplace charging station installations could reduce the time, costs, and confusion associated with workplace charging, and it is recommended for further consideration by SEMPO.

Zoning for Parking Policies and PEVs[2]

Overview

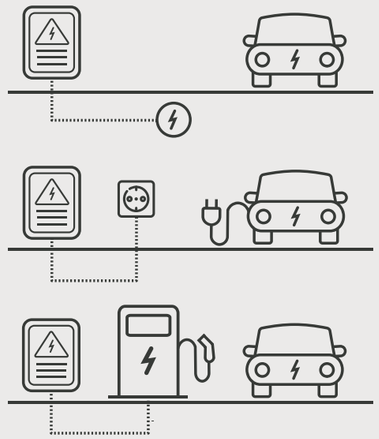
Zoning and parking policies help prescribe where and what types of development can occur within each jurisdiction and play a critical role in charging station deployment. Parking requirements defined by individual zoning ordinances or existing developments offer challenges to property owners or project developers when trying to identify optimal charger locations and capacity for such stations.

2 Sources: MUTCD: Manual on Uniform Traffic Control Devices (MUTCD) - MUTCD News Feed - FHWA (dot.gov)
DOE PEV Wayfinding Standards: https://afdc.energy.gov/fuels/electricity_charging_station_signage.html
Article 1. GENERAL PROVISIONS, Chapter 30. ZONING, Code of Ordinances, Cape Girardeau (elaws.us)

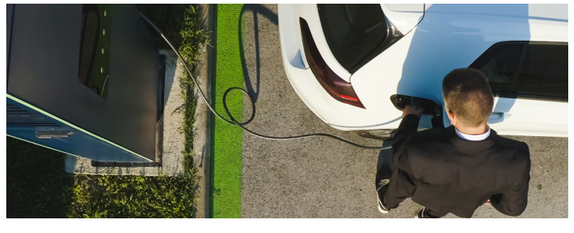
Charging stations and ADA accessible parking spaces:

1. It is important to consider ADA (Americans with Disabilities Act) accessible parking spaces when planning for charging station installations. Charging stations should be provided for both accessible and non-accessible spaces.
2. Charging stations for accessible spaces should display signage that indicates they are reserved for ADA accessible parking permit holders.
3. Charging stations for accessible spaces must be designed and installed in an ADA compliant manner, including access and operation.

EV Readiness requirements are recommended to be developed and categorized into the following three levels:



1. **EV Capable:** These parking spaces prepare for future charging station installation by providing dedicated electrical capacity in the service panel (40 amp breaker for every two EV-capable spaces) and conduit to the EV-capable space. These spaces do not require wiring to the space or a receptacle.
2. **EV Ready:** In addition to the EV-capable requirements, conduit is provided to each space with a 240-volt outlet receptacle.
3. **Charging Stations Installed:** These parking spaces are reserved for EVs and provide drivers the opportunity to charge their EV using EV charging stations rated at a minimum of 32 amp 7.2 kilowatts (kW). These spaces should be installed per the requirements of the NEC (NFPA 70) as adopted by the City of Cape Girardeau and Jackson.



Zoning Ordinance Changes

Zoning ordinances offer an ideal mechanism for local governments to define opportunities for charging station installations through development. Currently, none of the jurisdictions in the SEMPO region have mandatory charging station development requirements.

It is recommended that SEMPO jurisdictions add language and definitions to their zoning ordinances so when new development occurs, developers are using consistent language and standards that promote the development of charging stations.

Accessibility

The Americans with Disabilities Act (ADA) has specific access requirements to ensure that parking spaces accessible to persons with disabilities are provided in public, business, and non-profit parking facilities; however, these requirements have presented a number of challenges to charging station installations. There are currently no mandatory requirements for incorporating charging station-specific parking spaces in development projects.

Individual jurisdictions can develop standards for application within their own boundaries if they choose.

PEV Signage

Wayfinding signage helps PEV drivers navigate to charging stations from other locations, such as a freeway exit.

The Federal Highway Administration (FHWA) defines minimum standards for signage, which it publishes in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD standards apply to signage on all public highways, streets, bike-ways, and private roads open to the public, such as roads internal to shopping centers or airports. The current MUTCD was published in 2009, but a new version is due to be published no later than May 15, 2023.

The MUTCD is being completely rewritten and is expected to include standards on PEV signage; for the time being, the FHWA has approved the following interim designs for charging stations.

D9-11bp

D9-11b

These designs can be combined with directional arrows and mileage for wayfinding purposes. Additionally, signage can be used to designate parking used only for PEVs that are actively charging, or for place time limits.

To be enforceable, any signs posted in public right-of-way must be supported by local ordinances that specify time limits, penalties, and definitions. Pavement markings painted on the surface of a parking space can be used to reinforce signage for charging stations, but most jurisdictions deem pavement markings unenforceable on their own.

Building Code Changes[3]

Overview

Updating local building codes to accommodate charging stations can help overcome barriers to PEV adoption. Mandatory building codes can promote PEV by requiring prewiring for charging equipment and dedicating a percentage of parking spaces for PEVs.

The first step toward making building codes more charging-station friendly is to increase understanding about how building codes are updated among jurisdictions. The State of Missouri has not adopted statewide energy codes or statewide building codes. Numerous municipalities and counties throughout Missouri, such as the SEMPO region, have independently adopted the International Residential Code (IRC), the International Building Code (IBC), and the International Energy Conservation Code (IECC). These codes can be used strategically with best practices found in comparable regions to avoid the difficult process of writing and validating new code.

As deemed appropriate, the SEMPO region jurisdictions may also choose to adopt section 429 of the IBC which discusses recommendations for PEV charging infrastructure. Recommended parking requirements for EVs based on land uses included in the recently updated section 429 of the IBC is provided in **Table 9**.

3 Sources: orlandoevreadyguide_2021.pdf
Sec. 65-22. - Off-street parking and loading regulations. | Code of Ordinances | Jackson, MO | Municode Library
ARTICLE II. - OFF-STREET PARKING | Code of Ordinances | Cape Girardeau, MO | Municode Library
Missouri Building Code - Permit Place
Missouri State and local officials make requirements for electric vehicle charging stations more realistic | Missouri | thecentersquare.com

Recommendations

The SEMPO region can support charging station deployment by amending the Cape Girardeau and Jackson municipal codes. An effective first step would be to adopt a framework for requiring prewiring for charging stations and a number of charging stations installed spaces for development with the following conditions:

- All newly constructed residential and nonresidential buildings.
- Major remodeling affecting more than 25 percent of the existing building. (Excludes building repairs)
- Parking lot alterations affecting more than 50 percent of the existing parking lot.

Type	EV-capable Spaces	Charging Station Installed
Certified affordable multifamily housing	20%	Not Required
Multifamily, hotel	20%	2% *(requirement begins at 50 spaces)*
Non-residential ***(offices, retail, public, recreational, and institutional uses)***	10%	2% *(requirement begins at 250 spaces)*
Industrial ***(employee parking only)***	10%	2% *(requirement begins at 250 spaces)*

TABLE 9 | RECOMMENDED PARKING REQUIREMENTS FOR ELECTRIC VEHICLES (EV) BASED ON LAND USES

Education and Outreach

Overview

To facilitate the adoption of charging station installations and PEV usage, it is crucial that all relevant stakeholders (e.g., electrical contractors, property owners, utilities, and local government staff) are fully aware of charging station infrastructure installation requirements and potential challenges. Developing outreach activities specifically targeted to PEVs and charging stations will help local government staff, electrical contractors, and other stakeholders to be informed on how to execute seamless inspection and installation processes.

Local Government Staff

Several training and workshop opportunities are available and have been tailored to the specific needs and interests of local government staff. The Electric Vehicle Infrastructure Training Program (EVITP) is one of the organizations that provide training opportunities for local government staff. The EVITP program provides a comprehensive training for the installation of EV supply equipment as well as a full overview of the electric vehicle industry including an extensive section on customer relations and customer satisfaction.

As training needs evolve overtime for the region, it is recommended that SEMPO work with EV-related training providers to bring information to local government staff in the region.

Local Contractors

Local contractors and businesses are often exploring opportunities to expand the scope of their services to remain current and capable of meeting the needs of the existing market. Learning how to install charging stations is one way to drive the local economy toward an electrified future that supports local contractors and local jobs.

The Electrical Vehicle Infrastructure Training Program provides training and certification for contractors and electricians interested in installing charging stations. The program is coordinated by the United States Department of Energy (DOE), the International Brotherhood of Electrical Workers (IBEW), and the National Electrical Contractors Association (NECA), and is offered at community colleges and local electrical industry training centers.

SEMPO should work with local educational institutions to offer this training in the region.

First Responders

First responders encounter PEVs, whether it is on the scene of an accident or when assisting a stranded motorist. It is vital they have knowledge about the technology and learn how to safely remove a passenger and tow a vehicle off the road. Several private providers, such as the National Fire Protection Association (NFPA), offer specific training geared to first responders to ensure they are properly equipped when encountering a PEV on the road.

As PEVs become more prevalent in the SEMPO region, it is recommended that special PEV training be provided to first responders.

Utility Impacts and Considerations

Overview

The shift from gas-powered vehicles to EVs is a fundamental shift in the type of energy we use for transportation. Over time, we will depend less on gasoline and more on electricity. This growing reality requires a deep look into the impacts on these utilities. The shift also highlights the importance of sound system planning and an exceptionally reliable electrical grid that will be needed to carry the additional load.

The SEMPO region is currently served by three primary utilities; Ameren, City of Jackson, and Citizen's Electric. Two other providers, Black River Electric Cooperative and SEMO Electric Cooperative also cover small portions of the region. The coverage areas for each are shown in

Figure 6. As part of our outreach efforts, the project team interviewed Ameren and Citizen's Electric. Both companies are excited and willing to partner with agencies in the region to prepare for greater EV adoption. Ameren has already taken many steps to prepare its network and its business structure and has services available to assist with fleet transition efforts. Detailed information can be found at their website: https://www.ameren.com/missouri/residential/electric-vehicles.

Electrical Grid Challenges

An increased number of EVs introduces several challenges to our current electric infrastructure. A few of these challenges are described as follows.

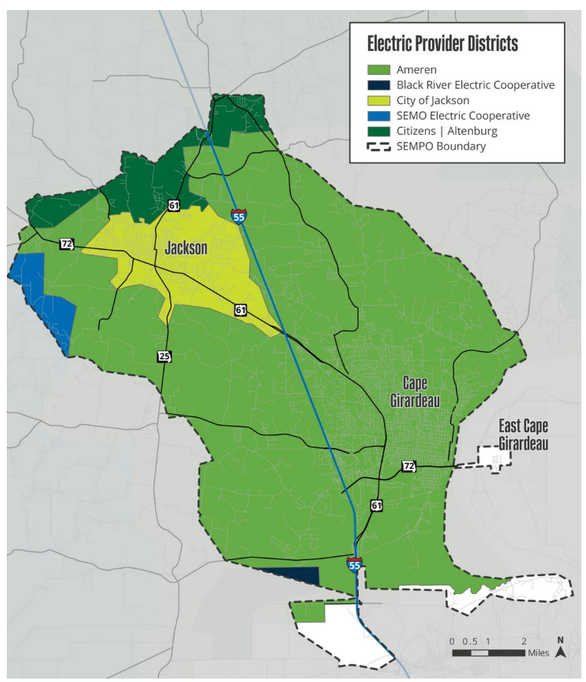
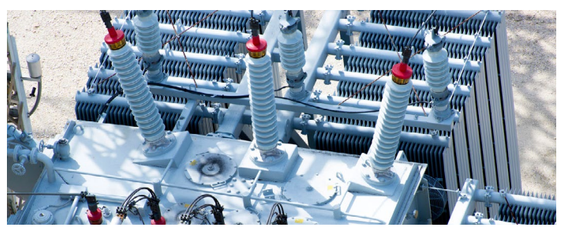


FIGURE 6 | ELECTRIC PROVIDER DISTRICTS



- **Charging time.** The peak load for energy usage is in the evening, roughly from the time most people get home from work until they go to bed. If people come home and immediately plug in their EV to charge, they will amplify the peak demand to even higher values. Many utilities are looking at ways to delay EV charging to off-peak times, such as the middle of the night.
- **Grid Condition.** Throughout the country, a significant portion of the electrical grid equipment and infrastructure is well beyond its original design life. Keeping prices low for consumers has provided enough income to maintain the systems, but not enough income for significant system upgrades.
- **Rate Structures.** Each electric utility has designed and set up its own rate structure to determine an appropriate method to charge its customers. Some utilities – especially those that serve rural communities, have structures that will not easily accommodate the varying demand that will come from EV charging stations.

The response from utilities to these upcoming challenges varies widely. Some have embraced the anticipated change and are actively looking for solutions to these challenges. They are planning, promoting, and facilitating the adoption of EVs. Ameren, the primary provider in the SEMPO area, is one of these progressive organizations. Many other organizations are too stretched maintaining their current system to worry about accommodating EVs until they have to.

System Planning

Most electric utilities have a regularly updated system plan. At the time of this report, most of these plans do not account for the anticipated impact of EVs. Utilities must plan for the increased loads in residential and business areas; and how these loads affect the entire system – all the way from the power plant to the charger. This is especially important where entire fleets of vehicles will be charged. Planning now and building for the future will help maintain the reliability of the system and save on costly emergency repairs and upgrades.

Managed Charging

Managed charging is one way of helping manage the peak demand on the electrical grid by postponing charging activities until off-peak hours. This important concept is being promoted at the national level. A recent report funded by the U.S. government included the concept of managed charging related to EVs as follows:

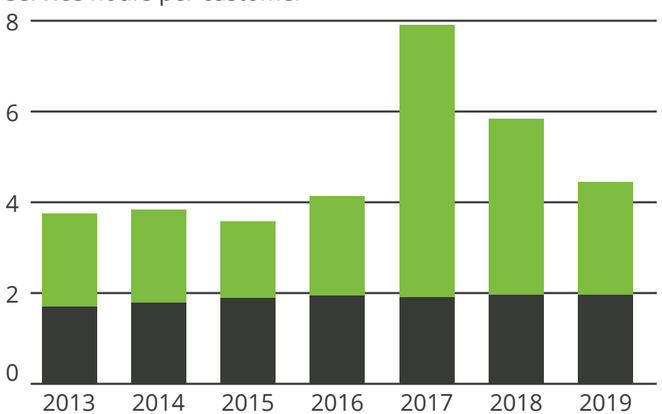
> ***"Managed charging is a critically important consideration in the ultimate grid impact of EVs at scale. Even without managed charging, EVs at scale can be accommodated through capacity expansions based on traditional utility experience and management; however, planning and investing without considering managed charging may lead to a higher-cost infrastructure."***
>
> *–GITT ISATT EVs at Scale Grid Summary Report FINAL Nov 2019*

There are many ways of implementing managed charging. One method, nationally recognized as a best practice, was pioneered by San Diego Gas & Electric. It is a three-tiered ***Time of Use Incentive***, through which customers pay 20 percent more for electricity during peak times than at off-peak times. Though this structure affects all electricity use, it encourages people to shift their EV charging time to off-peak hours.

A second method, used by Evergy in the Kansas City area, provides a $250 rebate to customers to help offset the cost of installing a Level 2 charger in their home. The rebate increases to $500 if those customers agree to sign up for Evergy's Time of Use Plan (similar to the plan used in San Diego). This plan has many benefits, including reducing a barrier to adoption, allowing Evergy to track the number and location of EVs using the grid, and managing charging times.

U.S. Power customers experienced an average of nearly five hours of interruptions in 2019

Average duration of total annual interruptions in electricity service hours per customer



Source: U.S Energy Information Administration, Annual Electric Power Industry Report

with major events **without major events**

Implementing a managed charging strategy in the SEMPO area can promote EV adoption and help minimize the impact that charging will have during peak energy usage times.

Reliability

Electricity is at the heart of everything we do. We rely on it for nearly everything from light to heating and cooling to modern communications. We need electricity to maintain and even save lives. At the same time, we all rely heavily on vehicles for transportation and commerce. As we shift our vehicles' power from gasoline to electricity, our reliance on already-critical infrastructure becomes even more entrenched and its reliability more vital.

A 2019 study by the U.S. Energy Information Administration showed that on average, a customer in the U.S. experiences five hours of outages per year, as shown in the following chart. To help minimize these impacts, utilities may consider solutions such as microgrids and other rapid Smart Grid outage response methods.

To provide reliable service, most mature electric utilities monitor and measure the operational health of their system so they can identify and correct problems early. These monitoring systems are called SCADA (supervisory, control, and data acquisition) systems. Data gathered from these systems is used to measure the reliability of the system primarily using two metrics – one measures the frequency of interruptions (System Average Interruption Frequency Index [SAIFI]), the other measures an outage's average duration (System Average Interruption Duration Index[SAIDI]).

When considering the additional demand that EVs will bring, utilities can use SAIFI and SAIDI metrics both to manage the system more effectively and to develop policy.

Charging Requirements

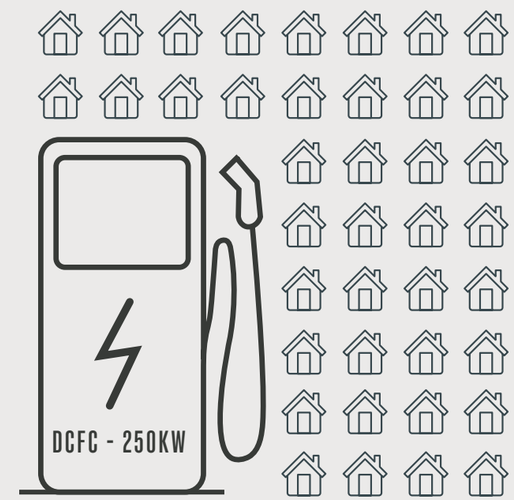
Charging stations, especially DCFC, require high levels of power (250kW for the newest Tesla supercharger) in a relatively short period of time. 250kW is an exceptionally high level of power consumption for a device drivers use every day. Currently, such chargers are uncommon. This will change as demand for EVs increases.

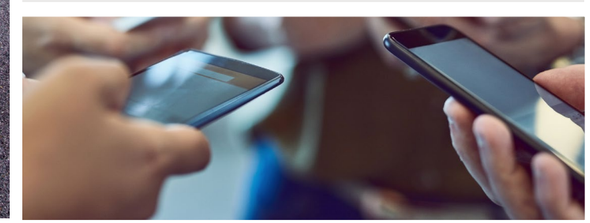
To put this demand on the grid into perspective, we'll compare a supercharger and a group of homes. A supercharger's 250kW requires roughly 10 times the amount of power supply connected to a group of four homes. In other words, one 250kW supercharger's maximum demand is roughly the same as that required to power 40 homes. A group of 4 superchargers, all in use, would require the same amount of electricity as a neighborhood of 160 homes.

Education and Outreach

The recent publicity and activity surrounding EVs has inspired a lot of curiosity and interest among individuals and organizations. It would be helpful for SEMPO, in partnership with the utilities in the area, to consolidate and provide reliable information and data about the costs, environmental impacts, and other information about EVs. To be most effective, the information can be targeted for consumers, businesses, and fleet managers.

One 250kW charger's maximum demand is roughly the same as that required for 40 homes





Modeled Impacts on SEMPO Region

To understand the direct impacts of EVs on the electrical grids that serve the SEMPO region, the project team used a tool developed by the DOE. The tool takes various inputs for a region and models the load impacts for a certain number of EVs. Note that the tool does not account for the recently developed 250kW superchargers but does accommodate the slightly less impactful 150kW DCFC. The tool also assumes that charging would be spread evenly throughout the region, and not concentrated in large groupings – something that would need to be accounted for in a more detailed plan and analysis.

The tool also considers many other nuances, such as the reduction of grid and EV efficiency during extreme temperatures, and other seasonal variations. The team used conservative values for this analysis, including an average ambient temperature of 14 degrees Fahrenheit. The results in **Figure 7** shows the load a local electric grid (within one mile) would incur on a typical weekday resulting from the addition of 1,000 EVs to the network. At approximately 8:30 pm, charging demand would be the highest, roughly 1.25 megawatts (MW), and at approximately 6:30 am, charging demand would be the lowest, roughly 0.25 MW.

Model assumptions:

- A 1,000 vehicle fleet addition
- 75 percent PEVs and 25 percent PHEVs
- Average daily drive of 35 miles
- Ambient temperature of 14 degrees Fahrenheit
- 80 percent of the fleet are sedans
- Workplace charging stations are 80 percent Level 1 and 20 percent Level 2
- 100 percent of the owners of these vehicles also have access to home charging
  - 80 percent Level 1 and 20 percent Level 2
- 100 percent had a preference for home charging
- A preference for immediate (versus delayed) charging at home
- A preference for immediate (versus delayed) charging at work

Results for SEMPO REGION

Supporting a fleet of 1,000 plug-in electric vehicles would result in the following electric load profile:

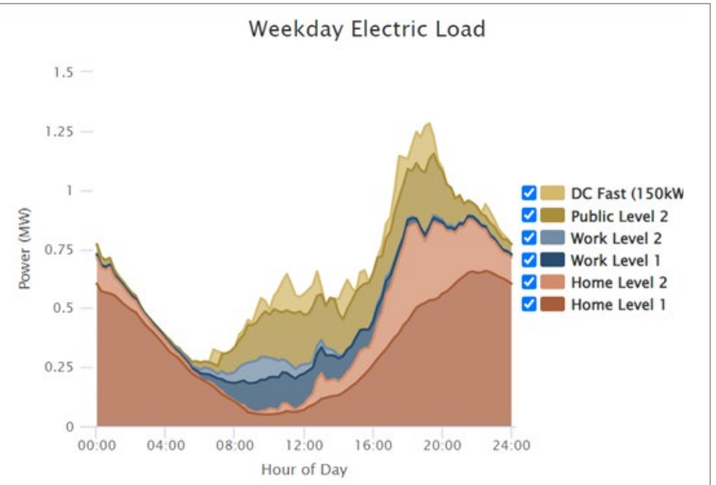


FIGURE 7 | 1,000 PLUG-IN ELECTRICAL VEHICLE (PEV) ELECTRICAL IMPACT GRAPH

INCREASING EV ADOPTION IN UNDERSERVED COMMUNITIES

The electrification of vehicles can and should benefit everyone. EVs need to be accessible to all kinds of households. SEMPO is determined to bring the benefits of EV to everyone – including Disadvantaged Communities (DACs), i.e., traditionally underserved communities.

The first step in this process is to determine what constitutes a DAC. For this plan, the team used the definition provided by the Justice40 initiative[4]. Justice40 is a "whole-government" initiative; the goal is for 40 percent of benefits from clean energy and clean transportation investments to benefit DACs. The current guidance for Justice40 suggests that agencies use data such as poverty levels, transportation access, health disadvantage, energy burden, economic disadvantage, and others. Specifically for this study, the team followed the guidance for the National Electric Vehicle Infrastructure (NEVI) program, which combines the formulas of both the US Department of Transportation (USDOT) and the DOE. The resulting formula highlights energy-and transportation-burdened communities, communities facing high rates of environmental pollution, those whose economies are highly dependent on fossil energy sources, and those with high rates of social vulnerability[5]. **Figure 8** shows the various percentages of persons living below the poverty level in the SEMPO area.

4 Source: https://www.transportation.gov/equity-Justice40 accessed May 2022

5 Agronne National Laboratory, https://www.anl.gov/es/electric-vehicle-charging-equity-considerations

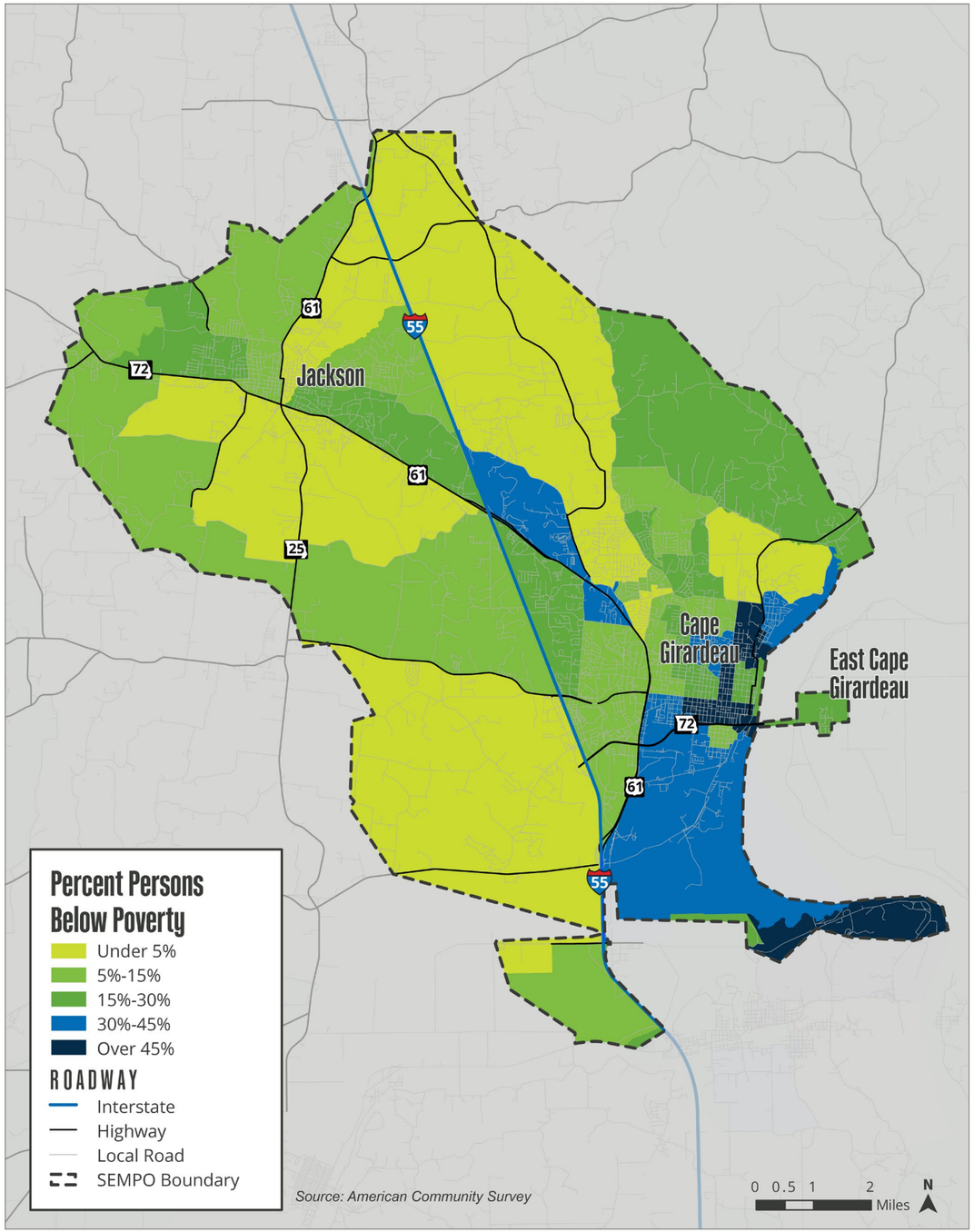


FIGURE 8 | PERCENT OF PERSONS BELOW POVERTY LEVEL

Socioeconomic Challenges to EV Adoption

Many factors can make EV adoption challenging in underserved communities. These factors relate not just to household income levels, but also to a historical lack of investment, advocacy, support, and community resources. A few of the primary factors and considerations are listed in **Table 10.**

Challenge	Description
Initial Vehicle Cost	Though the lifetime cost of owning an electric vehicle (EV) is less than a gas or hybrid vehicle, they are more expensive to purchase. Although EV prices are dropping faster than expected, everyday consumers still need financial subsidies to overcome the cost difference and incentivize them to buy an EV over a conventional car.
Community Trust & Buy-in	Because of a historical lack of support and advocacy, disadvantaged communities are often disengaged. This makes it difficult to understand a community's needs, which can lead to misunderstanding, lack of trust, and even pushback or resentment if public charging is installed in the neighborhood.
Community Capacity & Resources	Community capacity is the human, organizational, and social capital that combine to solve collective problems. Because of causes such as historical lack of investment, or community members not returning after gaining education, underserved communities simply don't have the community capacity to solve their collective issues.
EV Adoption vs Zero Emission Mobility	EV ownership is not practical for every underserved community because mobility needs vary. It is important to consider all modes of transportation, including transit and other zero-emission mobility options to improving the overall quality of life for a community.

TABLE 10 | SOCIOECONOMIC CHALLENGES TO ELECTRIC VEHICLE (EV) ADOPTION

Government EV Programs for Underserved Communities

To help address these challenges, the project team first looked at other programs from around the country to learn from their successes. Three specific programs are highlighted here.

AFFORDABLE HOUSING MOBILITY HUB (CALIFORNIA)[6]

With funding from the California Air Resources Board, TransForm is partnering with the Metropolitan Transportation Commission to bring EV car sharing, EV charging infrastructure, and other travel options to three affordable housing communities in Oakland, Richmond, and San Jose. The exact design of each mobility hub is based on residents' needs to ensure that the mobility hubs are effectively tailored to each community. The program offers car share and transit discounts, and also bike share and ride share credits.

CLEAN CARS 4 ALL (CALIFORNIA)[7]

The program's guiding legislation aims to focus the benefits of the program on low-income and disadvantaged communities and has a heavy emphasis on consumer protections, education of the new technologies, and coordination with other clean transportation programs.

6 Source: TransForm, EV Car Sharing and Mobility Hubs in Affordable Housing Pilot, Accessed March 2022

7 Source: California Air Resource Board, CC4A, Accessed April 2022

CONNECTICUT HYDROGEN AND ELECTRIC AUTOMOBILE PURCHASE REBATE (CHEAPR) (CONNECTICUT)[8]

This statewide program offers incentives to Connecticut residents who purchase or lease an eligible vehicle from a licensed Connecticut automobile dealership. Incentive amounts range from $4,250 for an eligible BEV, to $2,250 for a PHEV, and up to $9,500 for a fuel cell electric vehicle (FCEV) for income qualified individuals.

Utility EV Programs for Underserved Communities

In addition to the government programs described in the previous section, many utility companies have also taken steps to encourage EV growth, including specific programs for underserved communities. These companies (specifically, investor-owned utilities such as Ameren), can use infrastructure funding to encourage EV growth in low-income areas using identical program elements as those previously defined. However, because they are the distributors of electric energy, they have the ability to provide other types of programs, such as the following:

SCHOOL BUS ELECTRIFICATION (VIRGINIA)

Programs like that created by Dominion Energy in Virginia can encourage EV use in underserved areas through public and community transit. Through this program Dominion Energy installed DCFC to support 50 fully electric school buses.

9 Source: Connecticut's CHEAPR Program, Accessed April 2022

EMPOWER EV CHARGER INCENTIVE AND EDUCATION PROGRAM (CALIFORNIA)

This program created by Northern California Utility Pacific Gas and Electric Company, specifically addresses EV adoption barriers for underserved communities. The program consists of public outreach and education, and increasing access to EV charging stations; it provided 44 percent of distributed EV incentives to low-income and underserved communities.

Strategies for Addressing Equity in SEMPO's EV Program

From the research and analysis, the project team has identified various best practices and program focus areas that can help extend the benefits of EVs to the underserved communities in the SEMPO area.

Programs

- Support programs that provide financing to reduce the upfront cost of charging infrastructure in under served areas.
- Develop programs that incentivize the installation of charging at existing MUDs with lower rents, provide hands-on technical assistance to building managers, and ensure affordable charging rates.
- Support the implementation of subsidized or low-cost fast charging stations near MUDs, including utility or municipally owned charging infrastructure.
- Focus incentive programs on lower-income drivers, reducing information barriers and costs.

Codes

- Adopt EV readiness building code requirements that apply to all housing, including affordable units or public/social housing.

Charging Hubs

- Streamline permitting and location for public charging hubs, ideally in highly visible locations.
- Ensure affordable charging plans are available for the drivers who are most dependent on these hubs, such as Uber/Lyft drivers, taxis, and those without home charging
- Site public hubs in close collaboration with communities and as part of a broader engagement strategy that ensures residents and community-based organizations will benefit.
- Co-locate public hubs with other modes of transportation such as public transit, bike-share, etc.

Community Engagement[9]

- Conduct meaningful, purposeful, and effective community engagement in underserved areas prior to rolling out any program or initiative in these communities.
- Include individuals, community-based organizations, trade associations, government agencies, nonprofit organizations, and coalitions.

9 Source: Equity in Practice, Developing a City Transportation Electrification Roadmap, accessed April 2022

In addition, the following list includes actions that will help SEMPO and its member agencies meaningfully and purposefully address EV equity throughout the community.

- Consider all modes of transportation that may meet a community's needs, including personal vehicles, ride share, transit, micromobility, and active transportation.
- Meaningfully engage with the community and strive to collaborate with and empower community stakeholders in the decision-making process.
- Assess transportation needs during the beginning stages of planning to allow for a thorough understanding of the communities' necessities.
- Work with a local organization that has experience reaching out to the community and can invest time to build the relationship.
- Engage the individuals and communities that will be affected and using these mobility modes during the planning process, including individuals, community based organizations, trade associations, government agencies, nonprofit organizations, and coalitions.
- Choose the appropriate engagement strategy for the level of participation and collaboration you are seeking from a community stakeholder(s).
- Provide "EV 101" education in meetings with community stakeholders.
- Creatively incentivize participating community stakeholders for their time in meetings, focus groups, and other engagements.

THE ROAD AHEAD

Overview

This plan will allow the SEMPO region to make great strides toward integrating EVs into existing policies, processes, and lifestyles, but there is still a long way to go. This plan provides a platform for identifying and overcoming barriers for installation and obstacles to broader PEV adoption. However, a number of challenges and barriers are still stifling charging station installation and hindering EV adoption, such as those described in this Readiness Plan. To ensure progress continues, sustained collaboration is crucial for a cohesive regional charging network and for consistent and streamlined deployment.

Charging equipment and vehicle technologies continue to evolve at a rapid pace and it is necessary to understand the equipment demands and the needs and wants of the public. Monitoring and applying policies uniformly will help all public agencies, contractors, EV drivers, local businesses and manufacturers address gaps, emerging trends and future needs.

Increased PEV Presence

Though initial EV growth has been relatively slow to date, the increased availability of EV models and the addition of more public charging stations will lead to a significant rise in EVs on the road. It is difficult to predict the many national, regional, and local conditions that will affect the ultimate EV growth rate within a region, but it is important to study probable scenarios to demonstrate the impact on other factors such as charging stations and power requirements (discussed elsewhere in this report).

To establish a reasonable estimation of the increase in EV adoption within the SEMPO region, a three-scenario growth prediction model was developed. The low-adoption scenario assumes a 25 percent EV saturation in 2050, the medium-adoption scenario assumes a 50 percent saturation in 2050 and the high-adoption scenario assumes a 75 percent saturation in 2050. The starting value in 2020 was estimated by assuming the EV adoption rate in the SEMPO region matched the adoption rate of the State of Missouri. The model assumes steady population growth of 1.87 percent per year through 2050. Results of the three adoption scenarios are summarized in **Table 11**.

	2020	2025	2030	2040	2050
Low Adoption	73	1,353	3,335	9,409	18,294
Medium Adoption	73	2,675	6,670	18,842	36,588
High Adoption	73	3,997	10,005	28,275	54,882

TABLE 11 | INCREASED PEV PRESENCE - ADOPTION SCENARIOS

Estimating Future Demand for Charging Stations in the SEMPO Region

Adoption of EVs will be highly influenced by buyer perception of the availability of EV charging stations. Though most EV owners will charge their vehicles at home, there is still a significant need for public chargers near workplaces, in commercial locations, along major corridors and in MUDs. Using the projected EV growth data, the required charging station demand was modeled using the Alternative Fuels Data Center website[10]. These projections use several assumptions considering distance driven per day, average EV battery size, and range fluctuations because of environmental conditions. It should also be noted that the DCFC chargers indicated in this model do not reflect specific requirements related to corridor charging specifications for NEVI.

		2020	2025	2030	2040	2050
Low	Workplace	2	33	80	223	430
	Public	18	26	64	174	319
	DCFC	4	5	12	33	60
Med	Workplace	2	64	159	443	842
	Public	18	51	126	327	558
	DCFC	4	9	23	62	105
High	Workplace	2	95	237	657	1,251
	Public	18	76	184	459	791
	DCFC	4	14	34	87	136

TABLE 12 | SEMPO REGION FUTURE CHARGING STATION DEMAND SCENARIOS

Funding

Several funding mechanisms have been established at federal, state, and local levels to support the adoption of EVs and charging stations. These programs seek to offset some of the initial costs (see Barriers to EV Adoption) allowing consumers and private businesses to experience the benefits of EV ownership. Some funding types and specific funding programs are outlined below.

EV PURCHASE INCENTIVES

One of the most impactful incentives increasing adoption of EVs is the federal tax incentive for purchase of a new car or truck that includes a 2.5kWh or larger rechargeable battery (this covers both PEV and PHEV). The tax credit ranges from $2,500 to $7,500 depending on the battery size and is available for certain manufacturer vehicles. This incentive begins to phase out once the manufacturer sells 200,000 qualified vehicles.[11] Only two manufacturers have reached this phase out period; Tesla and General Motors (including Chevrolet and Cadillac) – both manufacturers have fully phased out as of April 1st, 2020.

FEDERAL FUNDING FOR CHARGING STATIONS

Current Funding: A settlement involving auto manufacturer Volkswagen has provided a robust amount of funding for offsetting the costs of EV charging station installations. In Missouri, these funds are managed by the Missouri Department of Natural Resources (DNR). Funds have been released in two rounds thus far. The first release was in October 2021 and the second release was in July 2022. Funds have been awarded for 28 sites throughout the state, with additional sites expected to be approved (subject to certain restrictions).

Future Funding: In November of 2021, the Infrastructure Investment and Jobs Act bill (IIJA) was signed into law at the federal level. The bill provides EV funding through several program,

10 Source: https://afdc.energy.gov/evi-pro-lite

11 Source: Ref 2 https://www.irs.gov/credits-deductions/individuals/plug-in-electric-drive-vehicle-credit-section-30d, accessed May 2022

grant, and financing opportunities and includes a $7.5 billion allocation for building out the EV charging network across the country. The State of Missouri is slated to draw at least $99 million of that funding over a five-year period ($18 million for 2022) and is eligible to receive portions in grant funding.

The State of Missouri is currently developing an EV Readiness Plan that will define the parameters of use for the funding that must align with federal guidelines. The $99 million in program funding will be focused on supporting charging station installations along major interstate corridors and rural and underserved communities. Missouri has until August 1, 2022 to submit its plan to the FHWA. All funding distributed under this program will go to grant programs requiring a 20 percent local match.

ELECTRIC UTILITY INCENTIVES

Utility providers are also significant contributors to regional EV incentives. Utility incentives can be administered through various program types including time of use rate structures, rebates for home charging station purchase/ installation, and commercial charging station cost sharing. Several utilities also incentivize EV use by installing and operating public charging stations.

Within the SEMPO region, Ameren is providing the Charge Ahead program which provides incentives for non-residential customers who install Level 2 or DCFC charging stations. Stations must be installed at qualified workplaces, MUDs, or public areas. Applicants can receive up to $500,000. Available funding programs related to EVs as of July 2022 are included in **Table 13**.

CHART OF AVAILABLE FUNDING

As of the release of this report, the following funding programs were identified for the Southeast Metropolitan Planning Organization (SEMPO) region:

Funding Administrator	Status	Allocation Type	Link
Missouri Department of Natural Resources	*Current*	Direct Current Fast Charge Charging Stations	https://dnr.mo.gov/air/what-were-doing/volkswagen-trust-funds/electric-vehicle-charging
Ameren	*Current*	Charging Station	https://www.ameren.com/missouri/company/environment-and-sustainability/electric-vehicles
Federal Highway Administration	*Future*	Charging Station	https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/90d_nevi_formula_program_guidance.pdf
Internal Revenue Service	*Current*	Vehicle Purchase Tax Rebate	https://www.irs.gov/businesses/irc-30d-new-qualified-plug-in-electric-drive-motor-vehicle-credit

TABLE 13 | AVAILABLE FUNDING PROGRAMS RELATED TO ELECTRIC VEHICLES

Installation Considerations

Installation of charging stations requires special considerations for how, where, and why EV operators charge their vehicles. Locations along travel corridors are ideal for DCFC. Level 2 is best suited at locations with longer dwell times. Predeployment charging station considerations for DCFC and Level 2 are included in **Figure 9** and **Figure 10**.

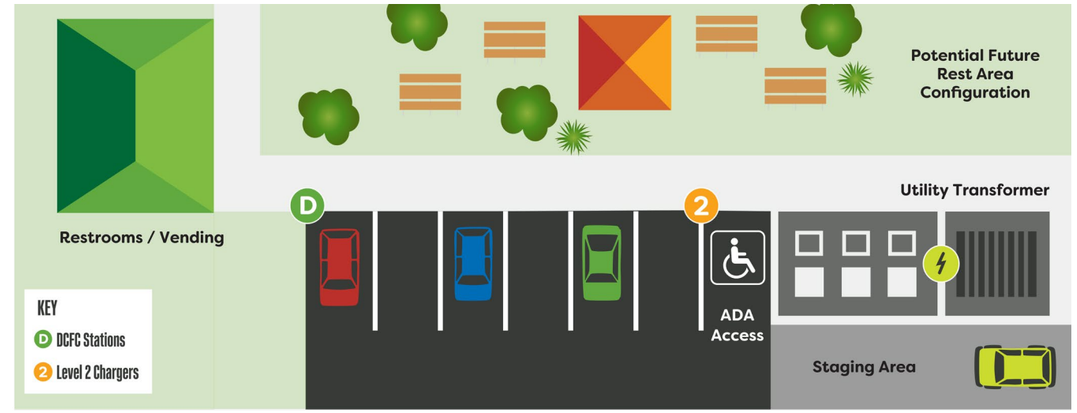


FIGURE 9 | DIRECT CURRENT FAST CHARGER (DCFC) INSTALLATION SITE | LONG RANGE TRAVEL

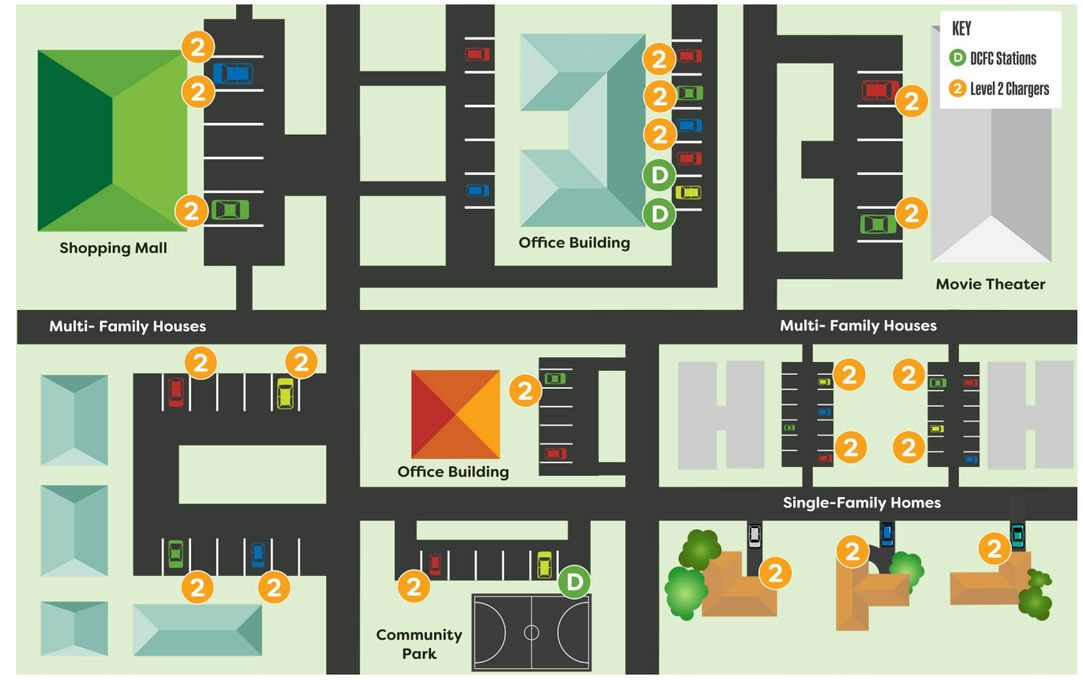


FIGURE 10 | LEVEL 2 INSTALLATION SITE | COMMUNITY CHARGING

Charging Station Predeployment Planning

A significant amount of planning must take place before EV charging stations can be deployed on a large scale. The following are considerations for predeployment planning.

POWER SUPPLY

GENERATION

Predeployment planning at the generation level will likely see responses in more localized generation capacity increases. For the short term, this could take the form of ~2MW natural gas generators. However, for the long term, deep assessments will be needed to navigate generation portfolio blends that meet future significant load increases.

DISTRIBUTION

Distribution infrastructure is more likely to be impacted first by large-scale deployment of EV charging stations, as opposed to substation facilities. Substation facilities, especially in the short term, will likely be able to accommodate general increases resulting from individual use. However, fleets will certainly affect distribution facilities and likely substation facilities.

- The following scenario illustrates how quickly a fleet could affect distribution facilities. This scenario is highly improbable but makes the illustration clear.
- This scenario assumes a fleet installation of 25 superchargers with an individual demand of 250kW each (equivalent demand of 40 homes). If every charger is used simultaneously, the demand would be 6.25M. However, a typical 12.45 kilovolt (kV) distribution feeder running at 50 percent capacity (industry standard) over 556 kcmil only carries approximately 6.5 MVA. Thus, a utility could argue that the implementation of a supercharger based fleet would result in the need for new feeder systems simply to provide for the demand of a single fleet of vehicles.

RATE STRUCTURE

The increase in electric demand due to EVs can be mitigated through rate structures that provide incentives, especially for fleet implementation. By timing fast and super-fast charging with off-peak hours through incentives, utilities can mitigate rapid changes in load demand. The intelligence needed to control and monitor the timing of charging patterns will require the use of SCADA information and analytics.

SPACE REQUIREMENTS

Electrical utilities will typically require an easement for the overhead or underground power supply and for the equipment. Distribution transformers typically have 3 feet of space available to the sides and rear for fire safety and up to 10 feet of clearance at the front for operational safety. Larger load sites (typically greater than 1 MW) may have additional utility requirements.

Charging stations located near parking stalls are recommended to be located within approximately 10 to 15 feet of the vehicle. ADA requirements and queue management for EVs waiting to charge should be taken into consideration at all charging station sites.

Identification of Potential New Charging Station Locations

A geographic information system (GIS) computer mapping analysis was used to identify gaps in the SEMPO region's long-range and short-range charging network. Multiple consideration factors were combined to find areas around the SEMPO region that had a high potential to fill the gaps in the charging station network and are detailed in this section.

Gap Analysis for Long-range Travel (DCFC)

Consideration factors used for the long-range travel gap analysis varied from proximity to existing DCFC charging sites, daily traffic patterns, and proximity to designated Alternative Fuel Corridors and State Highway Systems (SHS). How these consideration factors were used in the gap analysis are expanded below. Results of the Long-range Travel gap analysis are included in **Figure 11**.

PROXIMITY TO EXISTING DCFC CHARGING SITES:

- Areas within a 25-mile driving distance of an existing DCFC charging station were considered to be adequate.
- Locations between 25 and 50 miles driving distance of an existing DCFC charging station were considered to be potentially suitable.
- Areas more than 50 miles from a DCFC charging station were rated as most in need of new charging stations. Because the existing DCFC stations tend to be clustered in UAs, this factor also helped address equity concerns by finding potential charging station locations in more rural areas.
- The NEVI minimum requirement for Alternative Fuel Corridors was also considered by identifying areas where four DCFC plugs co-located at no more than 50 miles apart and no more than 1 mile off a designated Alternative Fuel Corridor. These locations were rated as most in need of new charging stations.

DAILY TRAFFIC AT INTERSECTIONS ALONG THE STATE HIGHWAY SYSTEM:

- Areas near high-traffic intersections rated higher than those with moderate- or low-traffic volumes.

PROXIMITY TO STATE HIGHWAY INTERSECTIONS ALONG EVACUATION-CRITICAL ROUTES:

- Located areas with easy access for motorists on the SHS.
- Identified areas within 1-minute, 5-minute or 10-minute drives from each SHS intersection.
- Areas within a short drive-time were rated higher than areas that took longer to reach.

TO ENSURE THE GREATEST BENEFIT TO THE MOST EV DRIVERS, THE PROPOSED CHARGING STATION LOCATIONS WERE PRIORITIZED BY THE FOLLOWING:

- The amount of daily road traffic on the SHS roadways.
- Higher priority given to the most heavily traveled roads.

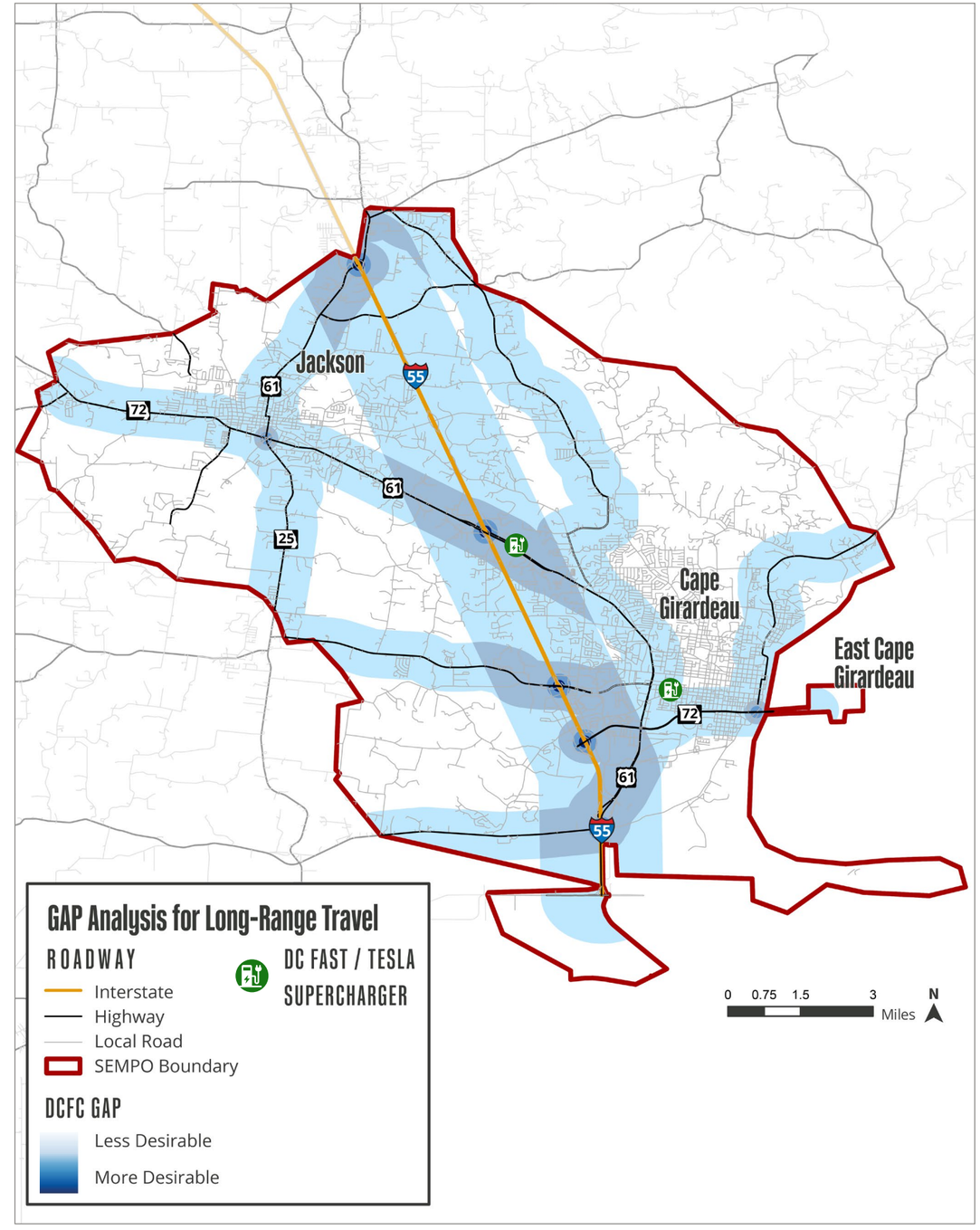


FIGURE 11 | GAP ANALYSIS FOR LONG-RANGE TRAVEL (DCFC)

Gap Analysis for Short-range Travel (Level 2)

Consideration factors used for the short-range travel gap analysis were largely based on a 10-minute walking distance proximity (or one-quarter mile) from land use types where drivers might park for extended periods of time. Land use types include multifamily housing with more than five units, parks, hotels, supermarkets, universities and trade schools, offices, theaters, retail commercial establishments, and the airport. Household income and the current presence of Level 2 chargers also played a role in the gap analysis.

All these factors were given a weight value ranging from -2 to +2, based on the likelihood the factor would affect need and use of public charging. **Table 14** provides an overview of each assigned weight. Results from the Short-range travel gap analysis are included in **Figure 12**.

WITHIN A QUARTER MILE OF...	
Park	1
Hotel	
Supermarket	
Multifamily unit with 5 plus DU	
College / Trade School	
Office	
Retail	
Theater	
Further than 1 Mile from Existing Charging Station	
Airport	2
University	
Existing Charger	-2
PERCENT PERSONS BELOW POVERTY	
Under 5%	0
5%-15%	0.5
15%-30%	1
30%-45%	1.5
Over 45%	2

TABLE 14 | CONSIDERATION FACTORS FOR SHORT-RANGE TRAVEL (LEVEL 2) GAP ANALYSIS

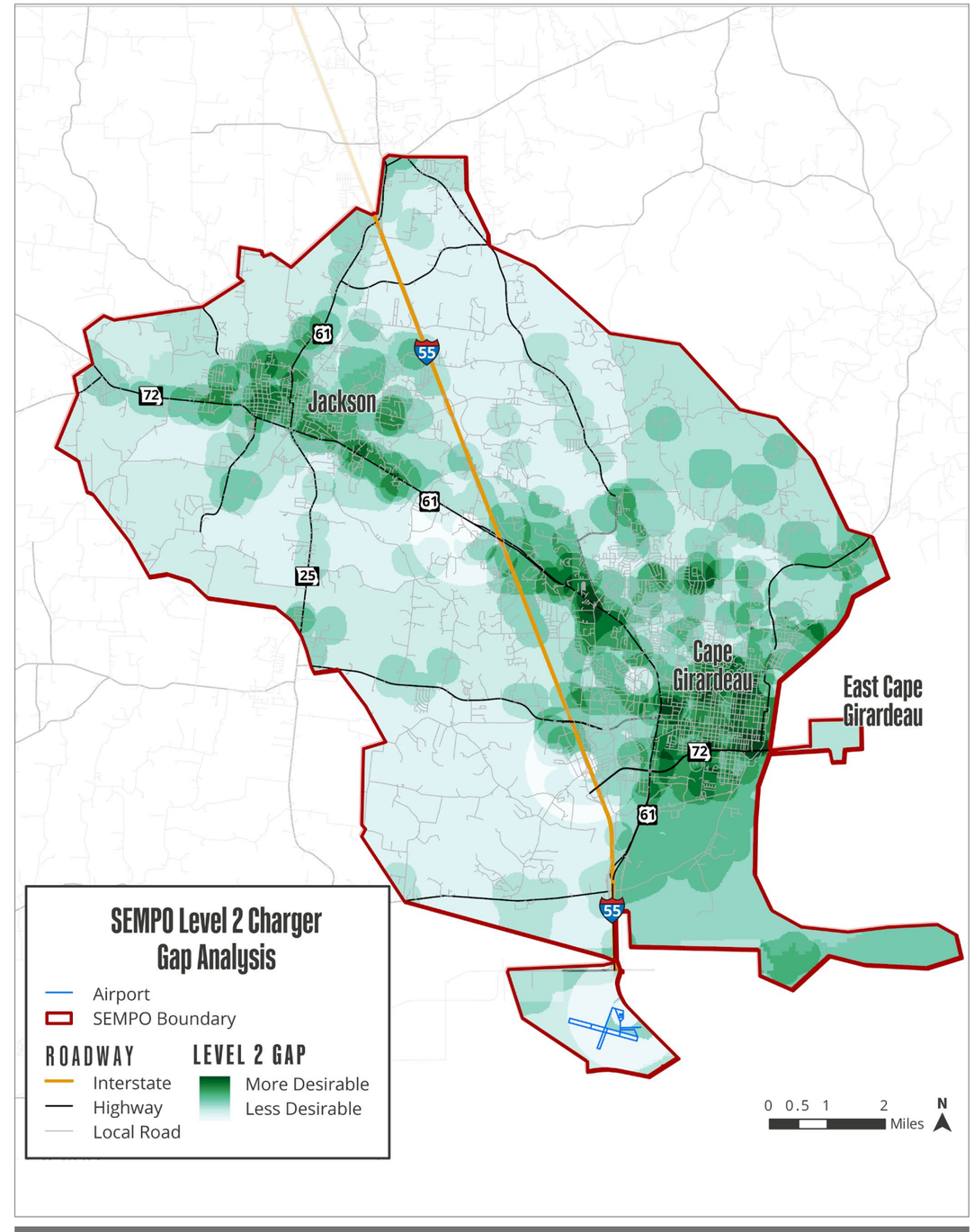


FIGURE 12 | GAP ANALYSIS FOR SHORT-RANGE TRAVEL (LEVEL 2)

RECOMMENDATIONS

Introduction

This section includes recommendations for actions and next steps toward facilitating the expansion and adoption of EVs in the SEMPO region to support transportation mobility goals. The recommendations were developed based on what the team heard from the SEMPO region stakeholders during the outreach portion of this project as well as results from the existing conditions analysis, best practices from around the country for similar geographic regions, and engineering judgment.

SEMPO's primary role in the region is to assist with planning and to advocate on behalf of its member agencies. SEMPO does not receive any funding for capital projects. The recommendations for this plan have been tailored specifically to the SEMPO region and its stakeholders.

The SEMPO Board will monitor and track the progress of these recommendations while also advocating and connecting stakeholders to facilitate the recommendations within this plan.

GOALS

The following goals were developed based on the 2045 SEMPO Metropolitan Transportation Plan to establish the framework of this Plan.

- ***Promote*** a variety of energy sources, reducing dependency on fossil fuels in transportation
- ***Position*** the SEMPO region to support transportation electrification
- ***Expand*** EV adoption and charging station access in the SEMPO region
- ***Anticipate*** changes in travel choice and transportation technologies toward EV adoption
- ***Support*** access to transportation for disabled and low-income persons
- ***Enhance*** Missouri's overall transportation system

FRAMEWORK

The framework provides an overview of recommendations that should be considered for action to support the identified goals, initiatives, objectives, and strategies.

In an effort to make the recommendations for this plan easily digestible, clear, concise, and actionable, recommendations have been organized into four initiatives: Adapt, Facilitate, Educate, and Coordinate. Each initiative has three to four recommended objectives. Each objective includes recommended strategies to fulfill each initiative. **Figure 13** provides an overview of the Framework.

GOALS *Desired outcomes expressed in simple and broad terms.*

INITIATIVES *Broad focus areas that describe how SEMPO could approach the implementation of this Plan.*

OBJECTIVES *Statement of what to achieve to support the Plans goals and Initiatives.*

STRATEGIES *Recommended plans of action to achieve a major or overall goal.*

FIGURE 13 | OVERVIEW OF FRAMEWORK

INITIATIVES AND OBJECTIVES

This section includes a general overview of each initiative followed by objectives to fulfill each initiative. Recommended strategies for each objective are detailed in the following section.

Initiative 1: Adapt

OBJECTIVES

1. Anticipate market and industry trends
2. Adapt Transportation policy framework
3. Expand charging station infrastructure
4. Support local agencies

Initiative 3: Educate

OBJECTIVES

1. Support charging station-focused education and outreach
2. Support local agencies
3. Increase awareness of publicly available charging station locations

Initiative 2: Facilitate

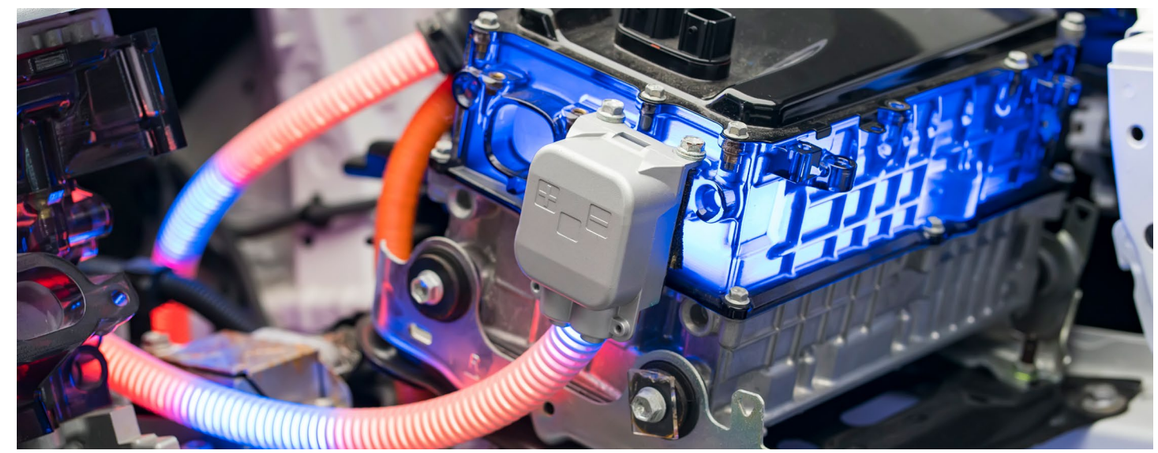
OBJECTIVES

1. Promote charging station infrastructure
2. Pursue various funding options
3. Promote installation of community charging infrastructure

Initiative 4: Coordinate

OBJECTIVES

1. Advance a regional and comprehensive approach to EV infrastructure
2. Continuously coordinate stakeholders to support charging station planning and implementation efforts
3. Establish regional and local agency roles and responsibilities
4. Coordinate the utility roles and rates to support the goals of this plan



Initiative 1: Adapt

OBJECTIVE 1	Anticipate market and industry trends		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*MPO or Local Agencies*
STRATEGY	• Monitor industry trends to inform decision-making • Track number of registered EVs in the SEMPO region – Understanding what is happening in the EV and charging station market is critically important to adapting transportation infrastructure to meet changing customer needs.		

OBJECTIVE 2	Adapt transportation policy framework		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*Local Agencies*
STRATEGY	• Remove legal and institutional barriers for installing charging stations • Identify alternative and innovative revenue sources – Motor fuel consumption is going to decrease while the wear and tear on our roads is going to increase. It is critically important to identify sustainable revenue sources.		

OBJECTIVE 3	Expand charging station network along transportation infrastructure		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*Local Agencies & Private Sector*
STRATEGY	• Fill charging station gaps – The private sector is leading the implementation; however, low return on investment creates infrastructure gaps in areas with low charging station use. SEMPO can play an important role in filling these gaps. Charging station infrastructure investments should be scaled with EV market adoption. • Develop and implement a phased approach to charging station deployment – Develop a charging station deployment plan that prioritizes immediate needs while expanding the network over time to meet future needs. • Include charging stations in planning and project development – Account for charging station needs when existing infrastructure is enhanced or new infrastructure is developed.		

OBJECTIVE 4	Support municipal and local agencies with implementation of the SEMPO EV readiness plan		
TIMELINE	*Short*	RESPONSIBILITY	*SEMPO*
STRATEGY	• Increase or raise awareness and provide guidance for early adopters of charging stations – Develop guidance and standards for the entire life-cycle of a charging station.		

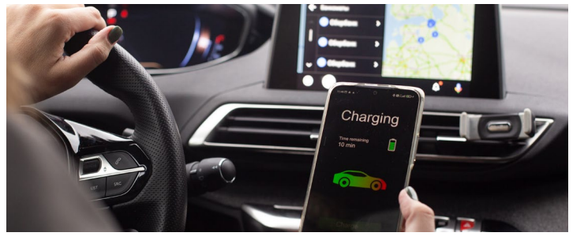
Initiative 2: Facilitate

OBJECTIVE 1	Promote charging station infrastructure to support short-range and long-range corridor travel		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*SEMPO, Local Agencies, & Private Sector*
STRATEGY	• Forge strategic partnerships to expand the charging station network – Facilitate charging station network expansion through public-private partnerships. • Encourage open-source data – Work with partners to encourage all DCFCs to adhere to latest Open Charge Point Protocol industry standards to ensure interoperability.		

OBJECTIVE 2	Identify and pursue a variety of funding options with partners to support charging station implementation		
TIMELINE	*Short to Long*	RESPONSIBILITY	*SEMPO, Local Agencies, & Private Sector*
STRATEGY	• Continuously monitor federal funding programs – Low and zero emission public transportation research, demonstration, and deployment funding – Alternative Fuel Infrastructure Tax Credit – Improved Energy Technology Loans – Congestion Mitigation and Air Quality (CMAQ) Improvement Program – Diesel Emissions Reduction Act (DERA) Funding – Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) – Rebuilding American Infrastructure with Sustainability and Equity (RAISE) – Department of Energy / Clean Cities Coalition Funding Opportunity Announcements (FOAs) – Federal Lands Access Program (FLAP) – Voluntary Airport Low Emissions Program (VALE) – Department of Energy Loans Program – Surface Transportation Block Grant Program (STBG) – Surface Transportation System Funding Alternatives (STSFA)		

Initiative 2: Facilitate (Cont.)

OBJECTIVE 3	Promote installation of community charging infrastructure		
TIMELINE	*Short to Long*	RESPONSIBILITY	*SEMPO, Local Agencies, & Private Sector*
STRATEGY	• Develop an innovative and ongoing funding program – Work with partners to develop a grant and/or loan program to expand access to charging station in low-income and historically disadvantaged communities. • Charging Station Planning program – Support agencies, counties, and municipalities to develop their own EV readiness plans. • Model building and zoning codes – Draft language that local governments can adopt or modify for use in establishing requirements and guiding the implementation of charging stations. Model building and zoning codes are provided in Appendix C. • Multifamily charging stations – Develop and promote educational campaigns related to installing charging station at multi-family developments. • Fast-tracked and streamline charging station permitting – Each permitting entity should allow fast-tracked permitting to charging station infrastructure. This should also include standardizations by agencies to allow designers to quickly meet standards and requirements. • Charging station minimum functionality standards – Provide guidance and minimum functionality, or operational requirements for charging stations installed in public areas or using public resources. These standards should include the latest in universal high-functionality payment standards, allowing travelers to seamlessly plug and charge. • Develop minimum EV-ready parking requirements – Work with local government partners to establish minimum EV-ready parking requirements for planning future charging stations or requirements for installing charging stations based on different land uses or building types. These requirements should acknowledge the crossover between EV charging spaces and ADA required spaces.		



Initiative 3: Educate

OBJECTIVE 1	Support charging station-focused education and outreach		
TIMELINE	*Short to Long*	RESPONSIBILITY	*SEMPO, Local Agencies, & Private Sector*
STRATEGY	• Develop and launch a consumer-oriented education and outreach program – A program to educate the public on the basics of EV ownership, such as how the charging works, the potential benefits and downfalls, the cost, the incentives available, and information relevant to purchasing or owning an EV. This program could inform the public on available EV infrastructure. This effort should be coordinated to provide education and outreach to the broader community with active engagement efforts in low-income and historically disadvantaged communities. • Develop a fleet and charging site-oriented education and outreach program – Develop a fleet and charging site-oriented program to educate owners and operators on the cost, planning considerations, benefits, available incentives, etc. This effort should target the rental agencies, businesses, and property owners, and incorporate feedback on any barriers to adoption of this technology. • Attract, retain, and train charging station installation and maintenance professionals to support adapting our transportation infrastructure – Collaborate with workforce development agencies to recruit talent. • Workforce development with active engagement efforts in disadvantaged communities – Coordinate with education providers around the state to develop the knowledge and curriculum needed to train the workforce to service EVs and to install, service and maintain charging station infrastructure.		
OBJECTIVE 2	Support local agencies		
TIMELINE	*Short to Long*	RESPONSIBILITY	*SEMPO*
STRATEGY	• Practical Guidance – Develop practical guidance for planning considerations, charging station installation, prioritization, and any of the knowledge that community planners and engineers need to support their EV and charging station implementation efforts. • Develop Long-range Transportation Planning (LRTP) Guidance – Develop potential guidance on how to best consider charging station and equity into the development of the LRTP.		
OBJECTIVE 3	Increase awareness of publicly available charging station locations		
TIMELINE	*Short to Long*	RESPONSIBILITY	*SEMPO, Local Agencies, & Private Sector*
STRATEGY	• Leverage partner and available resources – Promote charging station availability through signage, web sites and social media. – Promote publicly-available charging locations. This effort should be coordinated with charging network providers to offer up to date information and status of chargers in the SEMPO region.		

Initiative 4: Coordinate

OBJECTIVE 1	Advance a regional and comprehensive approach to EV infrastructure		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*SEMPO*
STRATEGY	• Coordination with the Missouri Department of Transportation (MoDOT), and other surrounding MPOs – Partner with MoDOT and surrounding MPOs to harmonize interstate corridor electrification efforts.		
OBJECTIVE 2	**Continuously coordinate stakeholders to support charging station planning and Implementation efforts**		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*SEMPO & Local Agencies*
STRATEGY	• Leverage SEMPO EV Readiness Plan steering committee and other surrounding MPOs and EV-interest groups – These groups should include diverse representation including but not limited to, low-income and historically disadvantaged communities throughout the region.		

Initiative 4: Coordinate (Cont.)

OBJECTIVE 3	Establish regional and local agency roles and responsibilities		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*SEMPO*
STRATEGY	• Program charter – Initiate a program charter that identifies the roles and responsibilities of each stakeholder involved in charging station planning and implementation. • Planning continuum – Develop structure to harmonize regional charging station planning and implementation with regional and local efforts.		
OBJECTIVE 4	**Coordinate the utility roles and rates to support the goals of this plan**		
TIMELINE	*Short to Intermediate*	RESPONSIBILITY	*SEMPO & Local Agencies*
STRATEGY	• Electrical grid benefits and impacts – Evaluate the benefits and impacts of incorporating charging station into the electrical grid. • Coordinate with local utilities – Facilitate EV infrastructure deployment best practices.		

APPENDIX A

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APPENDIX B

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APPENDIX C

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