COUNTY OF KERN/KERN TRANSIT

Zero-Emission Vehicle Transition Plan

Final Report
December 2022

moore
& associates

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Section A | Transit Agency Information

Transit agency name:	County of Kern/Kern Transit
Mailing Address:	Kern County Public Works Public Services Building 2700 M Street, Suite 400 Bakersfield, CA 93301
Name of transit agency's air district(s)*:	• Antelope Valley Air Quality Management District • Eastern Kern Air Pollution Control District • San Joaquin Valley Air Pollution Control District • South Coast Air Quality Management District
Name of transit agency's air basin(s)*:	• San Joaquin Valley Air Basin • Mojave Desert Air Basin • South Coast Air Basin
Total number of buses in annual maximum service:	40
Population of the urbanized area a transit agency is serving:	563,189 (Bakersfield Urbanized Area)
Contact information of the general manager, chief operating officer, or equivalent:	Alexa Kolosky, Public Works Manager Kern County Public Works Department 2700 M Street, Suite 400 Bakersfield, CA 93301 (661) 862-5002 akolosky@kerncounty.com
Is your transit agency part of a joint group?	No

**Includes all areas where Kern Transit routes operate.*

Section B | Rollout Plan General Information

Kern County's Zero-Emission Vehicle Transition Plan has a goal of full transition to zero-emission technologies by 2040. It does not include early retirement of any conventional transit buses. Conventional buses purchased between FY 2024 and FY 2027 are planned for replacement between FY 2035 and FY 2040. This will provide some flexibility for buses that are delivered late to be replaced in FY 2040 instead of FY 2039. The only buses scheduled to be purchased in 2040 will be spares. Therefore, if these buses are late being delivered, it will not affect Kern Transit's zero-emission operation.

The Zero-Emission Vehicle Transition Plan will be presented to the Kern County Board of Supervisors on December 13, 2022. A copy of the Board Resolution adopting the plan is provided below.

Contact information for the County's point-of-contact is provided in Section A. The Zero-Emission Vehicle Transition Plan was prepared by Moore & Associates, Inc., a transit-focused consulting firm.

Exhibit B.1 Adopting Resolution

BEFORE THE BOARD OF SUPERVISORS
COUNTY OF KERN, STATE OF CALIFORNIA

In the matter of:

Resolution No. 2022-403

AUTHORIZING KERN REGIONAL TRANSIT TO SUBMIT ZERO-EMISSION VEHICLE TRANSITION PLAN TO THE CALIFORNIA AIR RESOURCES BOARD

I, KATHLEEN KRAUSE, Clerk of the Board of Supervisors of the County of Kern, State of California, certify that the following resolution, on motion of Supervisor Maggard, seconded by Supervisor Peters, was duly passed and adopted by the Board of Supervisors of the County of Kern at a regular meeting on the 13th day of December, 2022, by the following vote:

AYES: Peters, Scrivner, Maggard, Couch, Perez

NOES: None

ABSENT: None

BOARD OF SUPERVISORS KERN COUNTY, CA

KATHLEEN KRAUSE
Clerk of the Board of Supervisors
County of Kern, State of California

Deputy Clerk

RESOLUTION

Section 1. WHEREAS:

(a) The Innovative Clean Transit (ICT) regulations were adopted by the California Air Resources Board (CARB) in December 2018 and became effective on October 1, 2019; and

(b) Title 13 of the California Code of Regulations § 2023 (13 CCR § 2023.1 through 2023.11) requires all public transit agencies to gradually transition their bus fleet to zero-emission technologies; and

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(c) Beginning in 2026, 25% of new fixed route vehicle purchase by transit agencies must be Zero-Emission Buses (ZEBs); and

(d) Beginning in 2029, 100% of new fixed route vehicle purchase by transit agencies must be ZEBs, with a goal of full transition by 2040; and

(e) Each transit agency must adopt and submit a complete Zero-Emission Vehicle Transition Plan that is approved by its governing body; and

(f) Careful planning is essential to ensure the synchronization of vehicle procurement, infrastructure build out , and fuel cost management; and

(g) Kern Regional Transit's goal is to fully transition to zero-emission technologies by 2040, avoiding early retirement of diesel/conventional fuel buses; and

(h) Kern Regional Transit's Zero-Emission Vehicle Transition Plan must be submitted to CARB by July 1, 2023.

<u>Section 2.</u> IT IS RESOLVED by the Board of Supervisors of the County of Kern, State of California, as follows:

1. This Board adopts this resolution approving the Kern Regional Transit Zero-Emission Vehicle Transition Plan.

2. This Board authorizes Kern Regional Transit to submit the Kern Regional Transit Zero-Emission Vehicle Transition Plan to the California Air Resources Board in accordance with the Innovative Clean Transit Regulations.

3. The Clerk of the Board of Supervisors shall transmit copies of this to the following:

County Administrative Office
County Counsel
Public Works - Transit

#26F4128-BVW

COPIES FURNISHED:
See above
12/15/2022 (SR)

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Section C | Technology Portfolio

This Technology Portfolio section is intended to provide a basic understanding of the battery-electric and hydrogen fuel cell vehicle technology necessary for the County of Kern (Kern Transit) to comply with California legislation by 2040. The County is considering both battery-electric and hydrogen fuel cell as a zero-emission technology with respect to its public transit program.

This section includes an assessment of zero-emission technology, summary of relevant state and federal legislation and requirements regarding this technology, and a discussion of potential fuel providers. A glossary of relevant terms is provided in Appendix A. This section also summarizes two case studies of California public transit operators which have begun the transition to hydrogen fuel cell buses.

Also included is a discussion of Kern Transit's current operating environment as well as its likely impact on future vehicle selection.

Section C.1 | Summary of Zero-Emission Technology

Electric Vehicle Technology

Electric Charging

As discussed in *Electrifying Transit: A Guidebook for Implementing Battery Electric Buses*[1] (BEB), rechargeable batteries onboard the vehicle store "power" as chemical energy, then convert the chemical energy to electricity when needed. Batteries are described using two metrics: energy capacity (kWh) and power (kW). Power (kW) identifies the amount of instantaneous work able to be performed by the battery. Energy (kWh) describes the exercise of that power over a period of time.

The energy capacity of a BEB (in kWh) can be likened to the fuel tank size of diesel buses. BEB range is determined by battery capacity, battery age, and environmental factors. BEB batteries range from 76 kWh to 660 kWh of capacity, though the actual usable capacity of the battery is typically less. Batteries degrade naturally over time; however, high usage and high temperatures can also impact degradation. Most warranties cover 12 years. Environmental factors such terrain, weather, temperature, and operator driving style can impact the range of the BEB.

The length of time required to charge a BEB is dependent on the type of charger as well as the energy capacity of the battery. Cold temperatures can also affect the charging speed. The type of charger is based on the location, whether it is at a depot (plug-in) or used for on-route charging station. Depot charging refers to plug-in charging infrastructure located where the buses are stored when not in use. Depot charging typically occurs overnight and can range from one to eight hours to charge, with most BEBs completing a full charge in five hours. The depot charging power supply ranges from 40 kW of power to more than 200 kW, with most requiring 100 kW or less. On-route charging is typically installed at locations

[1] Aamodt, Alana, et al. *Electrifying Transit: A Guidebook for Implementing Battery Electric Buses*. National Renewable Energy Laboratory, https://www.nrel.gov/docs/fy21osti/76932.pdf.

where vehicles dwell for 10 minutes or more, such as transit centers. The batteries charge wirelessly to extend the vehicle's range by a few additional miles for each 10 minutes of charging time.
For a Proterra *Catalyst* 40-foot bus, the vehicle specifications note the total energy capacity is 660 kWh with a maximum range of 350 miles. With a charging power of 120 kW, every five minutes of charging equals five miles. The plug-in charging time is optimally 4.5 hours. (Actual range and charging time will vary depending upon the actual infrastructure and battery configurations.)

Construction of Electric Charging Infrastructure

ZEB operators can opt for on-route charging, depot charging, or a combination of the two. On-route charging requires faster, more expensive chargers with the power of 350kW+. They are typically installed at locations where buses dwell for 10 minutes or more, such as transit centers or major transfer locations. With on-route charging, power can be delivered through a metal plate mounted in the ground or overhead, or through an overhead pantograph. With the plate, the bus simply parks on top of or under the plate and charging begins. For the overhead pantograph, a connector is required to deliver power to the battery.

Depot charging typically occurs while buses are parked overnight at the depot. Typically, power is delivered through plug-in chargers, though pantograph charging may also be used. One advantage to pantograph charging is it does not take up as much space, as much of the hardware is mounted above the buses, not in the yard.

A study published in 2022 by Atlas Public Policy found most ZEB operators are choosing to charge their buses as much as possible at the depot, thereby limiting on-route charging. Obstacles to on-route charging include acquiring land and rights of way, potential vandalism, collisions from other vehicles in public spaces, complaints from the community/residents, and chargers shutting off below 20 degrees Fahrenheit, according the study[2].

There are three standard types/levels of electric vehicle plug-in chargers. Level 1 chargers are typically used for home charging of light-duty electric vehicles as well as at commercial (retail) charging stations. For Level 1, the vehicle is plugged into a standard 120-volt outlet, and the battery is fully charged to a range of approximately 124 miles in approximately 20 hours (from empty). Level 2 chargers, which may also be installed at home or at a retail charging station, use a 240-volt outlet and can charge an empty battery to a range of 124 miles in approximately five hours. Level 3 chargers, also called DC fast chargers, reduce the charging time even further, although not all electric vehicles can use them.[3] Tesla also has superchargers that can recharge up to 200 miles in 15 minutes, but due to the connection hardware these are only usable by Tesla vehicles.

[2] Lepre, Nicole, et al. *Deploying Charging Infrastructure for Electric Transit Buses.* Atlas Public Policy, June 2022, https://atlaspolicy.com/wp-content/uploads/2022/05/Deploying-Charging-Infrastructure-for-Electric-Transit-Buses.pdf.
[3] https://chargehub.com/en/electric-car-charging-guide.html

There are multiple types of charging connectors, and the charging port on the vehicle has to be a match with the charging connector on the charger in order for it to work. As mentioned above, Tesla Supercharger plugs are typically only compatible with Tesla vehicles.

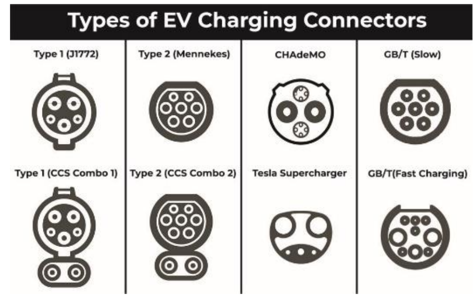


Exhibit C.1.1 AVTA bus using a depot-based plug-in charger

Exhibit C.1.2 AVTA bus approaching an in-ground inductive charger

Exhibit C.1.3 SJRTD bus using an overhead wireless charger

Exhibit C.1.4 Example of on-route overhead pantograph charger

Exhibit C.1.5 Example of gantry-based overhead pantograph charger

Exhibit C.1.6 Depot-based DC fast chargers (Level 3)

Electrifying Transit: A Guidebook for Implementing Battery Electric Buses recommends public transit providers engage their local utility early when making procurement and installation decisions. Electricity rates often vary by utility, translating to similarly variable cost for electricity by charging methods. Components affecting the electricity rate include energy charges ($/kWh), demand charges ($/kW), usage charges (generally $/month), and time-of-use charges. High-power fast chargers may be a potential challenge to the electric grid operators. The guidebook recommends research regarding local grid conditions and trends.

Installation costs are influenced by a variety of factors including the number and type of charging infrastructure, geographic location, site location and required trenching, existing wiring and required electrical upgrades to accommodate existing and future charging needs, labor costs, and permitting. A non-networked charging infrastructure is not connected to the internet and provides basic charging capabilities absent advanced utilization monitoring or payment capabilities. To install a networked station, the site must have access to a wired or wireless internet connection or cellular service[4].

Electric case studies

Antelope Valley Transit Authority

The Antelope Valley Transit Authority (AVTA) began its transition toward an all-electric fleet in 2016 when its board voted to purchase 85 battery-electric buses from BYD. With a service area covering 1,200 square miles, identifying ways to extend the range of the buses was important. Ultimately AVTA settled on plug-in depot charging as well as on-route charging through 12 WAVE wireless chargers spread throughout the service area. The agency reached its goal of a 100 percent battery-electric fleet in 2022 with the purchase of its 20th MCI commuter coach. AVTA's goal is to be self-sustainable, and will develop 47 acres of solar panels and batteries to increase its sustainability and offer protection against interruptions to the electric grid.

Anaheim Transportation Network

Anaheim Transportation Network (ATN) operates multiple transit programs serving the Anaheim area. It currently utilizes zero-emission vehicles for its three smaller/neighborhood services and is working toward a 100 percent battery-electric fleet for its Anaheim Regional Transit (ART) service by 2025. ATN broke ground on its new facility, which will ultimately serve 46 electric buses, in late 2020. However, there was an interim need for electric

[4] "Charging Infrastructure Procurement and Installation." *Alternative Fuels Data Center: Charging Infrastructure Procurement and Installation*, U.S. Department of Energy, https://afdc.energy.gov/fuels/electricity_infrastructure_development.html.

infrastructure to charge BEBs received before the facility would be completed in mid-2023. As a result, ATN worked with AMPLY Power (now bp pulse), which would be managing charging for its new facility, to provide a semi-permanent solution using containerized charging infrastructure until the facility could be completed. Each container provides four 80 kW charging stations and one 200 kW station.

Hydrogen Vehicle Technology

While hydrogen fuel cells may be seen as a separate zero-emission technology, vehicles powered by hydrogen are simply electric vehicles with a different power source. Like battery-electric buses, fuel cell electric buses (FCEB) utilize many of the same systems and batteries as an electric bus. However, rather than receiving power through an electric utility, the power is created onboard with hydrogen.

In a FCEB, hydrogen is used to produce electricity, which is then stored in the batteries that are used to power the bus. Only electricity, heat, and water are produced by a FCEB.

While all hydrogen vehicles are zero-emission, the process to create the hydrogen may not be. Hydrogen is created by processing natural gas through a steam reformer or by using an electrolyzer to separate water molecules into hydrogen and carbon atoms. Some hydrogen production processes use non-renewable feed stocks or rely on fossil fuels to produce the heat required to make the hydrogen.

The quality and renewable value of hydrogen is described by color, as shown in Exhibit C.1.7. The optimal type is “green” (or “clean”) hydrogen, which is produced with no greenhouse gas emissions using renewable energy sources. “Black” and “brown” hydrogen have the highest levels of greenhouse gas emissions, as they use black coal or lignite.

Most of the hydrogen on the market today is produced from either natural gas or water. Non-renewable hydrogen is produced from natural gas. Renewable hydrogen is produced by electrolyzing water using solar or wind power, or using biomass (such as agricultural waste) or biogas (from landfills or wastewater treatment plants). While the end product (hydrogen) is always the same, and a hydrogen fuel cell bus always operates with no emissions, the method of creating the hydrogen and the feed stock used make a significant difference in well-to-wheel carbon emissions. In California, transit agencies are required to purchase hydrogen where at least 33 percent is created using renewable methods and feed stocks as a result of Senate Bill 1505.

Carbon emissions can also be captured to lower the Carbon Intensity (CI) score used to measure all greenhouse gas emissions associated with the production, distribution, and consumption of fuel. Each year, new CI benchmarks are set to reach Low Carbon Fuel Standard (LCFS) program goals. Renewable natural gas (RNG) generated from animal waste tends to carry negative CI scores. As such, this source generally receives more favorable pricing in California than RNG produced from other sources (e.g., landfills).

As the hydrogen fuel cell industry continues to progress, hydrogen will be produced in larger quantities with renewable feed stocks and power.

Exhibit C.1.7 "Colors" of hydrogen

Color	Description
Green hydrogen	Hydrogen created by electrolyzing water using clean electricity from renewable sources, such as solar or wind power. Also referred to as "clean hydrogen."
Blue hydrogen	Hydrogen created from natural gas (methane) using steam methane formation. Carbon by-products are captured and stored.
Gray hydrogen	Hydrogen created from natural gas (methane) using steam methane formation but without capturing greenhouse gases resulting from that process.
Black or brown hydrogen	Hydrogen created from black coal or lignite (brown coal). This is the opposite of green hydrogen. Black and brown hydrogen may also be used to refer to any hydrogen made from fossil fuels through a "gasification" process.
Pink hydrogen (also called red or purple)	Hydrogen generated through electrolysis using nuclear energy.
Turquoise hydrogen	Hydrogen made by a process called methane pyrolysis, which also produces solid carbon. This method is new and has not resulted in any large-scale production.
Yellow hydrogen	Hydrogen made by electrolysis using solar power.
White hydrogen	Naturally occurring hydrogen found in underground deposits and created through fracking. Not used in fuel cells.

Source: https://www.nationalgrid.com/stories/energy-explained/hydrogen-colour-spectrum

Transporting hydrogen

Hydrogen is typically delivered to a refueling station in a specialized vehicle. It can also be generated on-site by separating water into hydrogen and oxygen using a reformer. Hydrogen can also be transported through pipes or supplied as a by-product of industrial processes.

If the hydrogen comes in liquid form, it must first be converted into gas before it can be used. To do so the liquid passes through vaporizing towers where it is heated until the liquid is converted into gas. Before hydrogen enters a vehicle, it must be compressed to high pressures. To prevent expansion and maintain energy density while pumping at high pressures, hydrogen must be cooled through a heat exchanger before it passes through a pump. Cooling prevents the vehicle's on-board tanks from overheating, which speeds up refueling.

There are three forms of distribution for the fuel: pipeline, high-pressure tube trailers, and liquefied hydrogen tankers. There are only 1,600 miles of pipelines for hydrogen delivery currently available. These pipelines are located near large petroleum refineries and chemical plants in Illinois, California, and on the Gulf Coast. High-pressure tube trailers are usually used for transporting compressed hydrogen gas less than 200 miles. The tankers can be used to transport liquid hydrogen across long distances.

Construction of a Fueling Station

Hydrogen refueling stations typically include gas storage, compression, and dispensing equipment to refuel vehicles according to internationally agreed protocols[5]. Hydrogen can be produced on location or delivered to the usage (fueling) point. According to the National Renewable Energy Lab, it takes approximately 10 minutes to refuel a hydrogen fuel cell bus. Hydrogen fueling stations are almost always developed through a partner.

The Orange County Transportation Authority (OCTA) partnered with several vendors to construct its initial hydrogen fueling station. Air Products designed and provided enabling equipment for the hydrogen fueling station, and will provide maintenance and hydrogen fuel. Trillium was contracted for construction, operations, and maintenance of the station. Fielder Group engineered upgrades to maintenance facilities to safely service hydrogen-fueled buses.

Golden Empire Transit in Bakersfield had a temporary refueling station (built and fueled by Air Products) at its maintenance facility while a permanent refueling station (through FirstElement) was being built. The permanent station was completed in November 2022. Located near Golden State Avenue and F Street in Bakersfield, the station can store up to 15,000 gallons of liquid hydrogen and has the capacity to fuel up to 30 buses. The station uses a combination of renewable natural gas and regular natural gas to achieve 33 percent renewable hydrogen. Ultimately, GET plans to use only 100 percent renewable hydrogen from recycled water and solar and wind power. The station was funded through an FTA Low or No Emissions Grant and LCTOP funds.

Containerized turn-key hydrogen fueling facilities can also be provided for small-scale operations.

Safety precautions of note: Hydrogen has a wide range of flammable concentrations in air and a lower ignition energy than gasoline or natural gas, which means it can ignite more easily. Consequently, adequate ventilation and leak detection are important elements in the design of safe hydrogen systems.

Hydrogen Case Studies

While many California public transit operators have elected to focus on battery-electric zero-emissions vehicles, two have already committed to a transition to hydrogen vehicles. An overview of their operations is provided below.

[5] "Hydrogen Infrastructure." *H2Haul,* https://www.h2haul.eu/hydrogen-infrastructure/#:~:text=Specific%20technical%20components%20are%20necessary,dispensers%20for%20delivering%20the%20fuel.

Orange County Transportation Authority (OCTA)

The Orange County Transportation Authority's service area spans the county's 34 cities. The OCTA recently introduced 10 hydrogen fuel cell buses and 10 plug-in battery-electric buses. The OCTA also unveiled the largest transit-operated hydrogen fueling station in the nation at its Santa Ana Bus Base. The hydrogen fuel cell buses average six miles per gallon (gas equivalent), and have a daily range of 300 miles. The buses are 40 feet in length and carry 35 seated passengers and 33 standing passengers.

Air Products equipped the new station with hydrogen fueling technology. The station is capable of fueling up to 50 buses, corresponding to 1,500 kilograms of hydrogen, in eight hours. The station fuels an average of 28 kg per bus in approximately six to eight minutes. It has the capability of back-to-back fueling for up to 30 buses, as well as simultaneous fueling with multiple lanes.

The hydrogen fuel is supplied by Air Products. The liquid hydrogen is delivered to the station by truck where it is vaporized and compressed into high pressure gas before being dispensed into the buses. The project was funded using grants from the California Air Resources Board (CARB) Zero-Emission Truck and Bus Pilot Commercial Deployment Project and the South Coast Air Quality Management District (SCAQMD). Assistance from the Center for Transportation and the Environment (CTE) helped to secure the CARB grant.

SunLine Transit

SunLine Transit provides public transit service throughout the Coachella Valley, spanning a 1,120 square mile service area. A media release in 2021 detailed SunLine's procurement of five additional New Flyer *Xcelsior* hydrogen fuel cell buses. The current composition of SunLine Transit's fleet includes 59 CNG buses, 16 hydrogen fuel cell buses, and four battery-electric buses. Following delivery of the new buses, SunLine will have 21 hydrogen fuel cell buses in its fleet.

SunLine has been able to lead the way in hydrogen fueling options due to its investment in a variety of fueling technologies, including a PEM hydrogen electrolyzer. The electrolyzer, which uses electricity to separate water into hydrogen and oxygen, allows the transit agency to manufacture its own hydrogen fuel at its Thousand Palms facility.

In a video uploaded to SunLine's website, Reed Alvarado (SunLine Transit's Communications Coordinator) discussed the agency's hydrogen fuel cell program. Alvarado detailed the agency's plan to build a 2.4-acre solar farm capable of producing 4 MWh of self-sustaining clean energy to power the electrolyzer that produces the hydrogen fuel for the transit fleet. As part of a further investment in zero-emissions fueling technology, SunLine partnered with NICE America Research to establish liquid hydrogen pump technology and a mobile refueling system. This technology features a mobile trailer, reducing the cost and time associated with construction of a permanent structure. SunLine began using this system in October 2021 at its Indio facility.

SunLine Transit was awarded a Zero-Emission Transit Fleet Infrastructure Deployment grant for construction of a stand-alone liquid hydrogen station. Upon completion, expected by the end of 2023, the station in combination with the electrolyzer will have the capability of fueling 57 fixed-route fuel cell electric buses and 39 paratransit fuel cell electric buses.

SunLine currently uses El Dorado National 40' Axess and New Flyer Xcelsior buses. The buses are equipped with Ballard's FCveloCity -HD6, 150kW power system, BAE systems series HybriDrive propulsion system, 50 kg at 5,000 psig of hydrogen storage, and a 200kW, 11.2 kWh nanophosphate lithium-ion battery pack. SunLine's hydrogen fuel cell buses have a 350-mile daily range.

Electric Bus Basics

Whether powered by hydrogen or plugging into a charger, most electric buses ultimately work the same way. An electric motor is connected to a drive shaft and differential. That motor is powered by a high-voltage battery, with an inverter that converts stored DC power to AC power. In a BEB, that high-voltage battery stores energy received through an electric charger. In a FCEB, it stores electricity produced by hydrogen, which is stored in fuel tanks onboard the vehicle. Electric buses have the ability to regenerate power back into the high-voltage battery – the drive unit essentially becomes a generator as the direction of power reverses. Electric buses also have lower-voltage batteries to run other systems such as the radio, lights, or power steering.

Section C.2 | Policy and Legislative Review

California state legislation

In 1998, the State of California passed the Carl Moyer Memorial Air Quality Standards Attainment Program, which sought to retrofit and replace greenhouse gas-producing heavy-duty engines with cleaner technology. The first set of guidelines was adopted as Assembly Bill 1571 in 1999, formally establishing the statutory framework for the program. The Carl Moyer Program has been expanded and extended numerous times, including AB 1390 (2001), Proposition 40 (2002), SB 700 (2003), AB 1394 (2004), AB 923 (2004), SB 1107 (2004), SB 225 (2006), AB 1507 (2010), AB 8 (2013), SB 513 (2015), and AB 1274 (2017). Several of these pieces of legislation are discussed further below.

Since its inception, the Carl Moyer Program has provided nearly $1 billion in funding to clean up older high-polluting equipment throughout the state. It currently funds approximately $60 million in annual grants. Projects are selected and grants are administered through local air districts.

Source: California Air Resources Board, "Carl Moyer Program: Laws and Regulations." https://ww2.arb.ca.gov/our-work/programs/carl-moyer-program-laws-and-regulations.

In 2004, Assembly Bill 923 increased the surcharge the Sacramento Metropolitan Area Air Quality Management District could apply to motor vehicle registrations by two dollars and required it to apply the additional funds to the implementation of the Carl Moyer Program. It also allowed air districts in non-attainment areas to increase registration fees by up to four dollars, with funds used for the same purposes. In addition, the bill increased fees on new tires to be used for the disposal and use of used tires.

Source: Assembly Bill 923, introduced by Assembly Members Firebaugh and Pavley, with principal co-authors Assembly Members Steinberg and Chan and Senator Soto. Filed with the California Secretary of State on September 23, 2004.

In 2006, California passed Senate Bill 1505, which amends the Health and Safety Code by addressing hydrogen as an alternative fuel. It codifies the Legislature's intent that the California Hydrogen Highway Blueprint Plan be implemented in a clean and environmentally responsible manner. It required the state board to adopt regulations that would ensure state funding is used for the production of hydrogen that effectively reduces greenhouse gas emissions to meet minimum requirements. The primary goal of this legislation was to ensure hydrogen as a fuel source actually reduces greenhouse gas emissions throughout its lifecycle, not just at the point of use as a fuel.

SB 1505 requires all hydrogen fueling stations receiving state funding to dispense hydrogen that is at least 33.3 percent renewable. As of 2019, all hydrogen stations in California met this requirement, though some were already 100 percent renewably sourced. According to the Hydrogen Fuel Cell Partnership, use of hydrogen that is 33 percent renewable results in greenhouse gas emission reductions roughly equal to battery-electric vehicles charged by the existing power grid, which was 31 percent renewable as of 2018. Some private entities are seeking to far exceed these requirements. The Hydrogen Council, for example, is a global industry coalition that has committed to an ambitious goal of 100 percent of the hydrogen produced for use in transportation being fully decarbonized by 2030.

Sources: Senate Bill 1505, introduced by Senator Lowenthal and Assembly Members Lieu and Pavley. Filed with the California Secretary of State on September 30, 2006.
Hydrogen Fuel Cell Partnership, "AB8 Webinar Questions and Responses from CaFCP and CARB, 2019." https://h2fcp.org/blog/ab8-webinar-questions-and-responses-cafcp-and-carb-2019.

In 2007, Assembly Bill 118 created the Alternative and Renewable Fuel and Vehicle Technology Program, which is administered by the California Energy Commission. This program provides grants, loans and loan guarantees to develop and deploy innovative fuel and vehicle technologies that improve environmental quality, enhance electrical system reliability, increase the efficiency of energy-using technologies, and lower electrical system costs, or provide other similar tangible benefits. The Alternative and Renewable Fuel and Vehicle Technology Fund receives $10 million in annual funding through increased vehicle and vessel registration fees and increased service fees for identification plates between July 1, 2008, and January 1, 2016. AB 118 also increased smog abatement fees during the same period.

AB 118 added Article 11, the Enhanced Fleet Modernization Program, to the Health and Safety Code. This program was aimed at voluntary retirement of high-polluting passenger and light- and medium-duty vehicles. Chapter 8.9 was also added to Part 5 of the Health and Safety Code as the California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007. It created the Alternative and Renewable Fuel and Vehicle Technology Program described above.

Source: Assembly Bill 118, introduced by Assembly Member Nunez. Chaptered by the California Secretary of State on October 14, 2007.

In 2013, Senate Bill 359 provided $30 million to fund the Clean Vehicle Rebate Project and the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project; $10 million to fund the Heavy-Duty Vehicle Air Quality Loan Program; and appropriated $8 million for the enhanced fleet modernization program.

Source: Senate Bill 359, introduced by Senator Corbett. Filed with the California Secretary of State on September 28, 2013.

In 2013, Senate Bill 454 built upon the Alternative and Renewable Fuel and Vehicle Technology Program to create the Electric Vehicle Charging Stations Open Access Act, which prohibited the charging of a subscription fee or requiring a membership to use charging stations. It also required stations to disclose to the public the actual charges for use; provide two payment options; and disclose to the National Renewable Energy Laboratory the station's location, fees, accepted methods of payment, and any network roaming charges for non-members.

Source: Senate Bill 454, introduced by Senator Corbett. Filed with the California Secretary of State on September 28, 2013.

Also in 2013, Assembly Bill 8 extended California's clean vehicle and fuel incentives introduced in AB 118, AB 923, and Carl Moyer legislation through January 1, 2024. It also amended the Alternative and Renewable Fuel and Vehicle Technology Program to make intelligent transportation systems an eligible project, to require the allocation of funds to be based on a cost-benefit score, and to award financial assistance to provide at least 100 publicly available hydrogen fueling stations.

AB 8 also required the California Energy Commission and California Air Resources Board to jointly review and report on progress toward establishing a hydrogen fueling network in California. The most recent report, completed in December 2021, found that California had 52 open retail hydrogen stations, nearly 10,000 light-duty FCEVs were on the road, and that the state was on track to have more than 100 stations by the end of 2023, meeting the AB 8 goal.

Sources: Assembly Bill 8, introduced by Assembly Members Perea and Skinner, with principal co-author Senator Pavley. Filed with the California Secretary of State on September 28, 2013.
California Energy Commission and California Air Resources Board, "Join Agency Staff Report on Assembly Bill 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California," December 2021. https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf

In 2015, Senate Bill 513 expanded the Carl Moyer Program to include projects involving alternative fuel and electric infrastructure to be eligible uses for fees collected under the program. It also revised the some of the program's activities and requirements and removed the repeal date of January 1, 2024, from provisions on how moneys are allocated and segregated.

Source: Senate Bill 513, introduced by Senator Beale. Filed with the California Secretary of State on October 8, 2015.

The California Air Resources Board's (CARB) adoption of the Innovative Clean Transit (ICT) regulation became effective October 1, 2019. The regulation requires all public transit entities to gradually transition to a 100-percent zero-emission fleet. The regulation also encourages public transit agencies to provide innovative "first and last-mile" connectivity and improved mobility for transit riders. The ICT regulation requires a gradually increasing percentage of buses to be zero-emission buses (ZEBs). The ZEB purchase requirements begin in 2023 and 2026 for large and small transit agencies, respectively. Starting in 2029, 100 percent of all new bus purchases must be ZEBs, with a goal of complete transition to ZEBs (where all buses in each transit agency's fleet are ZEBs) by 2040. Each public transit agency is required to create a Rollout Plan that will guide the implementation of zero-emission bus fleets.

Source: California Air Resources Board, updated January 9, 2020.

Federal legislation

In 2020, three members of the U.S. Senate and House of Representatives introduced the Zero-Emission Vehicles Act of 2020, which would amend the Clean Air Act to set a federal zero-emissions vehicle standard and eliminate the sale of gasoline-powered passenger vehicles by 2035. While the legislation was not implemented, it was co-sponsored by several members of Congress, many of whom represent western states such as California, Colorado, and Oregon.

Source: Press Release, "Reps. Mike Levin, Joe Neguse, and Senator Jeff Merkley Introduce Legislation to Transition America to 100% Zero-Emission Vehicles." October 20, 2020.
https://mikelevin.house.gov/media/press-releases/reps-mike-levin-joe-neguse-and-senator-jeff-merkley-introduce-legislation

On January 27, 2021, President Biden signed an Executive Order containing a number of zero-emission vehicle-related provisions. The Order established the While House Office of Domestic Climate Policy and a National Climate Task Force. It also identified a Federal Clean Electricity and Vehicle Procurement Strategy, which seeks to facilitate the use of "clean and zero-emission vehicles for Federal, State, local, and Tribal government fleets" and ensure union jobs are retained and created with respect to the operation and maintenance of electric fleets.

Source: President Joe Biden, "Executive Order on Tackling the Climate Crisis at Home and Abroad." January 27, 2021.
https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/

The Bipartisan Infrastructure Law (BIL), Pub. L. 117-58, signed by President Biden on November 15, 2021, amended the statutory provisions for these programs to include the requirement that any application for projects related to zero-emission vehicles include a Zero-Emission Transition Plan. The Bipartisan Infrastructure Law, as enacted in the Infrastructure Investment and Jobs Act, authorizes up to $108 billion for public transportation – the largest federal investment in public transportation in the nation's history.

As defined in statute, a Zero-Emission Transition Plan must, at a minimum:

1. Demonstrate a long-term fleet management plan with a strategy for how the transit agency intends to use the current request for resources and future acquisitions.
2. Address the availability of current and future resources to meet costs for the transition and implementation.
3. Consider policy and legislation impacting relevant technologies.
4. Include an evaluation of existing and future facilities and their relationship to the technology transition.
5. Describe the partnership of the transit agency with the utility or alternative fuel provider.
6. Examine the impact of the transition on the applicant's current workforce by identifying skill gaps, training needs, and retraining needs of the existing workers of the applicant to operate and maintain zero-emission vehicles and related infrastructure and avoid displacement of the existing workforce.

Source: Federal Transit Administration; Zero-Emission Fleet Transition Plan, updated March 11, 2022

On December 8, 2021, President Biden signed another Executive Order containing a number of zero-emission vehicle-related provisions. It called for the federal government to achieve 100-percent carbon pollution-free electricity generation by 2030; 100 percent zero-emission vehicle acquisitions by 2035, including 100-percent zero-emission light-duty vehicle acquisitions by 2027; and climate-resilient infrastructure and operations. It called for each agency with a fleet of 20 or more vehicles to develop and annually update a zero-emission fleet strategy including "optimizing fleet size and composition; deploying zero-emission vehicle re-fueling infrastructure; and maximizing acquisition and deployment of zero-emission light-, medium, and heavy-duty vehicles where the General Services Administration (GSA) offers one or more zero-emission vehicle options for that vehicle class." The Order also established a Buy Clean Task Force, which was charged with providing recommendations on "policies and procedures to expand consideration of embodied emissions and pollutants of construction materials" for federally-funded projects.

Source: President Joe Biden, "Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability." December 8, 2021. *https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/*

In December 2021, the U.S. Secretary of Energy and U.S. Secretary of Transportation formed a Joint Office of Energy and Transportation to support build-out of a nation-wide electric vehicle charging network. The Office is intended to accelerate deployment of the network, providing technical assistance to states and other entities to strategically build the required infrastructure. The Bipartisan Infrastructure Law included $7.9 billion in funding for the charging network.

Source: Press Release, "DOE and DOT Launch Joint Effort to Build Out Nationwide Electric Vehicle Charging Network." December 14, 2021. https://www.transportation.gov/briefing-room/doe-and-dot-launch-joint-effort-build-out-nationwide-electric-vehicle-charging

Other federal legislation includes the Federal Transit Administration's (FTA) Grants for Buses and Bus Facilities Competitive Program (49 U.S.C. § 5339(b)) and the Low or No Emission Program (49 U.S.C. § 5339(c)).

The Grants for Buses and Bus Facilities Competitive Program (49 U.S.C. 5339(b)) makes federal resources available to states and direct recipients to replace, rehabilitate and purchase buses and related equipment and to construct bus-related facilities, while the Low or No Emission competitive program (49 U.S.C. § 5339(c)) provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities. As noted earlier, both programs require agencies to have a zero-emission transition plan in place in order to be eligible for award.

Source: Federal Transit Administration; Grants for Buses and Bus Facilities Program.

Section C.3 | Zero-Emission Fuel Providers

Kern County Electric Vehicle Charging Stations

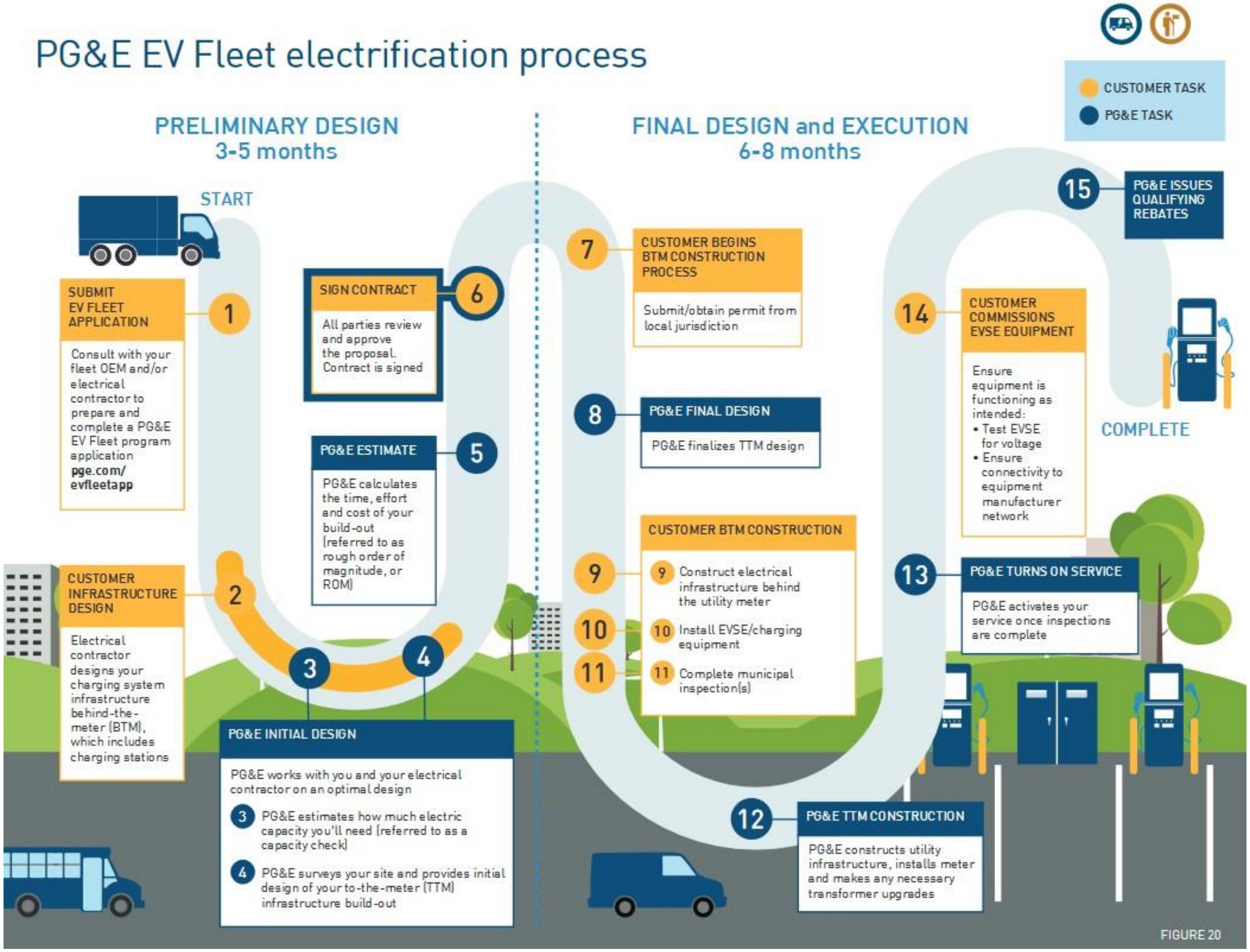
The largest operator of the electric charging stations in Kern County is ChargePoint. Other operators are SemaConnect, Tesla Destination, Tesla Supercharger, Electrify America, and EV Connect. This includes a mixture of Level 1, Level 2, and Level 3/direct current (DC) fast chargers.

In April 2021, the Bakersfield city council unveiled a proposal to add 30 ChargePoint charging stations to six city-owned areas of Bakersfield. As of April 21, 2021, when the article was written, there were 71 charging locations located in Kern County, with 42 in Bakersfield. Kern County will need to engage Pacific Gas & Electric (PG&E) to discuss potential resources and funding. Southern California Edison (SCE) offers EVCS related programs and resources, such as the *Charge Ready* program.

Electrical infrastructure development

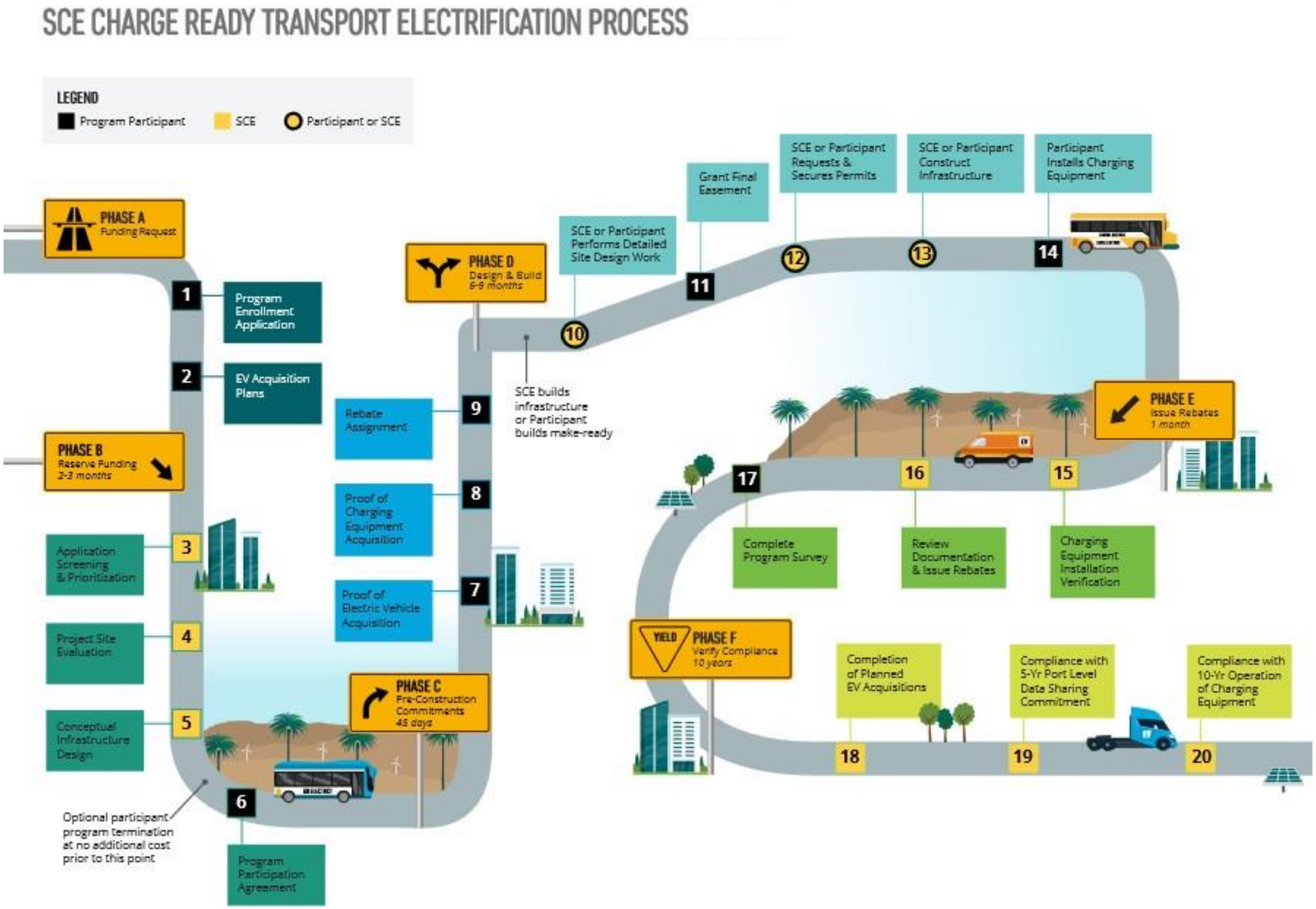
The charging station operator, or electrical contractor, is different from the electric utility. PG&E, for example, works closely with electrical contractors in developing electrified fleets and charging infrastructure. PG&E is responsible for everything up to the electric meter (e.g., transformers, distribution lines, etc.), while the electrical contractor handles everything on the other side of the meter (e.g., charging stations and any electric infrastructure behind the meter). SCE operates a similar program, but also provides an option where SCE handles the customer-side infrastructure work. The electrification process for PG&E's EV Fleet program and SCE's *Charge Ready* program are shown in Exhibits C.3.1 and C.3.2.

Exhibit C.3.1 PG&E electrification infrastructure process



Source: PG&E, Take Charge: A Guidebook to Fleet Electrification and Infrastructure, www.pge.com.

Exhibit C.3.2 Southern California Edison electrification infrastructure process

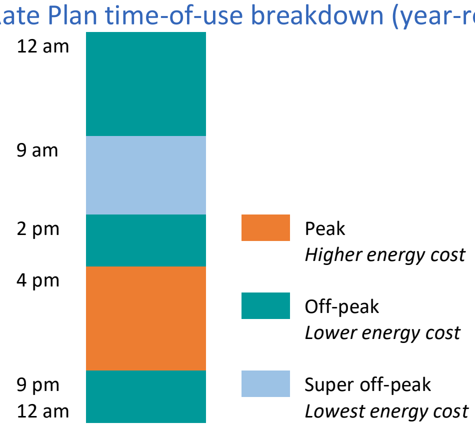


Source: Southern California Edison, Take Charge: A Guidebook to Fleet Electrification and Infrastructure. www.sce.com.

Purchasing electricity

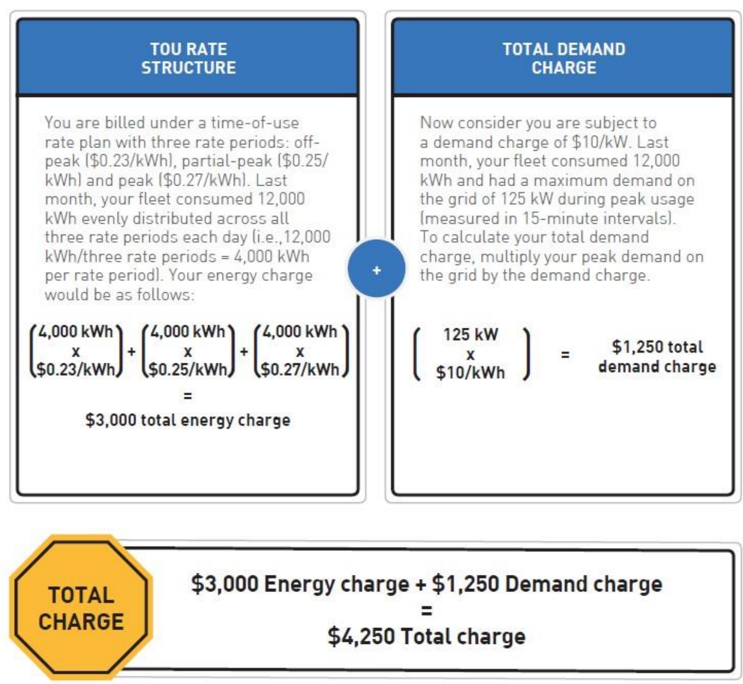
An important concept to understand when considering a battery-electric fleet is the cost of electricity. The cost of electricity can vary significantly based on the time of day, time of year, and overall demand. Therefore, it is important to work with the electric utility to identify a commercial electric rate plan that offers the best match for the agency's needs. PG&E, for example, offers a Business Rate Plan that combines a monthly cost (based on overall estimated usage) and a time-of-use (TOU) charge based on when during the day the electricity usage occurs. Prices during periods of high demand (peak periods) are higher than those during periods of lower demand (off-peak periods).

Exhibit C.3.3 PG&E Business Rate Plan time-of-use breakdown (year-round)



Source: www.pge.com.

Exhibit C.3.4 Example of electricity cost with demand charges



Source: PG&E, Take Charge: A Guidebook to Fleet Electrification and Infrastructure, www.pge.com.

Kern County Hydrogen Fueling Stations

According to the alternative fuels data center from the U.S. Department of Energy, there are no public or planned hydrogen fueling stations near Kern County. The closest facility is approximately two hours north of Bakersfield in Coalinga at 24505 West Dorris Avenue. The retail facility, owned and operated by FirstElement Fuel, features hydrogen storage (approximately 180 kg), compression, and cooling equipment; a dispenser with two fueling hoses; a customer payment system; a canopy; and a concrete pad for fuel cell vehicles while fueling. The next closest is a True Zero retail facility located at 15544 San Fernando Mission Boulevard in Mission Hills, approximately two hours south of Bakersfield, which maintains more than 600 kg of fuel. Neither of these stations was designed to fuel transit vehicles.

Golden Empire Transit (GET) in Bakersfield launched several new hydrogen fuel cell buses in October 2021. In January of that year, GET issued a Request for Proposals (RFP) for a temporary hydrogen fueling station for the newly purchased buses. In March 2021, the GET board of directors awarded a contract to Air Products in the amount of $1,200,000 for the lease of hydrogen fueling equipment and hydrogen fuel supply. This station is located at GET's maintenance facility at 1830 Golden State Avenue in Bakersfield.

After issuing the RFP for a temporary fueling station, GET issued a second RFP in February 2021 for the construction of a permanent hydrogen fueling station. In April 2021, the GET board awarded a contract to FirstElement Fuel in the amount of $7,648,681 to construct a hydrogen fueling station to be located at 1920B Golden State Avenue in Bakersfield. A ribbon-cutting for the permanent station – the first hydrogen fueling station in Kern County – was held in November 2022. It has the capacity to fuel 30 buses.

The primary suppliers for the current stations in California are True Zero, Iwatani, Air Products, and Shell Hydrogen. Messer operates a single station. Air Products operates and supplies Golden Empire Transit's temporary station. FirstElement Fuel will operate and supply the permanent fueling station once it is constructed.

Purchasing hydrogen

Unlike electricity, there is no public utility available from which to purchase hydrogen fuel. As mentioned earlier, hydrogen can either be created on-site or brought in from a commercial hydrogen producer via truck or pipeline. Historically, hydrogen can be purchased for approximately $14-$16 per kilogram in California, though some industry analysts predict prices will fall in the coming years as the development of hydrogen projects and technologies increases. One kilogram of hydrogen is the approximate equivalent of one gallon of gasoline. For hydrogen that is delivered via truck, transportation fees will increase the overall cost of the fuel. These fees will also depend on the quantity of hydrogen being delivered.

The amount of fuel provided via tanker depends upon the vendor, as tanker sizes vary. Golden Empire Transit reports being able to get approximately 120 fuel refills from a single tanker delivery, depending upon the level of fuel remaining in the transit vehicles.

Section C.4 | Operational and Fleet Considerations

Several factors influence a transit operator's decision as to what type of zero-emission technology to pursue. Some operators are able to utilize a single power type, while others many need to utilize a mixed-power fleet.

There are advantages and disadvantages to each fuel type (battery-electric and hydrogen fuel cell), and neither is a clear "winner" over the other. These are detailed in Exhibit C.4.1.

Exhibit C.4.1 Advantages and disadvantages of zero-emission fuel types

	Electric	Hydrogen
Advantages	• Increased access to fueling infrastructure (both commercial and with other transit operators) • Programs currently in place to assist with electrical infrastructure development and construction • Programs currently in place to assist with BEB vehicle purchases	• Fueling is fast (typically 6-10 minutes) • Longer vehicle range (can make longer roundtrips without needing mid-route fueling • Partnerships with hydrogen suppliers may be available for temporary fueling facility • More likely to result in a 1:1 replacement for existing vehicles
Disadvantages	• Fueling is time-consuming • High-power DC fast chargers are not always readily available • Vehicle range can be limited (depending on battery storage) • Vehicle range is variable depending upon route conditions and driver skill • Not likely to result in a 1:1 replacement for existing vehicles	• Limited access to fueling infrastructure (especially in Kern County) • High up-front cost to develop a fueling station • Vehicle range is variable depending upon route conditions and driver skill

With respect to vehicle range, Kern Transit's current route miles range from 38.6 miles roundtrip (Route 145 – Lamont) to 218.3 miles roundtrip (Route 100 – Lancaster) and 210.5 miles roundtrip (Route 130 – Santa Clarita).

Finding the right fleet mix to address long routes can be a challenge. While higher capacity batteries are becoming more readily available, they come with added weight that may not be feasible for cutaway vehicles, for example. In addition, because the fuel is never "used up" in the same way gas or diesel is, the added weight of the vehicle is constant. This can result in a bit of a "Catch-22" – by adding more battery capacity to extend range, the added weight of the batteries potentially reduces the range.

If increasing the battery capacity is not a viable solution, what options are available? First is to extend the range using on-route charging. This may be an option for some routes, which could potentially dwell at one end of the route to "boost" the state of charge. However, since the County does not own facilities in these locations, jurisdiction could be a concern. A second option is to rethink routes in order to make them more accessible given the range parameters of available battery-electric vehicles. Given Kern Transit is regional in nature, this is not an option for the majority of routes. The third option is to consider a different fuel, such as hydrogen, that can provide a quick turnaround for refueling.

Seven of the routes have roundtrip mileage greater than 100 miles, while five are between 60 and 100 miles. For long routes, such as Route 100 and Route 130, the vehicle must be able to either 1) make the complete roundtrip without refueling or 2) have a reliable on-route fuel source. From an operational perspective, hydrogen makes the most sense for these routes, as the assigned vehicle would not require refueling until the end of the route, and refueling afterward would take only a few minutes. Route 150 is also a good candidate for hydrogen, as it can fuel in Bakersfield after the inbound portion of its trip. While there are some battery-electric buses that have a range of more than 300 miles, and there is the potential for on-route charging in some destination locations (i.e., Lancaster), the vehicle would need to refuel after the roundtrip and would need around four or five hours to charge, which would require a larger fleet. Even for the shorter routes, vehicles may need to charge after just one or two trips, depending on the battery capacity.

Another challenge in determining the fleet mix is access to fueling facilities. For hydrogen, all vehicles would likely need to be fueled at the same location. Since hydrogen is most likely to be used for the longer routes, and given said routes originate from (or have access to) the operations facility in Bakersfield, a hydrogen fueling facility would need to be installed at that location. However, there is one bus on Route 100 that does not originate in Bakersfield. If that bus can be rotated back to Bakersfield at the end of its trip, then fueling can occur there.

If the County decides that the balance of the transit fleet should reflect battery-electric buses, it would need to identify charging locations for vehicles that are not based out of the operations facility in Bakersfield. Storage yards in Lake Isabella, Mojave, and Tehachapi are leased, and installation of charging infrastructure would be contingent upon approval of the property owners. Lastly, grant funding may not allow use of a short-term lease facility.

Fortunately, there are several transit operators within the region that have already built or planned their zero-emission fleets, which offers potential coordination opportunities for Kern Transit. First, both Antelope Valley Transit (AVTA) and Santa Clarita Transit will be utilizing battery-electric vehicles. While Santa Clarita is still in the early stages of its transition, AVTA has fully transitioned to a battery-electric fleet and has installed inductive charging at its primary transit center in Lancaster. Access to this facility could provide a mid-route "boost" for Route 100, if doing so would enable a battery-electric bus to complete the roundtrip. However, the County would need to purchase vehicles that are compatible with AVTA's system, and negotiate fees for use.

Santa Clarita Transit, in its ZEB rollout plan, has outlined a four-phase plan that would ultimately result in on-site reforming of hydrogen fuel sufficient for 30 vehicles as well as electric generation via 30 charging stations by 2029. This plan does not appear to be on schedule, even though the first phase would provide for hydrogen fueling for six vehicles by 2020, according to the plan. Once constructed, this could be a supplemental source of hydrogen fuel for Route 130.

Finally, as mentioned earlier, Golden Empire Transit (GET) is in the process of transitioning at least a portion of its fleet to hydrogen fuel cell technology, and has implemented a temporary fueling facility at its Bakersfield yard. A more permanent installation will be commissioned at GET's new operations and maintenance facility. This could be another opportunity to share ZEB resources. If the County is able to purchase hydrogen from GET, it may not need to construct its own hydrogen fueling facility.

Section D | Current Bus Fleet Composition and Future Bus Purchases

The purpose of this section is to analyze the range and vehicle requirements of a zero-emission fleet. It looks at both replacement of the existing fleet as well as the number and type of additional vehicles needed to accommodate the range and fueling/charging requirements of zero-emission vehicles. Given Kern Transit operates out of several locations, this section also takes into consideration where vehicles for the various routes are typically stored and fueled.

Section D.1 | Current Bus Fleet Composition

Kern Transit's current fleet is comprised of a mix of 22-foot cutaway buses (27), 25-foot cutaway buses (6), 32-foot cutaway buses (5), 35-foot transit buses (9), and 40-foot transit buses (11). Forty-four of the active vehicles are diesel-fueled, nine are CNG-fueled, and five are gasoline. The County also has four vehicles that are currently inactive: one diesel, one CNG, one gasoline, and one battery-electric.

Exhibit D.1.1 Current bus fleet

Number of Buses	Engine Model Year	Bus Model Year	Fuel Type	Bus Type
6	2003	2003	Diesel	Cutaway (25')
1 (inactive)	2009	2009	Diesel	Standard (32')
3	2009	2009	Diesel	Cutaway (32')
11	2011	2011	Diesel	Cutaway (22')
6	2012	2012	Diesel	Cutaway (22')
1 (inactive)	2013	2013	CNG	Standard (35')
4	2013	2013	CNG	Standard (35')
1	2013	2014	CNG	Standard (35')
5	2015	2015	Diesel	Cutaway (22')
7	2015	2015	Diesel	Standard (40')
4	2015	2015	CNG	Standard (35')
2	2017	2017	Gasoline	Cutaway (22')
4	2017	2017	Diesel	Standard (40')
1 (inactive)	N/A	2018	Battery-electric	Standard (40')
2	2019	2019	Gasoline	Cutaway (22')
2	2020	2020	Diesel	Cutaway (32')
1	2021	2021	Gasoline	Cutaway (22')
1 (inactive)	2021	2021	Gasoline	Cutaway (22')

The majority of vehicles are stored in Bakersfield, though there are also satellite storage facilities in Lake Isabella, Mojave, and Tehachapi. Both of the satellite facilities are leased. Dial-A-Ride vehicles operating in Frazier Park are stored at Kern County Roads Yard in Lebec.

Exhibit D.1.2 Current distribution of buses by route and storage yard

Route	Vehicles used	Storage yard
100 – Bakersfield – Lancaster	40' diesel (5)	Bakersfield (4) Mojave (1)
110 – Delano - Bakersfield	35' CNG (3)	Bakersfield
115 – Lost Hills – Bakersfield	Cutaway (1)	Bakersfield
120 – Taft – Bakersfield	35' CNG (3)	Bakersfield
130 – Santa Clarita – Bakersfield	Cutaway (3)	Bakersfield
140 – Lamont – Bakersfield North	Large cutaway (Freightliner) (2)	Bakersfield
145 – Lamont – Bakersfield South	Cutaway (2) (weekdays) 35' CNG (2) (weekends)	Bakersfield
150 – Lake Isabella – Bakersfield	Cutaway (1); Large cutaway (Freightliner) (1) (Sunday)	Bakersfield
227 – Lake Isabella – Ridgecrest	Large cutaway (Freightliner) (2)	Lake Isabella
230 – Mojave – Ridgecrest	Cutaway (1)	Mojave
240 – Boron – Mojave	Cutaway (1)	Mojave
250 – California City - Lancaster	40' diesel (2)	Mojave
Bakersfield Medical DAR	Cutaway (1)	Bakersfield
Frazier Park DAR	Cutaway (2)	Frazier Park
Kern River Valley DAR	Cutaway (5)	Lake Isabella
Lamont DAR	Cutaway (2)	Bakersfield
Mojave DAR	Cutaway (1)	Mojave
Rosamond DAR	Cutaway (2)	Mojave
Tehachapi DAR	Cutaway (2)	Tehachapi

Section D.2 | Future Bus Purchases

This section examines future bus purchases with respect to transitioning the entire Kern Transit fleet to zero-emission vehicles. The County would continue purchasing conventionally fueled vehicles through FY 2028, though would begin purchasing battery-electric vehicles in FY 2026 so as to remain in compliance with the State's Innovative Clean Transit (ICT) legislation. Effective January 1, 2026, one-quarter of vehicle purchases must be zero-emission vehicles. This schedule enables the County to be in compliance with that requirement. Beginning January 1, 2029, all new vehicle purchases must be zero-emission vehicles, with a goal of a complete transition of the fleet to zero-emission by 2040. Under this schedule, Kern Transit would achieve full transition of the fleet to zero-emission in 2040 with the replacement of its last 40-foot diesel buses.[6]

For the purposes of this report, we will refer to both the 22-foot and 25-foot cutaways as "small cutaways." Currently, the cutaway vehicles available are Class 4, which is consistent with the 25-foot cutaways. No 22-foot battery-electric cutaways are currently on the market, though large vans are available. Likewise, there are no 32-foot battery-electric cutaways (herein referred to as "large cutaways") on the market. As such, these vehicles are programmed for replacement in ten or more years, which may allow the market to catch up to the County's needs. Otherwise, the County may need to consider using a 30- or 35-foot bus on those routes, rather than a cutaway, if that passenger capacity is needed and there are no geographical limitations for those routes.

The fleet replacement plan was designed to introduce electric vehicles first, but not immediately, which provides the County sufficient opportunity to put charging infrastructure into place. Electric cutaways would begin being purchased in FY 2026. The first big buses to transition to zero-emission would be four 40-foot diesel buses (2017), which would be converted to battery-electric power in FY 2026 and FY 2027. Additional 35 and 40-foot buses would be purchased as new battery-electric buses beginning in FY 2028.

Hydrogen-fueled 40-foot buses (for the Lancaster route) would be introduced in FY 2029, with hydrogen-fueled cutaways for the Santa Clarita route introduced in FY 2037 and 2039, and for the Lake Isabella route (Route 150) in FY 2039.

Vehicle replacement is only one part of fleet development, however, as additional battery-electric vehicles will be needed to operate many of the routes, or to have a vehicle charged and ready for the Dial-A-Ride services. Rather than being a true spare (to be used when a vehicle is out of service), these extra vehicles need to be available to be switched out when fueling is needed. This is specific to the battery-electric vehicles. For hydrogen fuel cell vehicles, there needs to be a higher spare ratio; while fueling can be done quickly, at present these vehicles have a track record of lower availability than their conventionally fueled counterparts. This results in a fleet that is larger than the current fleet by about 15

[6] The County's inactive BYD battery-electric bus raises important questions about the reliability of such vehicles. The vehicle has never been put into regular service on a Kern Transit route, and is currently at the BYD facility in Lancaster for service. While it is likely newer buses will address issues that made older vehicles less reliable, this is still a concern. As such, a phased approach (such as that shown here) is necessary to ensure the battery-electric and hydrogen buses can reliably replace conventionally fueled vehicles. While additional battery-electric spares will be necessary for 100 percent zero-emission operations, the County should plan to keep some conventionally fueled vehicles as spares until the zero-emission fleet can be fully proven.

vehicles. Further discussion regarding operational ranges, charging needs, and other considerations is provided in Section D.3.

A summary of the schedule of future bus purchases is provided below, and further detailed in Exhibits D.2.2 and D.3.2 and Appendix B.

- FY 2024
    - Replace six 2003 25-foot diesel cutaways with comparable conventional fuel (diesel) cutaways (B0134, B1035, B0137, B1039, B1042, B0143).
- FY 2025
    - Replace three 2009 32-foot diesel cutaways with comparable conventional fuel (diesel) cutaways (B0902, B0904, B0906).
    - Replace seven 2011 22-foot diesel cutaways with comparable conventional fuel (diesel) cutaways (B1163, B1164, B1165, B1166, B1167, B1168, B1169).
- FY 2026
    - Replace one 2011 22-foot diesel cutaway with comparable battery-electric cutaway (B1171).
    - Replace two 2012 22-foot diesel cutaways with comparable battery-electric cutaways (B1201, B1202).
    - Replace four 2012 22-foot diesel cutaways with comparable conventional fuel (diesel) cutaways (B1203, B1204, B1272, B1273).
    - Replace two 2013 35-foot CNG buses with comparable conventional fuel (diesel or CNG) buses (B1340, B1350).
    - Convert two 2017 40-foot diesel buses from diesel to battery-electric power (B1747, B1748).
- FY 2027
    - Replace three 2013 35-foot CNG buses with comparable battery-electric buses (B1351, B1420, B1421).
    - Replace one 2015 22-foot diesel cutaway with comparable battery-electric cutaways (B1501).
    - Replace four 2015 22-foot diesel cutaways with comparable conventional fuel (diesel) cutaways (B1502, B1503, B1504, B1505).
    - Replace two 2015 40-foot diesel buses with comparable conventional fuel (diesel) buses (B1540, B1541,)
    - Convert two 2017 40-foot diesel buses from diesel to battery-electric power (B1749, B1750).
- FY 2028
    - Replace three 2011 22-foot diesel cutaways with comparable battery-electric cutaways (B1160, B1161, B1162).
    - Replace two 2017 22-foot gasoline cutaways with comparable battery-electric cutaways (B1701, B1702).
- FY 2029
    - Replace five 2015 40-foot diesel buses with comparable hydrogen fuel cell buses (B1542, B1543, B1544, B1545, B1546).

- FY 2030
  - Replace four 2017 35-foot CNG buses with comparable battery-electric buses (B1547, B1548, B1549, B1550).
  - Replace two 2019 22-foot gasoline cutaways with comparable battery-electric cutaways (B1904, B1905).
- FY 2032
  - Replace two 2020 32-foot diesel cutaways with comparable battery-electric cutaways (B1902, B1903).
  - Replace one 2021 22-foot gasoline cutaway with a comparable battery-electric cutaway (B2102).
- FY 2034
  - Purchase two 40-foot battery-electric buses.
- FY 2035
  - Replace six 2024 25-foot diesel cutaways with comparable battery-electric cutaways.
  - Purchase two 40-foot battery-electric buses.
- FY 2036
  - Replace three 2025 32-foot diesel cutaways with comparable battery-electric cutaways.
  - Replace seven 2025 22-foot diesel cutaways with comparable battery-electric cutaways.
- FY 2037
  - Replace two 2026 22-foot diesel cutaways with comparable battery-electric cutaways.
  - Replace two 2026 22-foot diesel cutaways with comparable hydrogen fuel cell cutaways.
- FY 2038
  - Replace two 2026 35-foot CNG buses with comparable battery-electric buses.
  - Purchase six 22-foot battery-electric cutaways.
- FY 2039
  - Replace four 2027 22-foot diesel cutaways with comparable hydrogen fuel cell cutaways.
  - Purchase three 22-foot battery-electric cutaways.
- FY 2040
  - Replace two 2027 40-foot buses with comparable hydrogen fuel cell buses.

Not reflected above are a 22-foot cutaway (B2101) that the County is anticipating will be replaced by the manufacturer and the existing BYD 40-foot battery-electric bus (B1901), both of which are currently inactive. If replaced in the next year, the cutaway would be replaced by a comparable battery-electric vehicle in FY 2034, while the 40-foot bus would likely be replaced after FY 2036 (assuming it goes into operation within the next year or two).

Depending on how the County wishes to use 35-foot and 40-foot buses, it may be some of the 35-foot buses are replaced with 40-foot buses, rather than purchasing additional 40-foot buses as expansion vehicles.

Exhibit 3 demonstrates how the fleet would be distributed to the various storage locations based on the current system needs. Only vehicles based in Bakersfield would be hydrogen fuel cell; all others would be battery-electric.

Exhibit D.2.1 Fleet by storage location

Storage/Fueling Location	Fleet
Bakersfield	Small cutaways (BEB) (9 + 3 spare) Small cutaways (FCEB) (2 + 1 spare) Large cutaways (BEB) (4 + 1 spare) 35' buses (BEB) (4 + 1 spare) 40' buses (BEB) (3 + 1 spare) 40' buses (FCEB) (5 + 2 spares)
Mojave	Small cutaways (BEB) (9 + 2 spares) 40' buses (BEB) (4 + 1 spare)
Lake Isabella	Small cutaways (BEB) (6 + 1 spare) Small cutaways (FCEB) (2 + 1 spare) Large cutaways (BEB) (3 + 1 spare)
Frazier Park	Small cutaways (BEB) (2 + 1 spare)
Tehachapi	Small cutaways (BEB) (2 + 1 spare)

Exhibit D.2.2 Future bus purchases

Timeline (Year)	Total # of Buses to Purchase	Number of ZEB Purchases	% of Annual ZEB Purchases	ZEB Bus Type(s)	ZEB Fuel Type(s)	# of Conventional Bus Purchases	% of Annual Conventional Bus Purchases	Type(s) of Conventional Buses	Fuel Type(s) of Conventional Buses
FY 2024	6	0	0%	N/A	N/A	6	100%	Cutaway	Diesel
FY 2025	10	0	0%	N/A	N/A	3	100%	Cutaway	Diesel
FY 2026	7	3	43%	Cutaway	BEB (depot)	6	67%	Cutaway	Diesel
	2	0	0%	Standard	BEB (depot)			Cutaway	Diesel
FY 2027	5	1	20%	Cutaway	BEB (depot)	6	60%	Cutaway	Diesel
	5	3	60%	Standard	BEB (depot)			Standard	Diesel
FY 2028	5	5	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
FY 2029	5	5	100%	Standard	Hydrogen	0	0%	N/A	N/A
FY 2030	4	4	100%	Standard	BEB (depot)	0	0%	N/A	N/A
	2	2	100%	Cutaway	BEB (depot)			N/A	N/A
FY 2032	3	3	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
FY 2034	2	2	100%	Standard	BEB (depot)	0	0%	N/A	N/A
FY 2035	6	6	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
	2	2	100%	Standard	BEB (depot)			N/A	N/A
FY 2036	10	10	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
FY 2037	3	3	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
	2	2	100%	Cutaway	Hydrogen			N/A	N/A
FY 2038	6	6	100%	Cutaway	BEB (depot)	0	0%	N/A	N/A
	2	2	100%	Standard	BEB (depot)			N/A	N/A
FY 2039	4	4	100%	Cutaway	Hydrogen	0	0%	N/A	N/A
	3	3	100%	Cutaway	BEB (depot)			N/A	N/A
FY 2040	2	2	100%	Standard	Hydrogen	0	0%	N/A	N/A

Section D.3 | Required Operational Ranges

As a regional transit provider operating throughout a very large county, Kern Transit covers a very broad service area. This results in some routes that are extremely long (up to 218 miles for Route 100), while others (such as Routes 140 and 145 or local Dial-A-Ride programs) have much lower daily mileage accumulations.

The route mileage shown in Exhibit 5 represents the longest trip the route operates, plus deadhead miles to and from the yard, separated by outbound and inbound direction as well as the total mileage. They are presented in order of total route length (longest to shortest). Exhibit 5 also includes the type of vehicle used to operate the route and the days of service for each route.

In addition to the route mileage, Exhibit D.3.1 also includes a mileage requirement inclusive of a "buffer" of 10 percent. This is due to reductions in maximum performance of battery-electric vehicles during winter conditions (which can reduce performance by 30 percent) and high heat (which can reduce performance by 15 percent). Given the nature of most of Kern Transit's routes, and the lack of on-route charging opportunities, it is critical to plan for the "worst-case" scenario in terms of range, rather than risk stranding passengers due to lack of sufficient power. For hydrogen vehicles, the buffer ensures they will not run out of fuel somewhere there is no refueling capability. For BEBs, the necessary battery capacity required to provide the longest range represents 80 percent of the battery capacity, to provide additional security.

It is also important to ensure the majority of vehicles types are operated on several different routes and Dial-A-Ride services. For the planned smaller battery-electric cutaways, even though not all of them require the same range, it is recommended they have a longer range to promote cross-utilization between the routes and services.

For the larger (32-foot) cutaways, there is not a comparable battery-electric vehicle currently on the market. However, given the replacement dates for the 32-foot cutaways are identified as FY 2032 and FY 2036, it is likely there will be further technology developments that will result in a 32-foot cutaway with the necessary range of at least 165 miles being available. However, if this range is not available in such a vehicle, the County will need to consider procuring 30- or 35-foot standard buses on the Lake Isabella-Ridgecrest route to ensure the range is adequate (assuming the geography allows such a bus to be operated). If feasible with current CNG fueling capacity, we recommend testing a 35' standard bus on Route 227 to determine if using such a vehicle is possible for this route.

Exhibit D.3.1 Operational ranges by fixed route

Route	Per Trip								
Route	Outbound (miles)	Inbound (miles)	Total (miles)	Minimum range (mi) needed (includes 10% buffer)	Minimum battery capacity (kWh)	Usable battery capacity (80%) (kWh)	Current Vehicles	Service Days	ZEV Fleet Requirement
100 (Lancaster)	110.90	107.39	**218.29**	240	645	516	40’ diesel (5)	Monday - Sunday	5-6
130 (Santa Clarita)	106.22	104.25	**210.47**	232	622	498	Cutaway (3)	Monday - Saturday	2-3
227 (Ridgecrest)	75.48	73.63	**149.11**	164	441	353	Cutaway (2) (Freightliner)	Monday, Wednesday, & Friday	2-3
230 (Mojave)	69.36	68.90	**138.25**	152	409	327	Cutaway (1)	Monday, Wednesday, & Friday	2
250 (California City)	69.09	68.94	**138.03**	152	408	326	40’ diesel (2)	Monday - Saturday	4
110 (Delano)	59.57	59.16	**118.73**	131	351	281	35’ CNG (3)	Monday - Sunday	3
115 (Lost Hills)	52.93	53.14	**106.07**	117	314	251	Cutaway (1)	Thursday & Saturday	2
150 (Lake Isabella)	50.55	49.34	**99.89**	110	295	236	Cutaway (1) (Freightliner on Sunday)	Monday - Sunday	2-3
120 (Taft)	46.39	44.84	**91.22**	100	270	216	35’ CNG (3)	Monday - Saturday	2-3
240 (Boron)	36.99	36.90	**73.89**	81	218	175	Cutaway (1)	Monday, Wednesday, & Friday	2
140 (Arvin)	34.51	32.79	**67.30**	74	199	159	Cutaway (2) (Freightliner)	Monday - Friday	4
145 (Lamont) (weekend)	30.66	29.51	**60.17**	66	178	142	35’ CNG (2)	Saturday - Sunday	2
145 (Lamont) (weekday)	19.96	18.68	**38.64**	43	117	93	Cutaway (2)	Monday - Friday	3

Minimum range based on mileage per trip. Some vehicles will need greater than the minimum because they must be able to complete two trips on a single charge.

Exhibit D.3.2 Range of future ZEB purchases

Timeline Year	Number of ZEVs	Bus Type(s)	Minimum Range Needed	Recommended Battery Capacity/ Onboard H^2 Storage
FY 2026	3	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2026	2	Battery-electric 40' standard bus (conversion)	130 miles	350 kWh
FY 2027	4	Battery-electric 35' standard bus	130 miles	350 kWh
FY 2027	2	Battery-electric 40' standard bus (conversion)	130 miles	350 kWh
FY 2028	5	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2029	5	Hydrogen fuel cell 40' standard bus	250 miles	35 kg
FY 2030	4	Battery-electric 35' standard bus	100 miles	275 kWh
FY 2030	2	Battery-electric small cutaway bus	120 miles	325 kWh
FY 2032	5	Battery-electric large cutaway bus	165 miles	445 kWh
FY 2032	1	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2034	2	Battery-electric 40' standard bus	150 miles	400 kWh
FY 2035	2	Battery-electric 40' standard bus	150 miles	400 kWh
FY 2035	6	Battery-electric small cutaway bus	150 miles	400 kWh
FY 2036	3	Battery-electric large cutaway bus	150 miles	400 kWh
FY 2036	7	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2037	2	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2037	2	Hydrogen fuel cell small cutaway bus	235 miles	35 kg
FY 2038	2	Battery-electric 35' standard bus	130 miles	350 kWh
FY 2038	6	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2039	3	Battery-electric small cutaway bus	100 miles	275 kWh
FY 2039	4	Hydrogen fuel cell small cutaway bus	235 miles	35 kg
FY 2040	2	Hydrogen fuel cell 40' standard bus	250 miles	35 kg

Section D.4 | Conversion of Existing Fleet

While the purchase of new battery-electric buses is appealing, it is also expensive. Conversion of a conventionally powered vehicle (such as diesel) to battery-electric can be done for approximately half the cost of a new vehicle, within a much shorter timeframe. The County has four 2017 40-foot diesel buses that would be good candidates for such conversion. A company such as Complete Coach Works (CCW) can re-manufacture the bus, install an all-electric-powered drivetrain, and return it in a like-new condition. This reduces the amount of material waste by reusing the majority of the vehicle, which overall has a longer useful life than the engine and power components. When the conversion is done at the time a mid-life engine refurbishment would generally be undertaken, this can extend the useful life of the bus by six years or more (that is, a total useful life of at least 18 years instead of 12).

In late 2021, CCW completed a battery-electric conversion of a 14-year-old 60-foot articulated diesel bus for TriMet in Portland, Oregon. The conversion included a complete restoration of the bus, installation of a Voith Electric Drive System (VEDS), and installation of CCW's Zero-Emission Propulsion System (ZEPS) battery technology, which included a 605 kWh lithium ion NMC battery pack. TriMet has been pleased with the converted bus's performance. CCW was also engaged to convert three 40-foot diesel buses to battery-electric at the same time. TriMet expects to get an additional 10 to 12 years of use out of the refurbished and converted buses.

Exhibit D.4.1 Schedule of converting conventional buses to zero-emission buses

Timeline Year	Number of ZEVs	Bus Type(s)	Required BEB Range/ Onboard H^2 Storage
2026	2	Standard (40') battery-electric	130 miles
2027	2	Standard (40') battery-electric	130 miles

Exhibit D.4.2 Range for converting conventional buses to zero-emission buses

Estimated Cost per Bus	Battery Capacity/ H^2 Storage	Range
$400,000	350 kWh	130 miles

Section E | Facilities and Infrastructure Modifications

The introduction of two new fueling types will require extensive upgrades to the County's current public transit vehicle storage and fueling infrastructure.

Kern Transit uses the County Roads Yards in several communities to fuel its buses, and these facilities are shared with other County fleets. Commercial fueling facilities are used in Mojave and Kernville, while fuel is also purchased from the Kern County Superintendent of Schools and Golden Empire Transit District in Bakersfield.

A factor complicating the anticipated transition is the continued use of leased vehicle storage in Mojave, Lake Isabella, and Tehachapi. Not only are these facilities limited to vehicle storage --not fueling-- the County does not have the ability to make modifications at any of these facilities absent the participation of the facility owner. This makes zero-emission fueling even more of a challenge in the outlying service areas.

Section E.1 | Existing Facilities

Kern Transit uses two Kern County Roads Yards for its primary vehicle storage, maintenance, and fueling. These yards are located at 5438 Victor Street and 2903 Patton Way in Bakersfield. Four satellite facilities are used for vehicle storage Lake Isabella, Lebec, Mojave, and Tehachapi. The County leases parking for seven vehicles (two 40-foot buses and five cutaway vehicles) at the Mojave Air and Space Port; 10 cutaway vehicles at a storage yard in Lake Isabella; and two cutaway vehicles at the Tehachapi airport. Two cutaway vehicles are stored at the Kern County Roads Yard in Lebec. These locations are detailed in Exhibit E.1.1.

Fueling takes place at a combination of County facilities, other transportation facilities, and commercial establishments. These include:

- Bakersfield
    - Kern County Roads Yard (2903 Patton Way) (gas and diesel)
    - Kern County Roads Yard (5438 Victor Street) (not currently used for fueling)
    - Golden Empire Transit District Maintenance and Operations Facility (1830 Golden State Avenue) (use them pretty heavily)
    - Kern County Superintendent of Schools (705 S. Union Avenue) (last resort) (emergency)
    - Pacific Gas & Electric (4101 Wible Road) (last resort) (emergency)
- Mojave
    - Archer Travel Center (16660 Sierra Hwy.) – no room in Road Yard
- Kernville
    - Kern County Roads Yard
    - Shell station (10800 Kernville Road)
- Tehachapi
    - Kern County Roads Yard

- Lebec
    - Kern County Roads Yard

The majority of the current County-owned facilities provide no existing zero-emission fueling infrastructure. Kern County currently has one charger installed at its Victor Street facility to charge its one BYD bus. However, this bus has never worked properly and is currently at the BYD facility awaiting service. The Victor Street facility is prewired to support a second charger for another electric bus. Golden Empire Transit currently has fueling facilities for battery-electric and hydrogen fuel cell buses. There are also some existing charging facilities in proximity to each of the satellite locations. These will be discussed further in Section E.2.

While Kern Transit does not typically fuel outside of the community in which each vehicle is stored, there may be increasing opportunities to do so. Arvin, for example, has already implemented electric buses and has charging infrastructure in place. Delano is also beginning its path toward zero-emissions buses and will likely have charging infrastructure in place as well within a few years. Therefore, as community-based transit operators introduce zero-emission fleets, this may provide Kern Transit with additional flexibility with respect to its own battery-electric vehicles. There may also be opportunities for charging as school bus fleets transition to battery-electric. Identifying alternative charging locations can also help strengthen Kern Transit's resiliency and ability to respond to interruptions to the power supply (discussed below).

Exhibit E.1.1 Facilities Information and Construction Timeline

Facility Name	Address	Main Function(s)	Type(s) of Infrastructure	Service Capacity	Needs Upgrade? (Yes/No)	Estimated Construction Timeline
Victor Street Roads Yard	5438 Victor Street, Bakersfield, CA	Maintenance and storage (fueling takes place at Patton Way, GET, Superintendent of Schools, or PG&E)	Maintenance facility, fueling, parking lot (fenced)	Usually around 40 buses	Yes	FY 2026 (electric depot) FY 2029 (hydrogen)
Patton Way Roads Yard	2903 Patton Way, Bakersfield, CA	Fueling	Fueling		Yes	
Mojave Storage Yard	Mojave Air and Space Port 1692 Sabovich St, Mojave, CA 93501 (7 parking spaces)	Vehicle storage (fueling takes place at Archer Travel Center, 16660 Sierra Hwy, Mojave using a fuel card)	Parking lot (not fenced)	2 40’ buses 5 cutaways	Yes	FY 2034 (electric depot)
Lake Isabella Storage Yard	6075 Lake Isabella Blvd, Lake Isabella, CA 93240	Vehicle storage (fueling takes place at Kern County Roads Yard in Kernville or at the Shell station at 10800 Kernville Rd, Kernville.)	Parking lot (fenced)	10 cutaways	Yes	FY 2032 (electric depot)
Tehachapi Storage Yard	Tehachapi Airport, 314 N. Hayes St., Tehachapi, CA 93561 (2 parking spaces)	Vehicle storage (fueling takes place at Kern County Roads Yard, 321 W. C St, Tehachapi, CA)	Parking lot (fenced)	2 cutaways	Yes	FY 2032 (electric depot)
Lebec Storage Yard	Kern County Roads Yard 1548 Lebec Service Road Lebec, CA 93243 (2 parking spaces)	Vehicle storage and fueling	County Roads Yard	2 cutaways	Yes	FY 2039 (electric depot)

Section E.2 | Necessary Upgrades/Infrastructure Modifications

The County's current transit vehicle storage and fueling facilities will need significant infrastructure upgrades in order to support a zero-emission fleet. For the satellite storage facilities, this may necessitate the purchase or long-term lease of properties on which to install dedicated charging infrastructure as well as provide a secure vehicle storage location (if such infrastructure cannot be accommodated within an existing County property). Existing maintenance shops would need to be equipped with appropriate tools and safety equipment to service battery-electric and hydrogen fuel cell vehicles. If this cannot be accommodated within either the Victor Street or Patton Way yards, a purpose-built facility may need to be considered.

- **Victor Street Roads Yard.** Located at 5438 Victor Street in Bakersfield, the County Roads Yard provides the majority of maintenance and vehicle storage for the Kern Transit fleet based in Bakersfield. It provides vehicle storage for approximately 40 vehicles, although this varies throughout the day. Fueling is not currently done at Victor Street; instead, vehicles primarily fuel at the Patton Way yard or the Golden Empire Transit facility, and could also use the Superintendent of Schools or PG&E if needed.

  Ultimately, the County will need to install at least 20 Level 3 (DC fast) charging stations[7] (at least 150 kWh) at its Bakersfield facility. This is because the majority of buses will need to charge overnight to be ready for the next day's service. While a charging management system (CMS) can be used to regulate when each bus charges after it is plugged in (to avoid peak-hour time-of-use fees), most in-service buses will need their own dedicated station. Spares can be charged during morning hours when in-service buses are out of the yard.

  Battery-electric vehicle charging infrastructure may be able to be accommodated at the Victor Street Roads Yard, although this would reduce the available vehicle storage space considerably. The charging infrastructure will need to accommodate at least five battery-electric vehicles by 2026, 32 by 2030, 34 by 2035, and 40 by 2040.

  For hydrogen fuel cell buses, the County will need to provide sufficient hydrogen storage to fuel up to nine vehicles per day on Routes 100, 130, and 150, using approximately 450 kilograms of fuel per day. (Route 150 buses would fuel in Bakersfield before their return trip to Lake Isabella.) Alternately, Kern Transit may be able to work with GET to purchase fuel for its hydrogen fuel cell buses, assuming the permanent hydrogen facility GET will be building has sufficient capacity to meet the County's needs. It will need to accommodate five hydrogen vehicles by 2029, seven by 2037, and 13 by 2040. Installation of a hydrogen storage tank, along with access for a tanker truck for deliveries, will also reduce the amount of vehicle storage space available.

  With respect to maintenance, the overall layout of the shop may be able to remain the same, but there will need to be space for tools and equipment needed for work on high-voltage equipment, including non-conductive tools, meters and other specialized equipment, and personal protective

[7] Note: Recommendations for DC fast chargers are based on the need for maximum flexibility. The County should work with its electric utility and electrical contractor to determine if a mix of Level 2 and DC fast chargers would be a better fit for each facility.

equipment. Depending upon where in the vehicles the batteries are located, there may need to be greater access to the side or roof of the vehicle, and forklifts would likely be required for battery removal. (Extensive training will also be required, which will be discussed in Section G.)

While Victor Street could have some chargers for electric buses installed in the existing parking area, there is very little room to accommodate an increase in the size of the bus fleet. Also, depending on size, there may not be room for a new hydrogen fuel station.

- **Patton Way Roads Yard.** Located at 2903 Patton Way in Bakersfield, the County Roads Yard provides overflow maintenance as well as some fueling for the Kern Transit fleet based in Bakersfield. This location does not feature transit vehicle storage. Depending on usage and space availability, the County could consider installing some of the charging infrastructure at this facility.

  The Patton Way corporation yard is currently under construction. The County could revisit the idea of adding buses once the initial construction is completed and all the crews currently assigned there move in. The County recently purchased approximately 10 acres at the corner of Downing Avenue and Wear Street. The first five acres are slated to become a new Special Waste facility. The remaining five acres may be a suitable site for the new EV fleet of buses and Public Works vehicles.

- **Mojave Storage Yard.** Located at the Mojave Air and Space Port, the Mojave Storage Yard currently provides vehicle storage for two 40-foot buses and five cutaway vehicles.

  Beginning in FY 2034, battery-electric buses will begin operating out of the Mojave location, requiring at least two 150 kWh DC fast charger (Level 3) by FY 2034. Additional DC fast chargers (for a total of 13) will need to be installed by FY 2036, to fuel a fleet of 17 battery-electric vehicles.

  A complicating factor at the Mojave Storage Yard is that it is leased parking space. As such, there is no guarantee the County could obtain permission to install charging infrastructure at the current location. In addition, the Roads Yard in Mojave is small and insufficient for this purpose. However, there are currently four Level 2 chargers (ChargePoint) and two Level 2 and two Level 3 (EV Connect) chargers at the Mojave Air and Space Port, so there may be an opportunity to expand one of the existing installations to include charging facilities for transit. The ChargePoint chargers feature J1772 plugs, while the EV Connect chargers have CHAdeMO, CCS, and J1772 plugs. There are also four Level 3 and two Level 2 ChargePoint chargers located at the Denny's in Mojave, and four Level 3 Electrify America chargers at the Comfort Inn and Suites; both facilities are open to the public and not likely suited for transit vehicle fueling. There are also two Tesla Supercharger stations in Mojave, although those are not currently compatible with most bus fleets.

- **Lake Isabella Storage Yard.** Located within a commercial vehicle storage lot, the Lake Isabella Storage Yard currently provides vehicle storage for 10 cutaway vehicles. Beginning in FY 2032, battery-electric buses will begin operating out of the Lake Isabella location, requiring nine 150 kWh Level 3 (DC fast) chargers to fuel a fleet of 13 vehicles.

A complicating factor at the Lake Isabella Storage Yard is that it is leased parking space. As such, there is no guarantee the County can obtain permission to install charging infrastructure at the location. There are no current charging facilities in Lake Isabella, with the nearest facilities located in Kernville, Inyokern, and Bakersfield. In addition, since vehicles are currently fueled in Kernville, rather than where they are stored, this would impact the vehicle range since there would be additional deadhead miles prior to actually starting the route, if they continue to be fueled there.

While there is likely space for charging infrastructure at the Kernville Roads Yard, the County may not continue to maintain that location. As such, there may not be an option to install charging infrastructure there.

- **Tehachapi Storage Yard.** Located at the Tehachapi Airport, the Tehachapi Storage Yard currently provides vehicle storage for two cutaway vehicles operating demand-response service. Beginning in FY 2032, battery-electric buses will be operating out of the Tehachapi location, requiring two Level 3 (DC fast) chargers to fuel a fleet of three vehicles. Two vehicles can charge overnight, while the third vehicle charges during the day (as needed). This will ensure two vehicles are always fully charged and available for the Dial-A-Ride service.

  A complicating factor at the Tehachapi Storage Yard is that it is leased parking space. As such, there is no guarantee the County can obtain permission to install charging infrastructure at the location. However, there are two Level 2 ChargePoint chargers at Tehachapi city hall, which could provide an opportunity for expansion to serve transit vehicles. There are also two Level 2 and two Level 3 ChargePoint chargers at 9000 Magellan Drive (Denny's) in Tehachapi, as well as two Level 2 Shell Recharge chargers at 421 West J Street in the Southern California Edison vehicle lot (not open to the public).

- **Lebec Storage Yard.** Located at the Kern County Roads Yard, the Lebec Storage Yard currently provides vehicle storage and fueling for two cutaway vehicles. Beginning in FY 2039, battery-electric buses will be operating out of the Lebec location, requiring two Level 2 chargers to fuel a fleet of three vehicles. Two vehicles can charge overnight, while the third vehicle charges during the day (as needed). This will ensure two vehicles are always available for the Dial-A-Ride service.

  There is current electric charging infrastructure in the vicinity of the storage yard. There are four Level 3 chargers at the Tejon Pass Rest Area (I-5 South) and two Level 2 and one Level 3 ChargePoint chargers at the Jack in the Box restaurant on Frazier Mountain Park Road.

Exhibit E.2.1 Infrastructure Modifications

<table>
<tr><th>Facility Name</th><th>Vehicles</th><th>Fueling infrastructure/capacity</th></tr>
<tr><td>Victor Street Roads Yard</td><td rowspan="2">Small cutaways (BEB) = 12
Small cutaways (FCEB) = 3
Large cutaways (BEB) = 5
35’ buses (BEB) = 5
40’ buses (BEB) = 4
40’ buses (FCEB) = 7</td><td rowspan="2">Electric chargers:
• 20 Level 3 (DC fast) chargers
Hydrogen fuel storage:
• Approximately 450 kg per day</td></tr>
<tr><td>Patton Way Roads Yard</td></tr>
<tr><td>Mojave Storage Yard</td><td>Small cutaways (BEB) = 11
40’ buses (BEB) = 5</td><td>Electric chargers:
• 13 Level 3 (DC fast) chargers</td></tr>
<tr><td>Lake Isabella Storage Yard</td><td>Small cutaways (BEB) = 8
Small cutaways (FCEB) = 3
Large cutaways (BEB) = 3</td><td>Electric chargers:
• 9 Level 3 (DC fast) chargers
Hydrogen fuel storage:
• None (fuel in Bakersfield)</td></tr>
<tr><td>Tehachapi Storage Yard</td><td>Small cutaways (BEB) = 3</td><td>Electric chargers:
• 2 Level 3 (DC fast) chargers</td></tr>
<tr><td>Lebec Storage Yard</td><td>Small cutaways (BEB) = 3</td><td>Electric chargers:
• 2 Level 3 (DC fast) chargers</td></tr>
</table>

Need for resiliency

Reliance on the power grid to operate the majority of the fleet can raise issues of reliability. Given California in particular is prone to rolling blackouts and Public Safety Power Shutoffs (PSPS), a back-up plan for charging the fleet becomes a necessity. As such, the County should also consider implementing one or more of the following strategies as it develops its electric charging infrastructure to minimize the impact such events will have on transit operations.

1. Installation of a back-up generator to power the charging infrastructure. AVTA installed a 1.5 megawatt generator to power its 87 charging stations in case of an emergency. The City of Arvin received funding to build a solar microgrid that can operate transit buses, police vehicles, and city hall for several days in the case of a power outage.
2. Identification of alternatives to the electrical grid. Ultimately, AVTA plans to use 100 percent solar energy to power its fleet. It is in the process of building a solar field with battery storage.
3. Installation of charging infrastructure in more than one location, with different locations on different local grids or transformers. This would allow vehicles to be charged at another location if the power goes down in their primary charging location.

A contingency plan will be easier to implement in Bakersfield, where the bulk of the fleet is located, than in the remote vehicle storage locations. However, resiliency solutions for those locations will need to be identified as well.

Electric vehicles can also be used to transfer power from the vehicle back to the grid (V2G) in emergency situations. For example, the City of Oakland has an emergency plan in place that calls for AC Transit ZEBs to be used to provide power to one of the City's libraries when used as an emergency shelter, in lieu of a diesel generator. Consider including electric vehicles as power sources for emergency planning.

Section E.3 | Vehicle Parking/Storage Modifications

Kern Transit will need to acquire and operate a larger fleet in order to successful transition to a fully zero-emission fleet. For many routes, only a single round trip will be able to be operated before the vehicle has to recharge. Therefore, there must be a sufficient number of vehicles assigned to each route (and each satellite storage facility) to ensure uninterrupted service. For all facilities, this will likely require access to additional parking capacity.

Exhibit E.3.1 Vehicle storage needs by location

<table>
<tr><th>Facility Name</th><th>Current Capacity</th><th>Needed Capacity</th></tr>
<tr><td>Victor Street Roads Yard</td><td>40 vehicles</td><td rowspan="2">15 small cutaways
5 large cutaways
5 35-foot buses
11 40-foot buses</td></tr>
<tr><td>Patton Way Roads Yard</td><td>No vehicle storage</td></tr>
<tr><td>Mojave Storage Yard</td><td>2 40-foot buses
5 cutaways</td><td>5 40-foot buses
11 small cutaways</td></tr>
<tr><td>Lake Isabella Storage Yard</td><td>10 cutaways</td><td>11 small cutaways
3 large cutaway</td></tr>
<tr><td>Tehachapi Storage Yard</td><td>2 cutaways</td><td>3 small cutaways</td></tr>
<tr><td>Lebec Storage Yard</td><td>2 cutaways</td><td>3 small cutaways</td></tr>
</table>

Section E.4 | Electric Utilities and NOx-Exempt Service Areas

Three of Kern Transit's storage yards are located in NOx-exempt areas, as defined under the Innovative Clean Transit (ICT) mandate: Lake Isabella, Mojave, and Tehachapi. The remaining locations are not in NOx-exempt areas.

Exhibit E.4.1 NOx-Exempt Areas and Electric Utilities' Territories

Facility Name	Type(s) of Bus Propulsion System	Located in NOx-Exempt Area[8]? (Yes/No)
Victor Street Roads Yard	Hydrogen fuel cell, Battery-electric	No
Patton Way Roads Yard	Hydrogen fuel cell, Battery-electric	No
Mojave Storage Yard	Battery-electric	Yes
Lake Isabella Storage Yard	Battery-electric	Yes
Tehachapi Storage Yard	Battery-electric	Yes
Lebec Storage Yard	Battery-electric	No

[8] The ICT regulation defines "NOx Exempt Areas" (13 CCR § 2023(b)(39)) as the following counties and air basins: Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Eastern Kern (the portion of Kern County within the Eastern Kern Air Pollution Control District), Glenn, Humboldt, Inyo, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Monterey, Nevada, Northern Sonoma (as defined in title 17, California Code of Regulations, section 60100(e)), Plumas, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz, Shasta, Sierra, Siskiyou, Northern Sutter (the portion of Sutter County that is north of the line that extends from the south east corner of Colusa County to the southwest corner of Yuba County), the portion of El Dorado County that is within the Lake Tahoe Air Basin (as defined in title 17, California Code of Regulations, section 60113), the portion of Placer County that is East of Highway 89 or within the Lake Tahoe Air Basin, Trinity, Tehama, Tuolumne, and Yuba.

There are two electric utilities operating in the Kern Transit service area: Pacific Gas & Electric (PG&E) and Southern California Edison (SCE). Each utility covers approximately half of Kern County. Southern California Edison is the electric utility in Los Angeles County (Lancaster and Santa Clarita).

Exhibit E.4.2 Electric utilities in service area

Electric utility	Service area
Pacific Gas & Electric Company	Western Kern County • Arvin • Bakersfield • Lamont • Lost Hills • McFarland • Shafter • Taft • Tehachapi • Wasco
Electric utility	**Service area**
Southern California Edison	Eastern Kern County • California City • Delano • Frazier Park • Lake Isabella • Lebec • McFarland • Ridgecrest • Tehachapi Northern Los Angeles County • Lancaster • Santa Clarita

Section F | Providing Service in Disadvantaged Communities

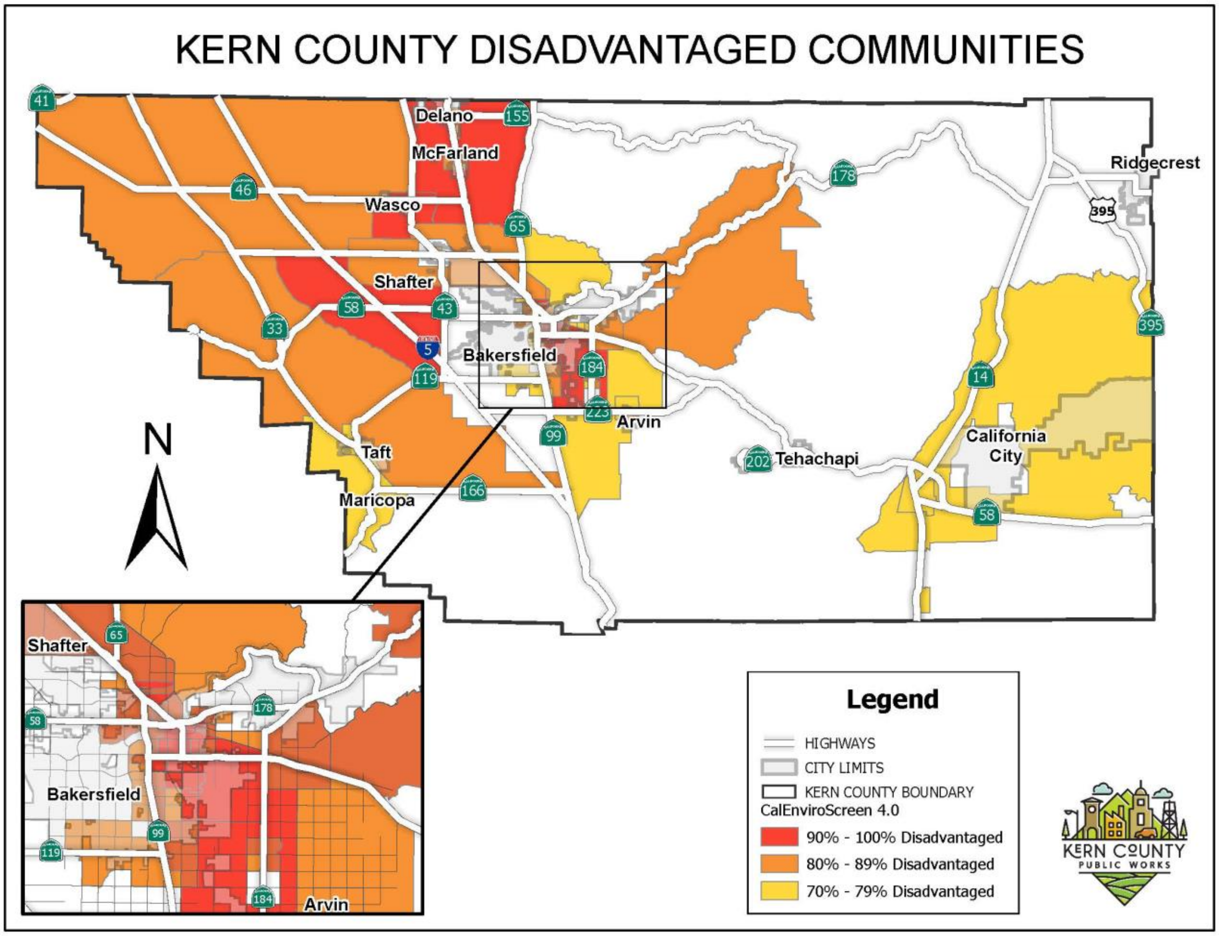
The purpose of this section is to detail how zero-emission vehicles will be deployed in disadvantaged communities (DACs). The Office of Environmental Health Hazard Assessment, on behalf of the California Environmental Protection Agency, developed the CalEnviroScreen tool (most recently updated in October 2021) to help identify disadvantaged communities in California. In this context, a disadvantaged community is one that is disproportionately burdened by multiple sources of pollution and with population characteristics that make them more sensitive to pollution. CalEnviroScreen identifies the highest 25 percent of overall scores for census tracts throughout California.

Deploying zero-emission vehicles in DACs helps to reduce pollution levels in these areas, thereby lowering the impact of pollution on more sensitive populations.

Section F.1 | Disadvantaged Communities Served by Kern Transit

The disadvantaged communities, as identified through CalEnviroScreen 4.0, located in Kern County are shown in Exhibit F.1.1. The more disadvantaged communities (80 to 100 percent) are located in the western and central portions of the county, while those in the eastern portion are in the 70 to 79 percent disadvantaged category.

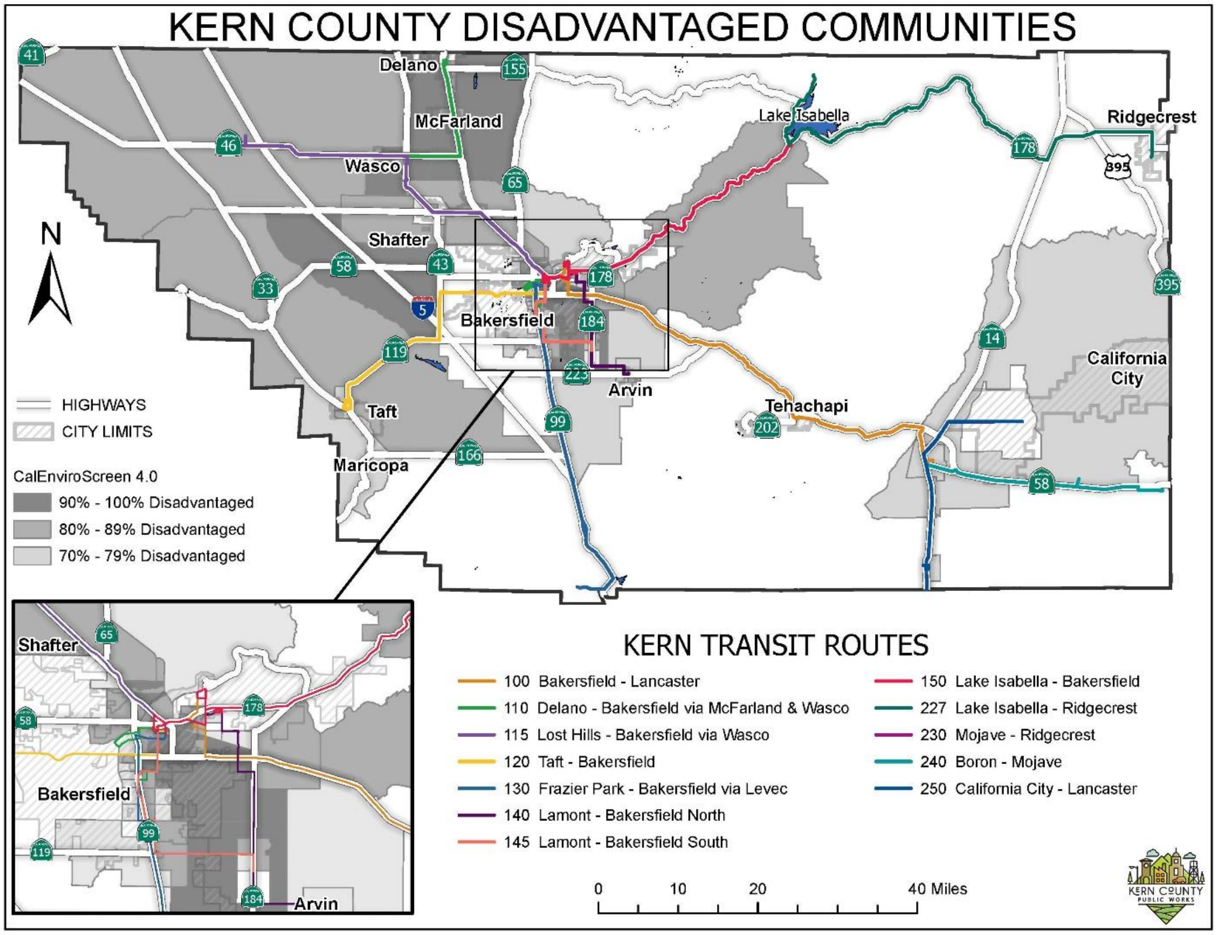
Exhibit F.1.1 Disadvantaged Communities (DACs) in Kern County



Fixed Routes

All routes operated by Kern Transit operate at least partially within a DAC. The full route network is shown in Exhibit F.1.2. Individual routes are shown below, along with what percentage disadvantaged the DACs they travel through are. DACs are represented in blue in the individual route maps.

Exhibit F.1.2 Disadvantaged Communities (DACs) in Kern County with transit route overlay



Route 100 – Bakersfield to Lancaster

Route 100 operates throughout several disadvantaged communities. In Lancaster stops along West K Ave, 15th St, W Ave J, Sierra Highway, and W 10th St are located in a DAC. The route travels through Mojave with a singular stop at Carl's Jr. on Inyo St.; that area is also considered a DAC. While Route 100 travels near DACs such as Edison and Algoso, Kern Transit does not serve these areas. The DAC percentiles for this route's stop locations range between 31 percent and 99 percent.

Route 110 – Delano to Bakersfield

A majority of Route 110 runs through disadvantaged communities with the exception of several stops in Bakersfield. These stops are located in the area surrounding Bakersfield College, most notably along Mt. Vernon Ave and Haley St. The DAC percentiles for this route's stop locations range between 60 percent and 95 percent.

Exhibit F.1.3 Route 100 service area

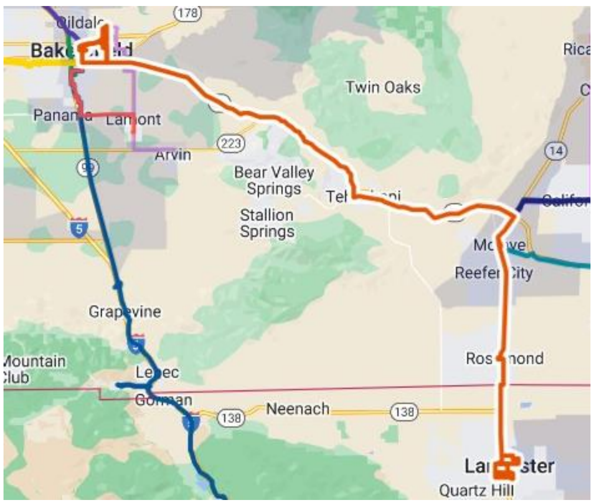


Exhibit F.1.4 Route 110 service area

Route 115 – Lost Hills to Bakersfield

From its origin in Lost Hills to its destination in Bakersfield, every stop along Route 115 lies within a DAC. The DAC percentiles for this route's stop locations range between 31 percent and 99 percent.

Route 120 – Taft to Bakersfield

While in Bakersfield, Route 120 travels within a DAC. As it travels near California State University Bakersfield, the area is no longer considered a DAC. Once the route proceeds through Tupman, Dustin Acres, and Valley Acres towards Ford City and Taft, the area is all classified as a DAC. The DAC percentiles for this route's stop locations range between 28 percent and 82 percent.

Exhibit F.1.5 Route 115 service area

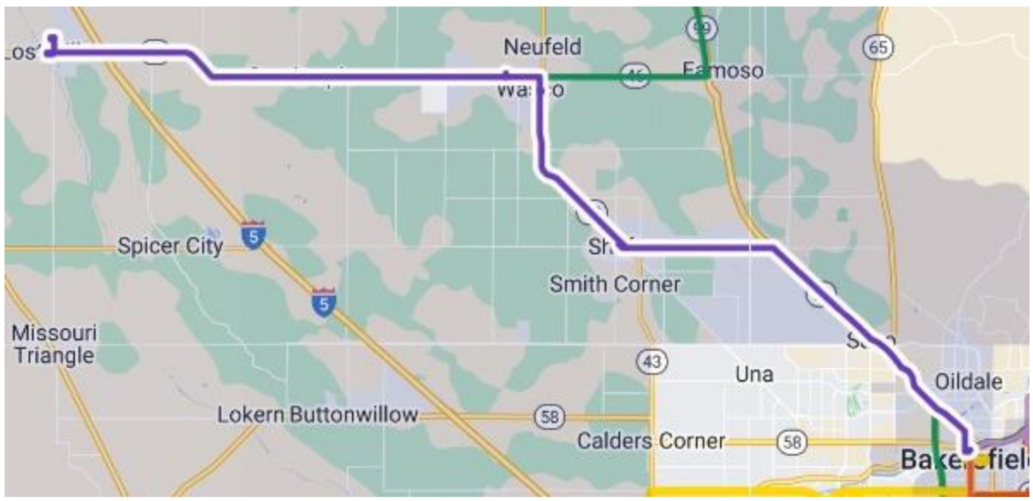
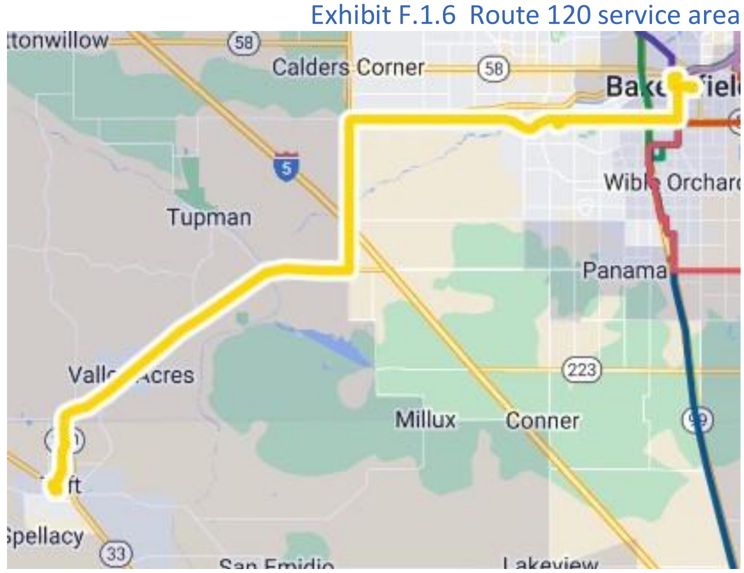


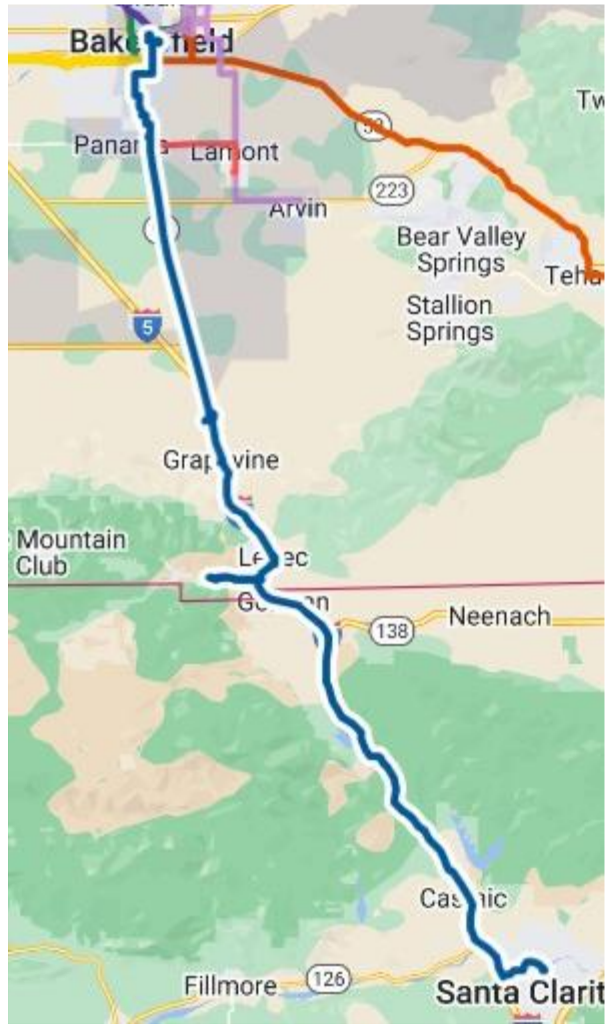
Exhibit F.1.6 Route 120 service area



Route 130 – Santa Clarita to Bakersfield

DACs along this route include Downtown Bakersfield, Wible Orchard, Greenfield, and Wheeler Ridge. The area between Wheeler Ridge (just north of Grapevine) and Santa Clarita is not a DAC. The DAC percentiles for this route stop locations range between 99 percent and 23 percent.

Exhibit F.1.7 Route 130 service area



Route 140 – Lamont to Bakersfield North

Route 140 serves several DACs. Areas served by this route but not classified as DACs include Hillcrest, Weedpatch, and the area surrounding Bakersfield College. The DAC percentiles for this route's stop locations range between 60 percent and 99 percent.

Route 145 – Lamont to Bakersfield South

Route 145 solely operates in DACs with the exception of stops located along Main St. and Buena Vista Blvd. in Weedpatch. The DAC percentiles for this route's stop locations range between 87 percent and 97 percent.

Exhibit F.1.8 Route 140 service area

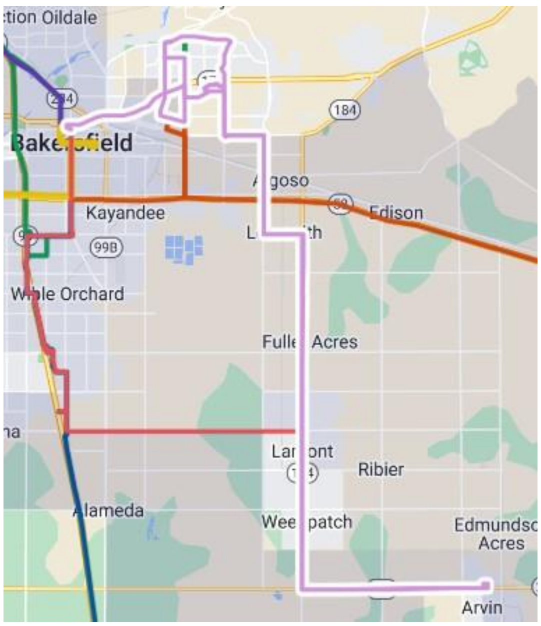


Exhibit F.1.9 Route 145 service area

Route 150 – Lake Isabella to Bakersfield

Route 150 operates in DACs located in Lake Isabella, the Kern River Valley, and East Bakersfield. Stops located near the College and Rio Bravo are not DACs. DACs in East Bakersfield served by this route are near Kern Medical Center, Kern County Supervisor Court, and Heritage Park. Highway 178 from approximately six miles east of Rio Bravo to Lake Isabella is fully within a DAC. The DAC percentiles for this route's stop locations range between 31 percent and 95 percent.

Route 227 – Lake Isabella to Ridgecrest

Route 227, traveling along California State Route 178 does not travel through any DACs with the exception of stops within the Lake Isabella area. A majority of the route is spent on the 178 and once it passes the Auxiliary Dam Campground is outside the boundaries of the Lake Isabella DAC. The DAC percentiles for this route's stop locations range between 28 percent and 80 percent.

Exhibit F.1.10 Route 150 service area

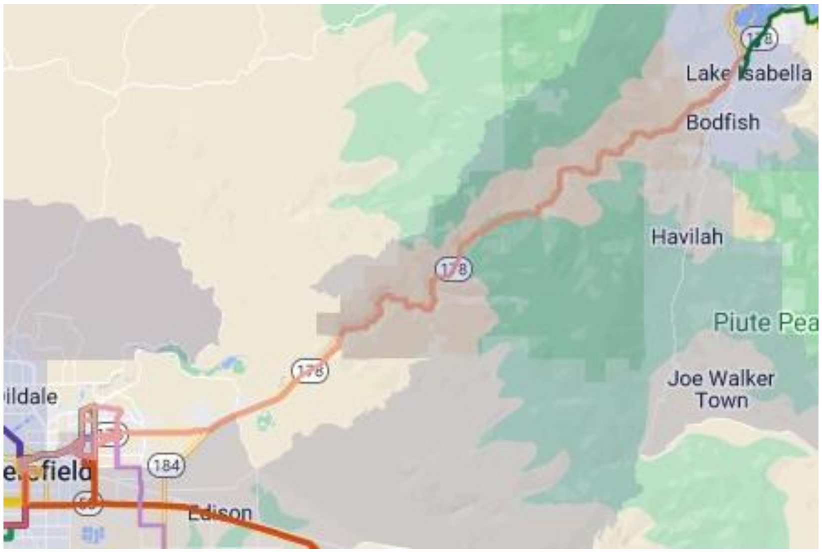
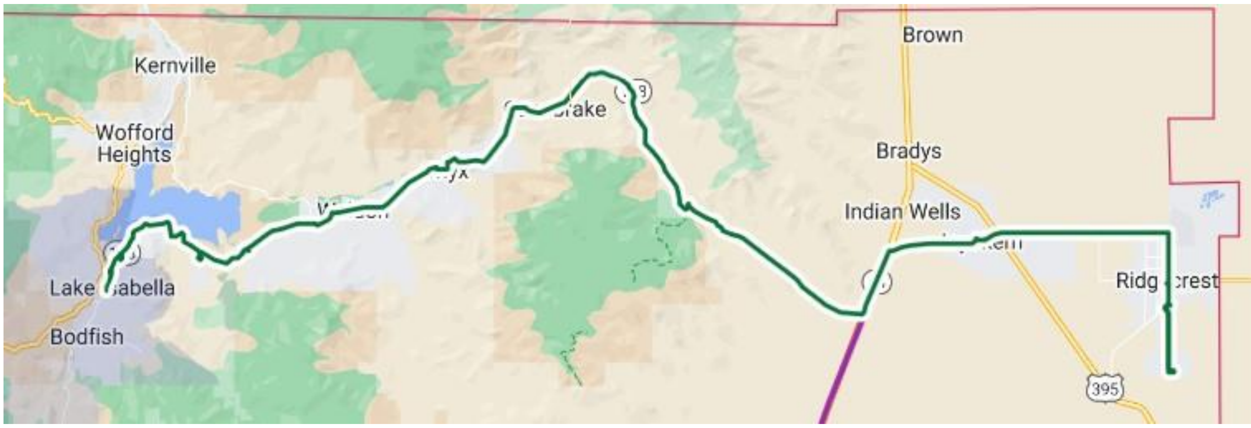


Exhibit F.1.11 Route 227 service area



Route 230 – Mojave to Ridgecrest

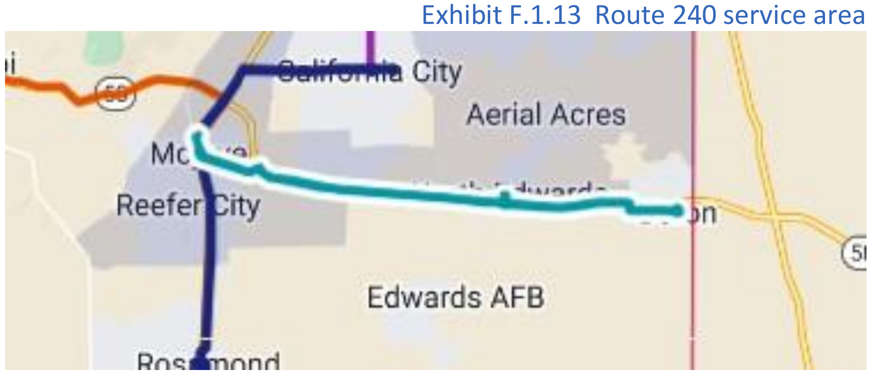
While traveling through Ridgecrest and a stop in Inyokern, Route 230 does not travel through a DAC. However, as the route moves along Aerospace Highway through Ricardo and Cantil, the route enters a DAC. The area along Neuralia Road after Harriet Avenue in California City is not classified as a DAC. The route continues to its destination in Mojave, which is within a DAC. The DAC percentiles for this route's stop locations range between 28 percent and 79 percent.

Route 240 – Boron to Mojave

This route travels the edge of DACs in North Edwards for a majority of the trip. The trip originates in Mojave, a DAC, before traveling along Highway 58. The bus stop at the North Edwards shopping center on Claymine Road is located in a DAC. As the route enters Boron, the area is no longer a DAC. The DAC percentiles for this route's stop locations range between 64 percent and 79 percent.

Exhibit F.1.12 Route 230 service area

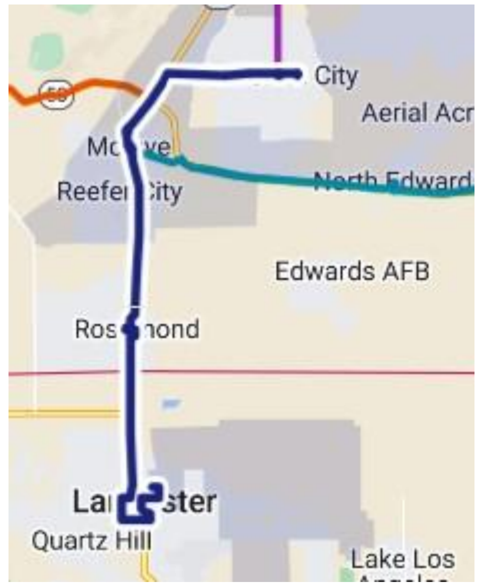
Exhibit F.1.13 Route 240 service area



Route 250 – California City to Lancaster

Route 250 serves DACs in Mojave and parts of Lancaster. While the route travels along Highway 14 and passes through DACs in Reefer City and Actis, Kern Transit does not serve these areas. Route 250 travels along W 15th St, onto Avenue J, along Sierra Highway, and W Jackman St. As the route approaches W 10th St, the area is no longer a DAC. The DAC percentiles for this route's stop locations range between 31 percent and 86 percent.

Exhibit F.1.14 Route 250 service area



Dial-A-Ride service

Kern Transit also operates Dial-A-Ride service in several communities. Unlike the fixed routes, several of the Dial-A-Rides do not serve disadvantaged communities.

Bakersfield Medical Dial-A-Ride

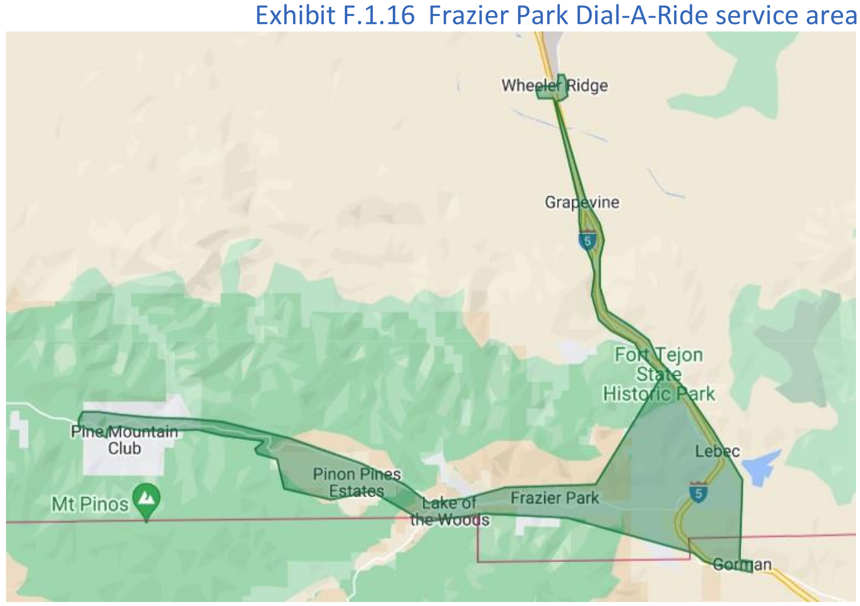
The Bakersfield Medical Dial-A-Ride serves much of the greater Bakersfield area, including several DACs. The DAC percentiles for this area range between 17 percent and 99 percent.

Frazier Park Dial-A-Ride

The Frazier Park Dial-A-Ride does not serve any disadvantaged communities. However, it does barely overlap with the DAC that begins at Wheeler Ridge, at the far north end of its service area. The DAC percentiles for this area range between 16 percent and 62 percent.

Exhibit F.1.15 Bakersfield Medical Dial-A-Ride service area

Exhibit F.1.16 Frazier Park Dial-A-Ride service area



Kern River Valley Dial-A-Ride

The Kern River Valley Dial-A-Ride has nine non-contiguous service areas. Only those serving the area southwest of Isabella Lake (Lake Isabella and Bodfish) serve DACs. The DAC percentiles for this area range between 39 percent and 80 percent.

Lamont Dial-A-Ride

The Lamont Dial-A-Ride primarily serves the communities of Lamont and Weedpatch. Approximately two-thirds of the service area consist of disadvantaged communities. The DAC percentiles for this area range between 68 percent and 97 percent.

Exhibit F.1.17 Kern River Valley Dial-A-Ride service area

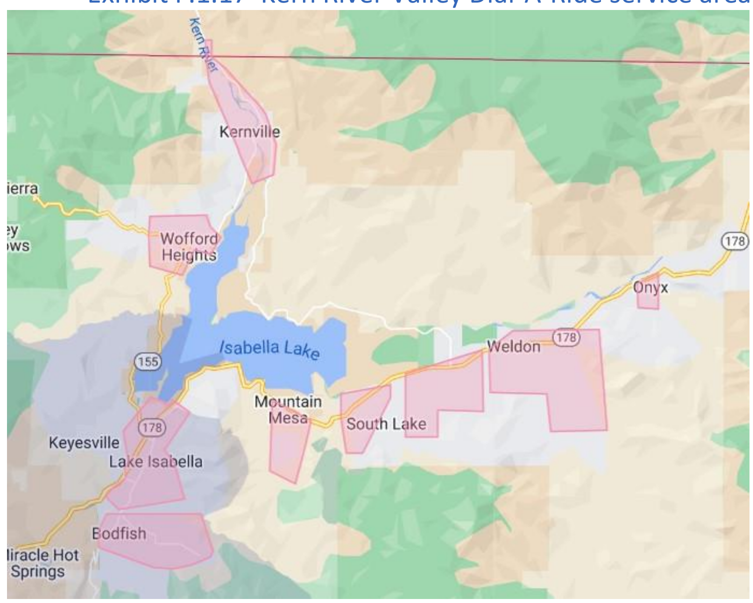
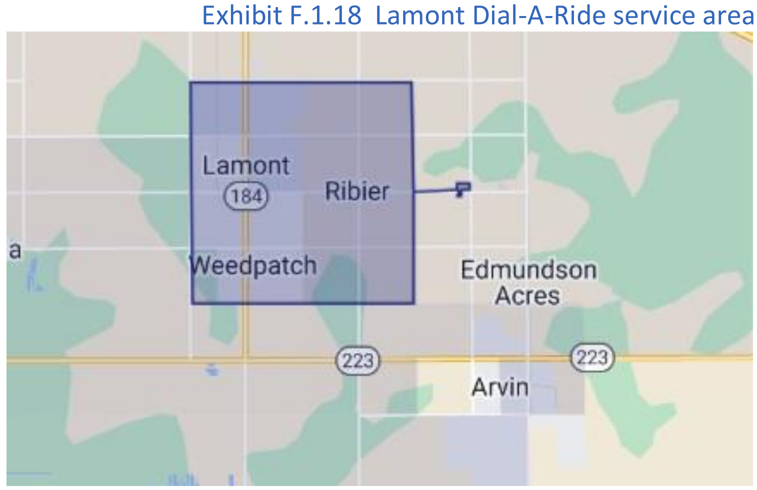


Exhibit F.1.18 Lamont Dial-A-Ride service area



Mojave Dial-A-Ride

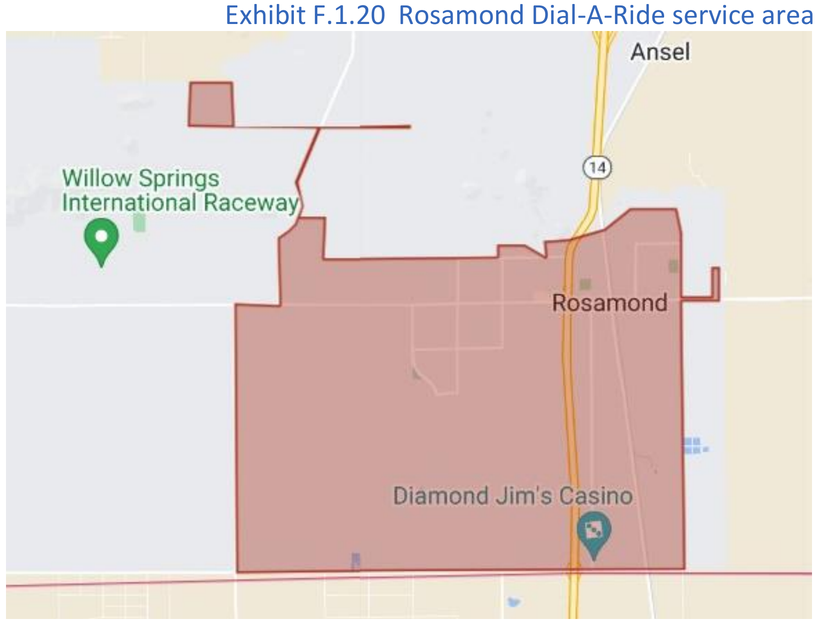
The Mojave Dial-A-Ride serves the community of Mojave. It operates entirely within DACs. The DAC percentiles for this area range between 77 percent and 79 percent.

Rosamond Dial-A-Ride

The Rosamond Dial-A-Ride serves the community of Rosamond. It does not serve any disadvantaged communities.

Exhibit F.1.19 Mojave Dial-A-Ride service area

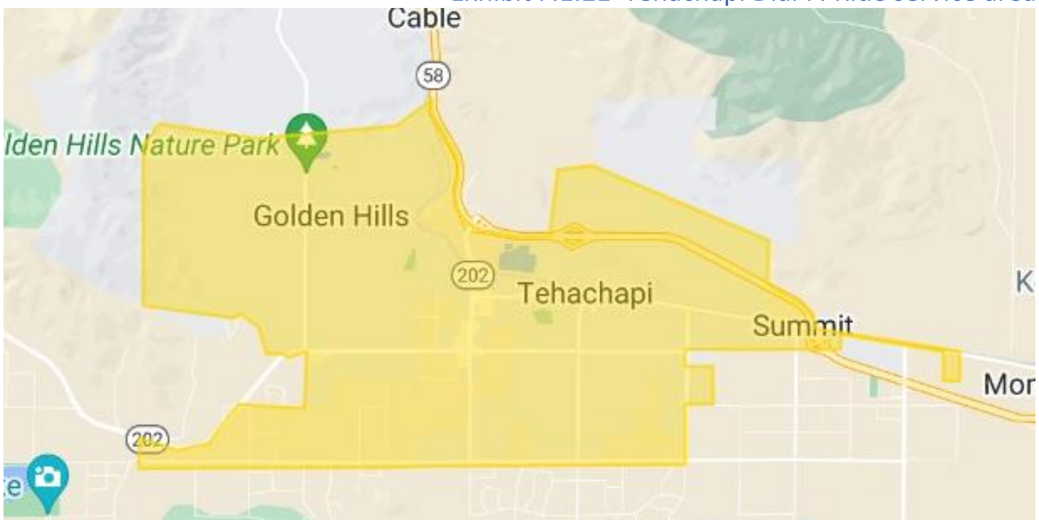
Exhibit F.1.20 Rosamond Dial-A-Ride service area



Tehachapi Dial-A-Ride

The Tehachapi Dial-A-Ride serves the community of Tehachapi. It does not serve any disadvantaged communities.

Exhibit F.1.21 Tehachapi Dial-A-Ride service area



Section F.2 | Deployment of Service in Disadvantaged Communities

Deployment of zero-emission buses will begin with the routes operating out of Bakersfield. This is due to the fact that charging and hydrogen fueling infrastructure will be available there before it is available to any of the satellite locations. As a result, deployment of battery-electric buses (BEBs) will begin with Routes 110, 115, 120, 140, and 145, as well as the Bakersfield Medical Dial-A-Ride and Lamont Dial-A-Ride. All of these routes operate within disadvantaged communities.

Deployment of hydrogen vehicles will begin in FY 2029 on Route 100, and continue onto Route 130 in FY 2037 and Route 150 in 2039. All three routes start in and travel through DACs. Route 100 ends in a portion of Lancaster that includes a DAC, while Route 130 only travels within a DAC until it reaches Wheeler Ridge (north of Grapevine). Route 150 operates within a DAC as it travels up Hwy 178.

Routes operating out of Mojave are expected to begin deploying BEBs in FY 2034. This will include one bus on Route 100; service on Routes 230, 240, and 250; and the Mojave and Rosamond Dial-A-Rides. Only the Rosamond Dial-A-Ride does not include service to a DAC.

Routes operating out of Lake Isabella are not expected to begin deploying BEBs until FY 2037 due to challenges with locating the charging infrastructure, vehicle storage, and range. This includes Routes 150 and 227 as well as the Kern River Valley Dial-A-Ride. Only a small portion of Route 227 serves a DAC.

Dial-A-Ride services operating in Tehachapi and Frazier Park (Lebec) are expected to be deployed in FY 2032 and FY 2039. Neither service operates within a DAC, though the Frazier Park Dial-A-Ride is immediately adjacent to the DAC located in Wheeler Ridge.

Exhibit F.2.1 ZEB deployment in disadvantaged communities

Timeline (Year)	Number of ZEBs	Location of Disadvantaged Community
2026	2	Delano/McFarland/Wasco/Shafter/Bakersfield
2026	2	Bakersfield
2026	1	Lamont
2027	2	Delano/McFarland/Wasco/Shafter/Bakersfield
2027	2	Arvin/Lamont/Bakersfield
2028	4	Lamont
2030	2	Lost Hills/ Wasco/Shafter/Bakersfield
2030	2	Taft/Bakersfield
2032	2	Arvin/Lamont/Bakersfield
2034	2	Mojave
2035	8	Mojave
2036	2	Arvin/Lamont/Bakersfield
2036	2	Mojave
2037	1	Lake Isabella/Kern River Valley
2038	6	Lake Isabella/Kern River Valley
2039	2	Lake Isabella/Bakersfield

Section G | Workforce Training

The purpose of this section is to review the current workforce, determine what skill gaps may exist with respect to the deployment of zero-emission vehicles (ZEVs), and identify training needs and opportunities available for workforce development.

While introduction of zero-emission vehicles often represent a significant skill gap, primarily for drivers and mechanics, retaining the existing workforce is the preferred path forward. By encouraging the current workforce to adapt to the new technology, not only would the County maintain employment for its existing staff, but also provide a valuable skill set. In addition, it would not be feasible to recommend the hiring of "more qualified" individuals, as there is no "pool" of new recruits with those skills currently available. Therefore, it is in the County's best interest to provide its current workforce with ample training opportunities, which will ultimately result in more efficient operation of the transit program.

Section G.1 | Description of Current Workforce

Maintenance

Fleet maintenance is provided by the County of Kern, and all maintenance personnel are employees of the County. All maintenance positions are either Heavy Equipment Mechanic or Supervising Heavy Equipment Mechanic. The Heavy Equipment Mechanic position has the following job description.

> **Position Description:** To locate mechanical trouble and to repair and overhaul road maintenance and construction equipment, both gasoline and diesel powered; and to do related work as required.
>
> **Duties:**
> - Examines and locates mechanical defects in a wide variety of automotive, road, and construction equipment, including diesel and gasoline powered trucks, tractors, motor graders, and powered shovels;
> - Makes major and minor mechanical repairs, disassembles, repairs, grinds, or replaced worn parts;
> - Adjusts and fits new parts in engines, oil, water, and fuel pumps, carburetors and fuel injectors, governors, starting motors, clutches, transmissions, differentials, brakes and steering gears;
> - Repairs crawl-type tractors, checking and replacing rollers, pins, and bushings;
> - Times and adjusts motors;
> - Replaces electrical wiring;
> - Overhauls hydraulic lifts and steering assemblies on motor graders and tractors;
> - Maintains records of time and materials used; and
> - Performs other job-related duties as required.

This position requires four years of experience repairing heavy motorized equipment, including experience with diesel engines and track-laying equipment as well as knowledge of the principles of gasoline and diesel engine mechanics as applied to the maintenance and repair of automotive and road construction equipment; the tools and equipment of the trade; and skill in their use in diagnosing and repairing a wide variety of heavy equipment.

The current position description references only gasoline and diesel engines, though current mechanics also maintain the CNG fleet. As such, there is currently no requirement for any heavy equipment mechanics to have knowledge of or experience in the maintenance of battery-electric or hydrogen fuel cell vehicles.

Transit Operators

The County contracts out the operation of its transit program. The current contractor is National Express, which has been operating the service since 2017. All operations personnel are employees of National Express.

National Express lists the following responsibilities as part of its transit driver position descriptions:

- Provides safe and reliable transportation service to passengers by operating position-specific vehicles which may include paratransit vans, shuttles, transit buses, and/or motor coaches with a fixed or changing route.
- Reports any maintenance problems to Maintenance in accordance with Company procedure and does not operate an unsafe vehicle.
- Reports to duty on time and maintains assigned route on time but in a safe manner.
- Physically assists passengers in evacuation of the vehicle in case of emergency.
- Immediately reports any accident or incident per Company policy.
- Exercises passenger management per Company policy.
- Informs all appropriate personnel of problems/procedures.
- Keeps the interior of the assigned vehicle clean and presentable.
- Presents a neat and professional personal appearance at all times.
- Ensures vehicle is properly fueled according to facility procedures.
- Completes all required paperwork (including route change sheets, time cards, vehicle repair requests) and submits to the appropriate authority in a timely manner.
- Maintains a cooperative attitude with fellow employees, supervisors, customers, and passengers while always promoting company goodwill.
- Prepares vehicle for inclement weather conditions, including scraping or cleaning windows, applying tire chains.
- Safely and efficiently utilizes vehicle equipment, including wheelchair lifts, radios and emergency equipment.

While there is little, if any, difference the position description for a transit bus operator for a conventionally fueled bus as a zero-emission bus, there are differences in the driving practices needed to operate a zero-emission vehicle. Given the current nationwide driver shortage, it is unlikely many new applicants will have zero-emission vehicle driving experience, and will need to be trained along with the rest of the driver team.

Section G.2 | Skill Gaps and Training/Retraining Needs

While differences in maintenance requirements are the most obvious skill gap with respect to a zero-emission fleet, ZEV implementation affects nearly all aspects of transit operations and maintenance. Since Kern Transit utilizes in-house maintenance and contracted operations, there will be some skill gaps and training opportunities that apply to both the contracted and in-house workforces.

(Note: While the County is considering both battery-electric and hydrogen fuel cell fleets, both propulsion types utilize high-voltage batteries. As such, when this section refers to electric buses, it refers to both types of vehicles, regardless of whether the energy stored in the battery comes from a charger or a hydrogen tank.)

OEM Training

Most initial training is provided through the original equipment manufacturer (OEM), or the company from which the buses are purchased. Opportunities for training from the OEM vary, but should be the agency's first approach to maintenance and driver training. Training through the OEM should be addressed as part of the procurement process, and services to be provided detailed in the contract. Since Kern Transit's vehicle purchases will be gradual, or could potentially be piggybacked onto another entity's larger purchase, determining how the OEM will provide support and training is essential.

Addressing Skill Gaps

Operations and maintenance training should begin before or in conjunction with the delivery of the first electric vehicles. Given Kern Transit already has one BYD battery-electric bus, once that bus can be effectively deployed, it could be utilized as a training vehicle, especially if the County is considering purchasing additional BYD battery-electric buses.

Not all drivers need to be trained initially, given rollout of ZEVs will be gradual. Many ZEV experts recommend providing initial training to drivers who are enthusiastic about the transition to battery-electric vehicles. Letting drivers who are more reluctant about the process see their colleagues demonstrate those skills can overcome some of the fear of the unknown. Additional drivers should be trained as opportunities to drive existing ZEVs arise (for example, if they are rotated through more routes), or as more ZEVs are purchased and ready to be put into service. As ZEVs are introduced on individual routes, Kern Transit may determine that all drivers on that route should be trained to operate ZEVs, and phase in service by route.

The operations contractor may also have personnel who have completed a train-the-trainer program, or who would be good candidates to do so. This way Kern Transit will not be solely reliant on the OEM every time drivers need to be trained in vehicle operation. Bear in mind that, when complete, the fleet will include at least four different types of vehicles (battery-electric buses and cutaways and hydrogen fuel cell buses and cutaways), each sharing many characteristics but likely with some distinct differences.

Maintenance personnel should undergo some driver training along with the bus operators. This is for two reasons. First, if maintenance personnel are required to move the buses within the yard, having a familiarity with how to drive the bus is essential. Second, maintenance personnel need to be aware of some of the differences in driving a battery-electric bus versus a conventionally fueled bus, such as how "jackrabbit starts" and abrupt braking can put additional stress on structural joints and how the consistent weight affects tire wear (since the fuel never burns off).

In planning for more advanced training, the County will want to determine what maintenance and repair services will be provided in-house, by the OEM, or by a separate third-party vendor. In order to avoid displacement of the current workforce, it may also want to consider training one or more mechanics through a comprehensive third-party program (such as that offered by Weber State University) as well as through the OEM (see Appendix C for more training opportunities). As positions turn over, they may be filled by individuals who already have experience and education in the new technologies. However, the County will still need traditional mechanics to work on conventionally fueled transit vehicles through at least 2039, as well as other County fleets, so displacement of the current workforce is not likely.

As battery-electric buses are introduced to various locations throughout the county, first responders will need training on how to respond to incidents involving battery-electric buses. The high-voltage batteries and hydrogen fuel tanks cannot necessarily be handled the same way in an emergency, and first responders need to know how to respond safely. This is typically something the transit provider can require the OEM to provide. However, given the County's expansive service area, this is training that may need to be conducted multiple times as ZEV fleets are introduced in various locations.

Also consider who will be towing any vehicles that need to be towed. That vendor/contractor/staff also needs training on how to safely handle battery-electric vehicles.

Training

As noted, drivers and maintenance personnel will share some skill areas as well as have specific skills to develop separately. Drivers will have the most consistent training needs, as all drivers qualified to drive an electric vehicle will need largely the same training and skills. Maintenance personnel, on the other hand, may receive different levels of training depending on what they will be called upon to do. A general overview of training for drivers and maintenance personnel is provided below.

Driver training

Driver training includes a significant amount of basic familiarity and safety training, as well as hands-on (or simulator-based) experience in actually driving the bus. Drivers must also be aware of how daily pre-trip inspections may be different for electric buses, as well as how to fuel them (especially in satellite locations). Key components of training include:

- Familiarization with the bus, including the dashboard and displays, as well as what notifications require immediate action as opposed to noting items for diagnostics or upgrades
- Basic high-voltage safety training
- Basic hydrogen fuel safety training
- How to conduct daily vehicle inspections
- How to fuel the vehicles (if applicable)
- Safe and efficient vehicle operation:
    - Pull-out from the curb and acceleration
    - Regenerative braking
    - Mechanical braking

- Hill holding and roll back
- How to optimize acceleration and deceleration to maximize efficiency
- How battery state of charge (SOC) affects range
- How environmental factors affect range
- Monitoring vehicle range
- Lack of noise (as a contributor to overall safety, especially with pedestrians)
- Lack of noise (making sure the vehicle is turned off at the end of the shift)

Maintenance training

Maintenance personnel may be trained at different levels. What training mechanics receive may be determined by what services they will be providing. How many mechanics are trained to service the ZEVs will be up to the County, but all personnel working in a maintenance shop that handles high-voltage vehicles should receive some basic safety training, even if they never touch the vehicle. This includes knowing what not to touch, where not to go, and where the emergency shut-off to the charger or hydrogen distributor is located.

One of the biggest roles of maintenance personnel, in addition to regular preventive maintenance, will be determining when to call in the OEM technicians and mechanics, especially while the vehicles and batteries are under warranty. To do this, they will need general knowledge of how the propulsion system works, but will not need to be able to repair it. While some mechanics may eventually develop the skills necessary to do the high-voltage work in-house, the County may choose to rely on the OEM mechanics. This may result in Kern Transit needing to retain conventionally fueled vehicles as spares if repairs cannot be made in a timely manner. Exhibit G.2.1 provides an overview of the technology maintenance readiness level "steps" needed for an operator to assume full maintenance responsibility for its ZEVs.

Preventive maintenance will be regulated by the manufacturers. Each bus is a composite vehicle made up of multiple components and, like conventionally fueled vehicles, the different systems have their own requirements. While there is no longer a need for oil changes or fuel/oil/air filter changes (since these items are not used on battery-electric buses), there will still be fluids and lubricants that need to be changed out periodically. They will still get contaminated through regular use, and the change-out period may vary depending on the system and manufacturer. There will also be different tools and processes required for vehicle inspections. These include both SAE and metric tools as well as a variety of meters. In some cases, the act of inspection can be the act of performing the preventive maintenance.

Key training components for mechanics and maintenance personnel include the following:

- General
    - Familiarization with the bus, including the dashboard and displays, as well as what notifications require immediate actions as opposed to noting items for diagnostics or upgrades
    - Basic driver training
    - Fueling processes
    - High-voltage safety training
        - Personal protective equipment (such as rubber gloves, shoes, hats, and vests that are NFPA 70E-compliant)

        - Having the right (non-conductive) tools
        - Safety guidance for mechanics/personnel not trained to work on electric buses
        - Battery-specific safety hazards
        - First aid
        - Location of emergency cutoff switches and fire response equipment
    - Hydrogen fuel safety training
    - Maintenance of safety-critical systems in the facility (hydrogen sensors, ground-fault detectors)
    - Preventive maintenance/vehicle inspections (most set by OEM)
        - Reduced frequency
        - No oil changes or fuel/oil/air filter changes
        - Motor coolant and transmission fluid refills/changes
        - Additional tools and meters
        - Tires have different wear characteristics on electric vehicles
- More advanced
    - How to work with onboard diagnostic systems
    - Lockout/tagout procedures
    - Servicing low-voltage onboard systems (such as radios, HVAC, etc.)
    - Zero-voltage verification procedures
    - Servicing battery packs, generators, inverters, and motors

Exhibit G.2.1 Technology maintenance readiness level guide

TECHNOLOGY MAINTENANCE READINESS LEVEL	TMRL DEFINITION	DESCRIPTION
TMRL 1	Initial ZEB demonstration or development of technology of interest	Pre-commercial ZEB (owned by OEM) in limited use by fleet with additional research and development planned by OEM. Fleet initiates modifications to facilities for specific technology.
TMRL 2	Technology selected and implementation planned	Fleet takes ownership/lease of commercially available ZEB. ZEB is operated in limited service and is fully repaired and maintained by OEM (without significant zero-emission component maintenance from fleet staff, fleet contractor, or third-party repair facility). Maintenance staff begins to plan for training.
TMRL 3	Draft training plan developed	Fleet owns/leases ZEBs, which are used in limited or expanded service. Fleet develops a training plan and begins to implement familiarization training for maintenance staff.
TMRL 4	Initial implementation of ZEB technology	OEM is on site doing all maintenance work on advanced technology components; maintenance staff begins doing vehicle-level maintenance work and preventive maintenance inspections. Maintenance manuals and troubleshooting guides are in draft form. OEM is developing special tools needed for advanced technology components. Facility modifications are complete.
TMRL 5	Training of select maintenance staff begins	OEM is on site and begins training select group of maintenance staff on advanced technology components. Maintenance staff is doing all general preventive maintenance inspections and vehicle maintenance but begins assisting OEM with other repairs. Maintenance manuals and troubleshooting guides are in advanced stage of development. OEM and fleet owner are developing spare parts list for technology and identifying what parts need to be in on-site inventory. All maintenance staff has completed familiarization training.
TMRL 6	Training transitioned to select maintenance staff	OEM is on site, but maintenance staff is doing most maintenance with supervision. Select maintenance staff is beginning to train other staff. Maintenance manuals and troubleshooting guides are in final stage of development. Special tools are available and spare parts supplies are readily available for most components.
TMRL 7	Transition of maintenance to staff begins	Select maintenance staff is fully trained and takes on training duties. OEM makes periodic site visits and provides remote assistance. More than 50% of designated maintenance staff is fully trained.
TMRL 8	Transition of maintenance to staff finalized	All maintenance is handled by staff. OEM is off site but available on an as-needed basis (usually remotely). Full manuals are available and all special tools and equipment needed have been acquired and incorporated into the facility. A large percentage of designated maintenance staff is fully trained. Training curriculum is complete.
TMRL 9	Maintenance staff fully maintaining ZEBs	All designated maintenance staff are trained on ZEB technology. Training is incorporated into standard training program. Spare parts are readily available for all components. OEMs have regional support centers or third-party repair facilities are available. Maintenance and repair training is available from external organizations (e.g., technical schools, community colleges); incoming maintenance staff is fully trained.

Source: "Technology Maintenance Readiness Guide for Zero-Emission Buses," National Renewable Energy Laboratory (NREL), Golden, CO 2019.

Section H | Potential Funding Sources

This section details the various grant and funding programs currently available for funding transition to zero-emission vehicles. It includes federal, state, and private programs that may be used for vehicle purchase and/or infrastructure development.

Exhibit H.1.1 describes how the identified potential funding sources could support Kern Transit in executing the Rollout Plan as currently designed by describing how each fund is planned to be used over time (e.g., to purchase a zero-emission bus, maintain a zero-emission bus, upgrade the charging/fueling infrastructure, construct or upgrade a maintenance facility). Summaries of each funding source are provided below.

Formula Grants for Rural Areas – 5311

Funding is apportioned to states under Section 5311 for distribution to subrecipients. Caltrans issues an annual call for projects, and transit agencies submit applications through BlackCat detailing how they will use their funds. In 2022, Caltrans began using a consolidated application for calls for projects for Sections 5311, 5311(f), CMAQ, and 5339. Capital projects – including vehicles, equipment, facilities, and maintenance – are eligible expenses under Section 5311. Under Caltrans, the funding split for capital projects is 88.53 percent federal and 11.47 percent local funds, though CMAQ projects may be approved for up to 100 percent federal funding. Capital funding is not available under Section 5311(f) (Intercity Bus).

Grants for Buses and Bus Facilities Formula Program – 5339 (a)

FTA Section 5339 is a grant program that provides funding for bus and bus facilities. Section 5339 (a) is a formula grant provided by the Federal Transit Administration (FTA). The grant provides funding to states and transit agencies through a statutory formula to replace, rehabilitate and purchase buses and related equipment and to construct bus-related facilities. In addition to the formula allocation, the Grants for Buses and Bus Facilities program (49 U.S.C. 5339) includes two discretionary components: the Bus and Bus Facilities Discretionary Program (5339(b)) and the Low or No Emissions Bus Discretionary Program (5339(c)).

Eligible recipients designated by the FTA include designated recipients that operate fixed-route bus service or that allocate funding to fixed-route bus operators; and State or local governmental entities that operate fixed-route bus service that are eligible to receive direct grants under 5307 and 5311.

Funding can be used for capital projects to replace, rehabilitate, and purchase buses, vans, and related equipment. Additionally, funds may be used for constructing bus-related facilities, including technological changes or innovations to modify low- or no-emission vehicles or facilities.

Grants for Buses and Bus Facilities Formula Program (discretionary) – 5339 (b)

Section 5339 (b) is a discretionary grant provided by the Federal Transit Administration (FTA). Eligible recipients designated by the FTA include designated recipients that operate fixed-route bus service or that allocate funding to fixed-route bus operators; and State or local governmental entities that operate fixed-route bus service that are eligible to receive direct grants under 5307 and 5311.

Funding can be used for capital projects to replace, rehabilitate, and purchase buses, vans, and related equipment. Additionally, funds may be used for constructing bus-related facilities, including technological changes or innovations to modify low- or no-emission vehicles or facilities.

Low or No Emission Vehicle Program – 5339 (c)

The Low or No Emission program is a competitive program that provides funding to state and local government authorities for the purchase or lease of zero-emission and low-emission transit buses. Funds may also be used for the acquisition, construction, and leasing of required facilities and related equipment.

Funding is provided by the FTA. The FTA notes that eligible applicants include direct or designated recipients of FTA grants; States; local governmental authorities; and Indian Tribes. Activities eligible for funding include: purchasing or leasing low- or no emission buses; acquiring low- or no-emission buses with a leased power source; constructing or leasing facilities and related equipment for low- or no-emission buses; constructing new public transportation facilities to accommodate low- or no-emission buses; and 0.5% of a request may be used for workforce development training and an additional 0.5% may be used for training at the National Transit Institute (NTI).

PG&E EV Fleet Program

Through Pacific Gas and Electric's (PG&E) EV Fleet Program, transit agencies can apply for funding towards incentives and rebates, site design and permitting, construction and activation, and maintenance and upgrades. To be eligible for medium and heavy-duty programs, applicants must be a part of the transit industry. The applicant is required to be a PG&E customer, own or lease the property to install charging infrastructure, acquire at minimum two electric vehicles, and agree to all terms and conditions. Additionally, applicants must provide data related to electric vehicle usage for at least five years after the chargers are installed and operational, as well as make a 10-year commitment.

Infrastructure incentives include PG&E constructing, owning, and maintaining all electrical infrastructure from the transformer to the customer meter; fleet operators will design, build, own, and maintain the electrical infrastructure from the customer meter to the EV charger. Funds available for transit buses and class 8 vehicles is $9,000 per vehicle incentive cap. Incentives are limited to 25 vehicles per site.

PG&E's EV Fleet Program utilizes Level 2 and direct current (DC) fast chargers based on operator's needs. Participants are responsible for procuring the chargers and having them installed. Based on the EV chargers' power output and industry type and location participants may be eligible for charger rebates. Rebates for chargers with a power output up to 50 kW can receive 50 percent of the cost of EV charger, up to $15,000. Rebates for chargers with a power output of 50.1 kW – 149.9 kW can receive 50 percent of the cost of the EV charger, up to $25,000. Rebates for chargers with a power output of 150 kW and above can receive 50 percent of the cost of the EV charger, up to $42,000.

Southern California Edison (SCE) Charge Ready Transport Program

The Charge Ready Transport Program provides funding to install the infrastructure needed to operate an electric vehicle fleet. To be eligible applicants must complete the following: lease, purchase, or convert at least two medium- or heavy-duty battery-powered EVs; own or lease property where chargers are installed, and operate and maintain chargers for a minimum of 10 years; select, purchase, and install SCE-approved charging equipment; provide data related to charging equipment usage for a minimum of five years; provide property easement for the SCE infrastructure; and agree to the terms and conditions.

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

Launched by the California Air Resources Board (CARB) in 2009, the HVIP is part of the California Climate Investments. The project provides point-of-sales vouchers to make advanced vehicles more affordable. As of September 27, 2022 funds specifically set aside for drayage trucks, school buses, and Innovative Small e-Fleet (ISEF) have been fully subscribed. However, applications for Public Transit Bus Set-Aside are still open and funding available was listed $48 million. Vouchers generally offset $45,000 to $120,000 of the cost of the vehicle, depending on type.

Low Carbon Transit Operations Program (LCTOP)

Operated by the California Department of Transportation (Caltrans), the program provides operating and capital assistance for transit agencies to reduce greenhouse gas emissions and improve mobility, with priorities towards serving disadvantaged communities. The State Controller's Office provides a list of transportation planning agencies and transit operators that are eligible for LCTOP funds on an allocation basis. All funds for Kern County are apportioned to Kern COG, which prepares a program of projects. The next Call for Projects should be in early 2023, for adoption by the Kern COG Board in early April.

Transportation Development Act – Local Transportation Fund (LTF)

While typically used for operations, TDA funds claimed under Article 4 may be used for capital purchases such as vehicle purchase and facility construction. Funds claimed under Article 8(e) may be used to purchase vehicles and related equipment. While the County is not likely to use LTF to fund its ZEV transition, it is allowable to use this funding for that purpose.

Transportation Development Act – State Transit Assistance (STA) Fund

STA funds may be used for capital purposes, including vehicle purchases and infrastructure. This includes accruing STA funds for a larger purchase. Kern Transit is expected to receive approximately $100,000 in STA funding for FY 2022/23 (as of August 2022). If those funds are not needed for operations, the County may wish to retain them to fund vehicle and infrastructure projects.

State of Good Repair (SOGR) (Senate Bill 1)

State of Good Repair funds may also be available to purchase vehicles, since electric vehicles will be purchased as existing vehicles reach the end of their useful lives. For the last couple of years, Kern County has received approximately $1.5 million, which is allocated throughout the region. In FY 2021/22, Kern Transit's allocation was just under $500,000. Kern COG issues an annual Call for Projects, which are then programmed for funding. Historically, Kern Transit has claimed its allocation, and in FY 2021/22 claimed it to build funding for a ZEV purchase. The FY 2022/23 allocation was significantly lower (approximately $140,000), and is being used to fund the purchase of a cutaway bus.

Agencies may also look to obtain loans to cover the costs of vehicles and infrastructure installation.

Infrastructure State Revolving Fund (ISRF) Program

The ISRF program is authorized to provide low-cost public financing to state and local government entities. Financing is available in amounts ranging from $50,000 to $25 million with loan terms for the useful life of the project up to a maximum 30 years. Eligible applicants must be located in California and include any subdivision of a local government, including cities, counties, special districts, assessment districts, joint powers authorities and non-profit organizations sponsored by a government entity.

Climate Tech Finance

Climate Tech Finance supports emerging technologies that reduce greenhouse gas emissions. Greenhouse gas emissions reductions include either direct reductions on-site (e.g., process improvements, electrification) or indirect reductions (e.g., reduced energy consumption). Eligible technologies include fuel cell or battery systems for on-site energy storage; waste-to-energy systems at wastewater treatment or solid waste facilities; carbon-sequestering cement substitutes; and in-vessel composting systems. Technology eligibility is determined on a project-by-project basis. Loans are accepted on a rolling basis and can be combined with grants or other sources of funding. Climate Tech Finance offers loan guarantees of up to $5 million are offered on loans of up to $20 million, with up to a 7-year term (the loan term can be longer). IBank provides loans for public entities ranging from $500,000 to $30 million, with up to 30-year terms.

Exhibit H.1.1 Potential Funding Sources

Name of Funding Source	How Each Fund is Planned to be Used	Estimated Amount(s) of Each Funding Source ($)
Formula Grants for Rural Areas – 5311/CMAQ	Can be used for operating, capital, or planning purposes	Amount available for capital varies; CMAQ funds are flexible funds
Grants for Bus and Bus Facilities Program (formula) – 5339(a)	Purchase zero-emission buses; construct or lease facilities and related equipment	Varies; allocation through the state
Grants for Bus and Bus Facilities Program (discretionary) – 5339(b)	Purchase zero-emission buses; construct or lease facilities and related equipment	Varies; competitive application
Low or No Emission Vehicle Program – 5339(c)	Purchase zero-emission buses; construct or lease facilities and related equipment; workforce development	Varies; competitive application
PG&E EV Fleet Program	Infrastructure incentives and charger rebates.	$9,000 per vehicle incentive cap. Charging infrastructure: • Up to 50 kW, up to $15,000 • 50.1 kW – 149.9 kW, up to $25,000 • 150 kW and above, up to $42,000
Southern California Edison (SCE) Charge Ready Transport Program	Infrastructure	
Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)	Purchasing zero-emission vehicles	Funds available for public transit bus set-aside as of 9/27/22 - $48 million (vouchers valued at $45,000 - $120,000 depending on vehicle type)
Low Carbon Transit Operations Program (LCTOP)	Can be used for operating and capital assistance	Varies
Transportation Development Act – LTF	Can be used for operating and capital assistance	Varies depending on allocation and amount required for operations
Transportation Development Act – STA	Can be used for operating and capital assistance	Varies depending on allocation and amount required for operations

Name of Funding Source	How Each Fund is Planned to be Used	Estimated Amount(s) of Each Funding Source ($)
State of Good Repair (SB 1)	Replace existing fleet vehicles with zero-emission vehicles at the end of their useful life	Varies depending upon allocation and program of projects
Infrastructure State Revolving Funds (ISRF)	Infrastructure	Loans from $50,000 to $25 million
Climate Tech Finance	Infrastructure and related equipment	Loans from $500,000 to $30 million

Section I | Start-up and Scale-up Challenges

The County of Kern has two main challenges for its zero-emission bus deployment. The first is the long regional routes, several of which exceed 100 miles round trip. While hydrogen fuel cells are a reasonable solution for some routes, only those based in (or traveling to) Bakersfield can reasonably utilize this fuel type.

The second challenge is the dispersed nature of the fleet. Implementing a zero-emission fleet means all satellite storage and fueling facilities will need to be able to provide charging for battery-electric vehicles. Several of the storage facilities are leased, though in some cases a County roads yard is used for fueling. As a result, deployment of charging infrastructure (and battery-electric buses) at these satellite facilities is expected to be complicated.

Scaling up deployment of zero-emission buses will also be a challenge because Kern Transit shares facilities with the County Roads Department. All decisions regarding infrastructure development and vehicle storage/fueling needs will also need to take other County fleets and activities into account before any decisions can be made.

Appendix A | Glossary of Terms

AC generator (or alternator): An electric device that produces an electric current that reverses direction many times per second. Also called a synchronous generator.

Adsorption: The adhesion of the molecules of gases, dissolved substances, or liquids to the surface of the solids or liquids with which they are in contact.

Air: The mixture of oxygen, nitrogen, and other gases that, with varying amounts of water vapor, forms the atmosphere of the earth.

All-electric range (AER): Driving range of a vehicle in a driving cycle using only electric power from its battery pack. The total range per charge of a Battery Electric Vehicle is its AER. All-Electric Range of PHEV is the range in charge depleting mode.

All-wheel drive (AWD): An electric vehicle whose all wheels are powered from electric motors (either from a single motor or multiple motors)

Alkaline fuel cell (AFC): A type of hydrogen/oxygen fuel cell in which the electrolyte is concentrated potassium hydroxide (KOH) and the hydroxide ions (OH^-) are transported from the cathode to the anode.

Alloy: Mixture containing mostly metals. For example, brass is an alloy of copper and zinc. Steel contains iron and other metals but also carbon.

Alternating current (AC): A type of current that flows from positive to negative and from negative to positive in the same conductor.

Alternative fuel: An alternative to gasoline or diesel fuel that is not produced in a conventional way from crude oil. Examples include compressed natural gas (CNG), liquefied petroleum gas (LPG), liquefied natural gas (LNG), ethanol, methanol, and hydrogen.

Ambient air: The air surrounding a given object or system.

Ambient temperature: The temperature of the surrounding medium, usually used to refer to the temperature of the air in which a structure is situated or a device operates.

Ampere (A): Ampere (amp) is the unit of electric current in an electric circuit. It's the measure of the rate of electron flow in an electrical conductor. One ampere of current represents one Coulomb of electrical charge moving past a specific point in one second.

Ampere-hour (Ah): Ampere-hour is a unit of electric charge that has a dimension of electric current multiplied by time. One Ah is equal to 3600 Coulomb.

Anion: A negatively charged ion; an ion that is attracted to the anode.

Anode: The electrode at which oxidation (a loss of electrons) takes place. For fuel cells and other galvanic cells, the anode is the negative terminal; for electrolytic cells (where electrolysis occurs), the anode is the positive terminal.

Atom: The smallest physical unit of a chemical element that can still retain all the physical and chemical properties of that element. Atoms combine to form molecules, and they themselves contain several kinds of smaller particles. An atom has a dense central core (the nucleus) consisting of positively charged particles (protons) and uncharged particles (neutrons). Negatively charged particles (electrons) are scattered in a relatively large space around this nucleus and move about it in orbital patterns at extremely high speeds. An atom contains the same number of protons as electrons and thus is electrically neutral (uncharged) and stable under most conditions.

Atomic battery: See nuclear battery.

Atmospheric pressure: The force exerted by the movement of air in the atmosphere, usually measured in units of force per area. For fuel cells, atmospheric pressure is usually used to describe a system where the only pressure acting on the system is from the atmosphere; no external pressure is applied.

Battery: An energy storage device that produces electricity by means of chemical action. It consists of one or more electric cells each of which has all the chemicals and parts needed to produce an electric current.

Battery-as-a-Service (BaaS): Battery-as-a-Service model allows customers to lease batteries as a separate component from cars. Leasing the battery saves the upfront purchase cost of an electric vehicle. This new service provides battery swapping options that offer a solution to address shorter range issues of an EV.

Battery electric bus (BEB): A bus that has only a battery as the power source.

Battery electric vehicle (BEV): A vehicle that has only a battery as the power source. “Electric Vehicle” also refers to battery electric vehicle in general.

Battery management system (BMS): An electronic system that manages battery parameters such as state of charge, state of batter, maximum and minimum limits of energy, etc. It also controls energy flow to and from the battery.

Bidirectional charger: An electric vehicle charger that can flow charge to a battery and from battery to grid, vehicle, and home.

Bipolar plates: The conductive plate in a fuel cell stack that acts as an anode for one cell and a cathode for the adjacent cell. The plate may be made of metal or a conductive polymer (which may be a carbon-filled composite). The plate usually incorporates flow channels for the fluid feeds and may also contain conduits for heat transfer.

Blended mode: A type of charge-depleting strategy in which the engine supplements the battery during medium and heavy loads.

British thermal unit (BTU): The mean British thermal unit is 1/180 of the heat required to raise the temperature of one pound (1 lb.) of water from 32°F to 212°F at a constant atmospheric pressure. The BTU is equal to the quantity of heat required to raise one pound (1 lb.) of water 1°F.

Carbon (C): An atom and primary constituent of hydrocarbon fuels. Carbon is routinely left as a black deposit on engine parts, such as pistons, rings, and valves, by the combustion of fuel.

Carbon dioxide (CO_2): A colorless, odorless, noncombustible gas that is slightly more than 1.5 times as dense as air and becomes a solid (dry ice) below -78.5°C. It is present in the atmosphere as a result of the decay of organic material and the respiration of living organisms. It is produced by the burning of wood, coal, coke, oil, natural gas, or other fuels containing carbon.

Carbon monoxide (CO): A colorless, odorless, tasteless, poisonous gas that results from incomplete combustion of carbon with oxygen.

Catalyst: A chemical substance that increases the rate of a reaction without being consumed; after the reaction, it can potentially be recovered from the reaction mixture and is chemically unchanged. The catalyst lowers the activation energy required, allowing the reaction to proceed more quickly or at a lower temperature. In a fuel cell, the catalyst facilitates the reaction of oxygen and hydrogen. It is usually made of platinum powder very thinly coated onto carbon paper or cloth. The catalyst is rough and porous so the maximum surface area of the platinum can be exposed to the hydrogen or oxygen. The platinum-coated side of the catalyst faces the membrane in the fuel cell.

Catalyst poisoning: The process of impurities binding to a fuel cell's catalyst, lowering the catalyst's ability to facilitate the desired chemical reaction. See also fuel cell poisoning.

Cathode: The electrode at which reduction (a gain of electrons) occurs. For fuel cells and other galvanic cells, the cathode is the positive terminal; for electrolytic cells (where electrolysis occurs), the cathode is the negative terminal.

Cation: A positively charged ion.

Celsius: The metric temperature scale and unit of temperature (°C). Named for Swedish astronomer Anders Celsius (1701–1744) even though the thermometer first advocated by him in 1743 had 100° as the freezing point of water and 0° as the boiling point, the reverse of the modern Celsius scale. Also called the Centigrade scale (Latin for "hundred degrees").

Centimeter (cm): A metric unit of linear measure. One-centimeter equals about 0.4 inch, and one-inch equals about 2.5 centimeters. One foot is equal to approximately 30 centimeters.

CHAdeMO: CHAdeMO is a DC charging protocol for electric vehicles named after the association that developed the protocol. A maximum of 62.5kW power is delivered to the car battery at 500V, 125A DC.

Charge depleting mode: Mode of vehicle operation in which the vehicle uses energy only from the battery pack. Most plug-in hybrid electric vehicles operate in charge depleting mode at startup and switch to charge sustaining mode after the battery has reached its minimum state of charge.

Charging station: An infrastructure that provides the facility to charge an electric vehicle (BEV and PHEV). Also called electric vehicle supply equipment (EVSE).

Combined charging system (CCS): A combination of the slower Type 1 or Type 2 AC charging socket with an additional 2 pins for much faster DC charging. Only one socket is needed instead of having two like in the Nissan LEAF, which has the AC socket and the DC CHAdeMo socket.

Combustion: The burning fire produced by the proper combination of fuel, heat, and oxygen. In the engine, the rapid burning of the air-fuel mixture that occurs in the combustion chamber.

Combustion chamber: In an internal combustion engine, the space between the top of the piston and the cylinder head in which the air-fuel mixture is burned.

Composite: Material created by combining materials differing in composition or form on a macroscale to obtain specific characteristics and properties. The constituents retain their identity; they can be physically identified, and they exhibit an interface among one another.

Compressed hydrogen gas (CHG): Hydrogen gas compressed to a high pressure and stored at ambient temperature.

Compressed natural gas (CNG): Mixtures of hydrocarbon gases and vapors, consisting principally of methane in gaseous form that has been compressed.

Compressor: A device used for increasing the pressure and density of gas. See Turbocharger.

Connector: A device attached to the cable from an EVSE (electric vehicle supply equipment) that connects to an electric vehicle allowing it to change.

Cryogenic liquefaction: The process through which gases such as nitrogen, hydrogen, helium, and natural gas are liquefied under pressure at very low temperatures.

Current collector: The conductive material in a fuel cell that collects electrons (on the anode side) or disburses electrons (on the cathode side). Current collectors are microporous (to allow fluid to flow through them) and lie in between the catalyst/electrolyte surfaces and the bipolar plates.

DC fast charging (DCFC): A charging technology for electric vehicles by use of direct current (DC). They can make an EV battery charge at a much faster rate. This will fully charge an average electric car in 30 to 40 minutes. (See Level 3 charging.)

Demand charge: A demand charge encourages businesses to spread their electricity use throughout the day. It is calculated by using the 15-minute interval during each billing month when a business uses its maximum amount of electricity. Typically a rate plan with demand charges offers lower rates for regular electricity usage charges.

Density: The amount of mass in a unit volume. Density varies with temperature and pressure.

Depth of discharge (DoD): Indicated the level of charge in a battery. It is the inverse of SoC (100% = empty; 0% = full).

Direct methanol fuel cell (DMFC): A type of fuel cell in which the fuel is methanol (CH_3OH) in gaseous or liquid form. The methanol is oxidized directly at the anode instead of first being reformed to produce hydrogen. The electrolyte is typically a PEM.

Dispersion: The spatial property of being scattered over an area or volume.

Direct current (DC): An electric current of constant direction.

DISCOMs: Electric power distribution companies.

Drive train: A set of components that deliver power to the driving wheel of the vehicle. Electric motors are not included in the drive train. They have power train – electric motor.

Driving cycle: The velocity vs time graph of a vehicle. Sometimes driving cycle incorporates road gradient details also. They are useful for energy analysis, design, parameter selection of electric vehicles.

Dynamic electric vehicle charging (DEVC): Wireless charging of an electric vehicle when it is being driven.

Electric vehicle (EV): A vehicle that uses electricity as a source of energy for propulsion. They are classified as battery electric vehicle (BEV), hybrid electric vehicle (HEV), and plug-in hybrid electric vehicle (PHEV).

Electric vehicle supply equipment (EVSC): A safety protocol that enables two-way communication between a charging station and electric vehicle. Basically, it controls the safe current flow between the charger and your EV.

Electrode: A conductor through which electrons enter or leave an electrolyte. Batteries and fuel cells have a negative electrode (the anode) and a positive electrode (the cathode).

Electrolysis: A process that uses electricity, passing through an electrolytic solution or other appropriate medium, to cause a reaction that breaks chemical bonds (e.g., electrolysis of water to produce hydrogen and oxygen).

Electrolyte: A substance that conducts charged ions from one electrode to the other in a fuel cell, battery, or electrolyzer.

Electron: A stable atomic particle that has a negative charge; the flow of electrons through a substance constitutes electricity.

Emission standards: Regulatory standards that govern the amount of a given pollutant that can be discharged into the air from a given source.

Endothermic: A chemical reaction that absorbs or requires energy (usually in the form of heat).

Energy: The quantity of work a system or substance is capable of doing, usually measured in British thermal units (BTU) or Joules (J).

Energy charge: The baseline price of electricity, calculated by the amount of electricity (measured in kWh) used per time period multiplied by the per-kWh rate for those respective time periods.

Energy content: Amount of energy for a given weight of fuel.

Energy density: Amount of potential energy in a given measurement of fuel. See gravimetric energy density and volumetric energy density.

Engine: A machine that converts heat energy into mechanical energy.

Ethanol (CH_3CH_2OH): An alcohol containing two carbon atoms. Ethanol is a clear, colorless liquid and is the same alcohol found in beer, wine, and whiskey. Ethanol can be produced from cellulosic materials or by fermenting a sugar solution with yeast.

Exhaust emissions: Materials emitted into the atmosphere through any opening downstream of the exhaust ports of an engine, including water, particulates, and pollutants.

Exothermic: A chemical reaction that gives off heat.

Extended range electric vehicle (EREV): Although the electric motor of a PHEV always drives the wheels, EREVs feature an auxiliary power unit, usually an internal combustion engine, that acts as a generator to recharge the battery when it runs out.

Fixed charge: A fee covering the regulator-approved costs that the electric utility pays to supply your power, such as distribution and transmission (typically billed in dollars per month).

Fuel cell electric vehicle (FCEV): An electric vehicle that use fuel cells to energize the vehicle. Electricity to drive the motor is directly generated by the chemical reaction of hydrogen and oxygen.

Fuel cell vehicle (FCV): See fuel cell electric vehicle.

Fahrenheit: A temperature scale and unit of temperature (°F) named for German physicist Gabriel Daniel Fahrenheit (1686–1736), who was the first to use mercury as a thermometric fluid in 1714.

Flammability limits: The flammability range of a gas is defined in terms of its lower flammability limit (LFL) and its upper flammability limit (UFL). Between the two limits is the flammable range in which the gas and air are in the right proportions to burn when ignited. Below the lower flammability limit, there is not enough fuel to burn. Above the higher flammability limit, there is not enough air to support combustion.

Flashpoint: The lowest temperature under very specific conditions at which a substance will begin to burn.

Flexible fuel vehicle: A vehicle that can operate on a wide range of fuel blends (e.g., blends of gasoline and alcohol) that can be put in the same fuel tank.

Fuel: A material used to create heat or power through conversion in such processes as combustion or electrochemistry.

Fuel cell: A device that produces electricity through an electrochemical process, usually from hydrogen and oxygen.

Fuel cell poisoning: The lowering of a fuel cell's efficiency due to impurities in the fuel binding to the catalyst.

Fuel cell stack: Individual fuel cells connected in a series. Fuel cells are stacked to increase voltage.

Fuel processor: Device used to generate hydrogen from fuels such as natural gas, propane, gasoline, methanol, and ethanol for use in fuel cells.

Gas: Fuel gas such as natural gas, undiluted liquefied petroleum gases (vapor phase only), liquefied petroleum gas-air mixtures, or mixtures of these gases.

Natural Gas: Mixtures of hydrocarbon gases and vapors consisting principally of methane (CH_4) in gaseous form.

Liquefied petroleum gases (LPG): Any material composed predominantly of any of the following hydrocarbons or mixtures of them: propane, propylene, butanes (normal butane or isobutane) and butylenes.

Liquefied Petroleum Gas-Air Mixture: Liquefied petroleum gases distributed at relatively low pressures and normal atmospheric temperatures that have been diluted with air to produce desired heating value and utilization characteristics.

Gas Diffusion: Mixing of two gases caused by random molecular motions. Gases diffuse very quickly, liquids diffuse much more slowly, and solids diffuse at very slow (but often measurable) rates. Molecular collisions make diffusion slower in liquids and solids.

GENCOM: Electric power generation companies.

Graphite: Mineral consisting of a form of carbon that is soft, black, and lustrous and has a greasy feeling. Graphite is used in pencils, crucibles, lubricants, paints, and polishes.

Gravimetric energy density: Potential energy in a given weight of fuel.

Greenhouse effect: Warming of the Earth's atmosphere due to gases in the atmosphere that allow solar radiation (visible, ultraviolet) to reach the Earth's atmosphere but do not allow the emitted infrared radiation to pass back out of the Earth's atmosphere.

Greenhouse gas (GHG): Gases in the Earth's atmosphere that contribute to the greenhouse effect.

Home charging: The charging of an electric vehicle from a standard home installed socket.

Hybrid electric vehicle (HEV): HEV is a vehicle that has one or more energy sources along with electricity. A combination of gasoline and electricity combination is widely used in hybrid electric vehicles.

Heat exchanger: Device (e.g., a radiator) that is designed to transfer heat from the hot coolant that flows through it to the air blown through it by the fan.

Heating value: The number of British thermal units (BTU) produced by the combustion of one cubic foot of gas at constant pressure when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

Higher heating value (HHV): The value of the heat of combustion of a fuel measured by reducing all of the products of combustion back to their original temperature and condensing all water vapor formed by combustion. This value takes into account the heat of vaporization of water.

Hybrid electric vehicle (HEV): A vehicle combining a battery-powered electric motor with a traditional internal combustion engine. The vehicle can run on either the battery or the engine or both simultaneously, depending on the performance objectives for the vehicle.

Hydrides: Chemical compounds formed when hydrogen gas reacts with metals. Used for storing hydrogen gas.

Hydrocarbon (HC): An organic compound containing carbon and hydrogen, usually derived from fossil fuels, such as petroleum, natural gas, and coal.

Hydrogen (H_2): Hydrogen (H) is the most abundant element in the universe, but it is generally bonded to another element. Hydrogen gas (H_2) is a diatomic gas composed of two hydrogen atoms and is colorless and odorless. Hydrogen is flammable when mixed with oxygen over a wide range of concentrations.

Hydrogen-rich fuel: A fuel that contains a significant amount of hydrogen, such as gasoline, diesel fuel, methanol (CH_3OH), ethanol (CH_3CH_2OH), natural gas, and coal.

Impurities: Undesirable foreign material(s) in a pure substance or mixture.

Internal combustion engine (ICE): An engine that converts the energy contained in a fuel inside the engine into motion by combusting the fuel. Combustion engines use the pressure created by the expansion of combustion product gases to do mechanical work.

Incentives: Many governments offer incentives to encourage buyers to choose an electric car. It includes grants towards the purchase price, free parking, zero road tax, low company car tax and exemption from city emissions and congestion charges.

Inverter: An electronic circuit that changes direct current to alternating current

Ion: Atom or molecule that carries a positive or negative charge because of the loss or gain of electrons.

J Plug: See SAE J1772.

Kilogram (kg): Metric unit of weight or mass equal to approximately 2.2 lb. Related units are the milligram (mg) at 1,000,000 per kg and the metric tonne at 1,000 kg.

Kilowatt (kW): A unit of power equal to about 1.34 horsepower or 1,000 watts.

km/kWh: Unit that indicates how long electric car travel with unit energy consumption.

Kilowatt hour (kWh): One unit of energy. Equipment of 1kW rating consumes 1kWh energy if it operates for 1 hour.

kWh/km: Energy required to travel a unit kilometer.

Level 1 charging: Use a 120-volt (V) alternating-current (AC) plug and require a dedicated circuit, offering about 5 miles of range for every hour of charging

Level 2 charging: Use a 240-volt (V) alternating-current (AC) plug and require home charging or public charging equipment to be installed. Provide 10 to 20 miles of range for every hour of charging. Most common type of chargers.

Level 3 charging: DC fast charging is Level 3 charging (480-volt direct current). They bypass the onboard charger and provide DC electricity to the battery via a special charging port. DC fast chargers provide up to 40 miles of range for every 10 minutes of charging but are not compatible with all vehicles. They can be deployed in electric charging stations and houses to charge the vehicle at a faster rate. The Tesla Model S75 has 80 percent of the battery charged in 30 minutes and it takes a maximum of 1 hour to get fully charged.

Liquefied hydrogen (LH_2): Hydrogen in liquid form. Hydrogen can exist in a liquid state but only at extremely cold temperatures. Liquid hydrogen typically has to be stored at -253°C (-423°F). The temperature requirements for liquid hydrogen storage necessitate expending energy to compress and chill the hydrogen into its liquid state.

Liquefied natural gas (LNG): Natural gas in liquid form. Natural gas is a liquid at -162°C (-259°F) at ambient pressure.

Liquefied petroleum gas (LPG): Any material that consists predominantly of any of the following hydrocarbons or mixtures of hydrocarbons: propane, propylene, normal butane, isobutylene, and butylenes. LPG is usually stored under pressure to maintain the mixture in the liquid state.

Liquid: A substance that, unlike a solid, flows readily but, unlike a gas, does not tend to expand indefinitely.

Lower heating value (LHV): The value of the heat of combustion of a fuel measured by allowing all products of combustion to remain in the gaseous state. This method of measure does not take into account the heat energy put into the vaporization of water (heat of vaporization).

Mechanical energy: Energy in a mechanical form.

Megawatt (MW): A unit of power equal to one million watts or 1,000 kilowatts.

Membrane: The separating layer in a fuel cell that acts as electrolyte (an ion-exchanger) as well as a barrier film separating the gases in the anode and cathode compartments of the fuel cell.

Meter (m): Basic metric unit of length equal to 3.28 feet, 1.09 yards, or 39.37 inches. Related units are the decimeter (dm) at 10 per meter, the centimeter (cm) at 100 per meter, the millimeter (mm) at 1,000 per meter, and the kilometer (km) at 1,000 meters.

Methane (CH_4): See natural gas.

Methanol (CH_3OH): An alcohol containing one carbon atom. It has been used, together with some of the higher alcohols, as a high-octane gasoline component and is a useful automotive fuel.

Micro-hybrid: A micro-hybrid is not strictly a hybrid electric vehicle. It does not have an electric power train. The fuel economy of micro-hybrids is a little bit high due to techniques such as regenerative braking, and start-stop feature.

Mild hybrid: A hybrid electric vehicle in which the motor and battery alone is not capable of driving the vehicle. An electric motor supports the internal combustion engine in the vehicle.

Miles per gallon Equivalent (MPGE): Energy content equivalent to that of a gallon of gasoline (114,320 BTU).

Millimeter (mm): Metric unit of length equal to 0.04 inches. There are 25 millimeters in an inch and 1,000 millimeters in a meter.

Milliwatt (mW): A unit of power equal to one-thousandth of a watt.

Molten carbonate fuel cell (MCFC): A type of fuel cell that contains a molten carbonate electrolyte. Carbonate ions (CO_3^{-2}) are transported from the cathode to the anode. Operating temperatures are typically near 650°C.

Nafion: Sulfonic acid in a solid polymer form that is usually the electrolyte of PEM fuel cells.

Natural gas: A naturally occurring gaseous mixture of simple hydrocarbon components (primarily methane) used as a fuel.

Nitrogen (N_2): A diatomic colorless, tasteless, odorless gas that constitutes 78 percent of the atmosphere by volume.

Nitrogen oxides (NO_x): Any chemical compound of nitrogen and oxygen. Nitrogen oxides result from high temperature and pressure in the combustion chambers of automobile engines and other power plants during the combustion process. When combined with hydrocarbons in the presence of sunlight, nitrogen oxides form smog. Nitrogen oxides are basic air pollutants; automotive exhaust emission levels of nitrogen oxides are regulated by law.

Nuclear battery: A nuclear battery (atomic battery) is a device that uses the energy from the decay of radioactive isotope to generate electricity. The anatomic battery does not use a chain reaction to generate electric energy. Used in space, military, underwater, and medical applications as they are long-lasting sources of electricity. The use of nuclear batteries in vehicles is still being studied.

Oxidant: A chemical, such as oxygen, that consumes electrons in an electrochemical reaction.

Oxidation: Loss of one or more electrons by an atom, molecule, or ion.

Oxygen (O_2): A diatomic colorless, tasteless, odorless, gas that makes up about 21 percent of air.

Parallel hybrid: A vehicle power train configuration in which both the electric motor and internal combustion (IC) engine can propel the vehicle independently and together. Power split between the IC engine and electric motor is possible in this configuration.

Partial oxidation: Fuel reforming reaction where the fuel is oxidized partially to carbon monoxide and hydrogen rather than fully oxidized to carbon dioxide and water. This is accomplished by injecting air with the fuel stream prior to the reformer. The advantage of partial oxidation over steam reforming of the fuel is that it is an exothermic reaction rather than an endothermic reaction and therefore generates its own heat.

Pascal (Pa): The Pascal is the International System of Units (SI)-derived unit of pressure or stress. It is a measure of perpendicular force per unit area. It is equivalent to one newton per square meter. A megapascal equals 1,000,000 Pascals.

Peak Day Pricing: A type of electric rate plan that offers businesses a discount on regular summer time-of-use electricity rates in exchange for higher prices during nine to 15 Peak Pricing Event Days per year, typically occurring on the hottest days of the summer. (PG&E)

Permeability: Ability of a membrane or other material to permit a substance to pass through it.

Phosphoric acid fuel cell (PAFC): A type of fuel cell in which the electrolyte consists of concentrated phosphoric acid (H_3PO_4). Protons (H^+) are transported from the anode to the cathode. The operating temperature range is generally 160°C–220°C.

Plug-in hybrid electric vehicle (PHEV): A hybrid electric vehicle that can be plugged in and charged from a power socket.

Polymer: Natural or synthetic compound composed of repeated links of simple molecules.

Polymer electrolyte membrane (PEM): A fuel cell incorporating a solid polymer membrane used as its electrolyte. Protons (H^+) are transported from the anode to the cathode. The operating temperature range is generally 60°C–100°C.

Polymer electrolyte membrane fuel cell (PEMFC or PEFC): A type of acid-based fuel cell in which the transport of protons (H^+) from the anode to the cathode is through a solid, aqueous membrane impregnated with an appropriate acid. The electrolyte is a called a polymer electrolyte membrane (PEM). The fuel cells typically run at low temperatures (<100°C).

Propane (C_3H_8): See liquid petroleum gas (LPG).

Proton: A subatomic particle in the nucleus of an atom that carries a positive electric charge and is not movable by electrical means.

Proton exchange membrane (PEM): See polymer electrolyte membrane.

Power factor adjustment: An adjustment to an electricity demand charge according to how efficiently your facility consumes power.

Power train: The set of components used to generate the power required to move the vehicle and deliver it to the wheels.

Propulsion motor: See traction motors.

Public charging stations (PCS): The electric vehicle charging stations commercially accessible to the electric cars to charge the battery. They are available on the sides of roads and other locations.

Reactant: A chemical substance that is present at the start of a chemical reaction.

Reactor: Device or process vessel in which chemical reactions (e.g., catalysis in fuel cells) take place.

Reformate: Hydrocarbon fuel that has been processed into hydrogen and other products for use in fuel cells.

Reformer: Device used to generate hydrogen from fuels such as natural gas, propane, gasoline, methanol, and ethanol for use in fuel cells.

Reforming: A chemical process in which hydrogen-containing fuels react with steam, oxygen, or both to produce a hydrogen-rich gas stream.

Reformulated gasoline: Gasoline that is blended so that, on average, it reduces volatile organic compounds and air toxics emissions significantly relative to conventional gasolines.

Regenerative fuel cell: A fuel cell that produces electricity from hydrogen and oxygen and can use electricity from solar power or some other source to divide the excess water into oxygen and hydrogen fuel to be re-used by the fuel cell.

Renewable energy: A form of energy that is never exhausted because it is renewed by nature (within short time scales; e.g., wind, solar radiation, hydro power).

Reversible fuel cell: See regenerative fuel cell.

Rechargeable energy storage systems (RESS): An energy storage system that can recharge once it discharges. Rechargeable batteries are examples of this.

Regenerative braking: Braking in which the energy that would have been lost as heat energy during braking is captured using a traction motor (acting as a generator) and stored in the battery.

Residential charging: See home charging.

SAE COMBO (CCS): The CCS plug is an enhanced version of the Type 2 plug, with two additional power contacts for the purposes of quick charging and supports AC and DC charging power levels of up to 170 kW. In practice, the value is usually around 50 kW.

SAE J1772 (IEC Type 1): also known as a J plug, is a North American standard for electrical connectors for electric vehicles maintained by SAE International and has the formal title "SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler." It covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler.

SAE J2954: The emerging standard for inductive car charging over a pad, with power delivery up to 11kW.

Seasonal rates: Additional electricity distribution fees covering the costs of addressing weather stressors on the electric grid during winter or summer.

Separated extra low voltage (SELV) system: An extra-low voltage electrical circuit that is electrically separated from other circuits that carry higher voltages, isolated from earth and from the protective earth conductors of other circuits.

Series hybrid: A hybrid electric vehicle configuration in which only an electric motor can propel the vehicle and the internal combustion engine runs a generator to generate electricity to power the motor.

Solar charging: An electric car charging from solar-based charging stations or panels integrated on the vehicle itself.

Solar assisted electric vehicle (SAEV): An SAEV is a vehicle that partially uses solar energy for propulsion.

Solid oxide fuel cell (SOFC): A type of fuel cell in which the electrolyte is a solid, nonporous metal oxide, typically zirconium oxide (ZrO_2) treated with Y_2O_3, and O^{-2} is transported from the cathode to the anode. Any CO in the reformate gas is oxidized to CO_2 at the anode. Temperatures of operation are typically 800°C–1,000°C.

Sorbent: Material that sorbs another (i.e., has the capacity or tendency to take it up either by adsorption or absorption).

Sorption: Process by which one substance takes up or holds another.

Stack: See fuel cell stack.

Steam reforming: The process for reacting a hydrocarbon fuel, such as natural gas, with steam to produce hydrogen as a product. This is a common method for bulk hydrogen generation.

Stop/start technology: A technology in which the vehicle engine goes off whenever the vehicle stops for more than a fixed time (a few seconds) and start instantly when the gas pedal is pressed.

State of charge (SoC): State of charge (SoC) is the level of charge of an electric battery relative to its capacity. The units of SoC are percentage points (0% = empty; 100% = full).

Strong hybrid: Consist of a combustion engine and an electric motor that work together as well as independent of each other. The electric motor can power the car in certain scenarios like low-speed city driving, but when the driver demands more pace, the engine comes to life.

Supercapacitor: A capacitor that has high capacitance values but lower voltage limits.

Space vector pulse width modulation (SVPWM) inverter: A SVPWM inverter is a power electronics inverter that converts DC from the battery to AC to run a vehicle.

Tesla Supercharging: A fast-charging standard for electric vehicles developed by Tesla Motors.

Time-of-Use: An electricity rate plan where the cost of electricity varies based on the time of day and season in which it is used. Electricity rates are higher during times of peak energy demand and lower at all other times.

Traction motor: Motors powered by electricity and generate the power to rotate the wheels of the train. The turning force produced by traction motors is transmitted to the wheels via the driving gear unit and axle.

TRANSCOM: Electric power transmission company.

Technology validation: Confirming that technical targets for a given technology have been met.

Temperature: A measure of thermal content. See also ambient temperature.

Tritium battery: See nuclear battery.

Turbine: Machine for generating rotary mechanical power from the energy in a stream of fluid. The energy, originally in the form of head or pressure energy, is converted to velocity energy by passing through a system of stationary and moving blades in the turbine.

Turbocharger: A device used for increasing the pressure and density of a fluid entering a fuel cell power plant using a compressor driven by a turbine that extracts energy from the exhaust gas.

Turbocompressor: Machine for compressing air or other fluids (reactant if supplied to a fuel cell system) in order to increase the reactant pressure and concentration.

UK 3 pin: The plug for a standard UK electrical outlet. This connector can be used to charge some EVs in an emergency but lacks the safety, speed and security features of a dedicated charge point.

Ultracapacitor: See super capacitor.

Utility rate (time of use or TOU): Utility rates for electricity vary according to peak use hours. Thus the rate charged to an EV customer is based not only on the total electricity used but also upon the time of day the energy was drawn.

Vehicle to grid (V2G): A technology that enables energy to be pushed back to the power grid from the battery of an electric car. With electric vehicle-to-grid technology—also known as car-to-grid—a car battery can be charged and discharged based on different signals — such as energy production or consumption nearby.

Vehicle to home (V2H): V2H allows for two-way power flows between your home and your electric car or van (EV). This means as well as charging your EV as normal, you can use the energy stored in your EV battery to power your home when it makes sense to do so.

Vehicle to vehicle (V2V): A technology in which one electric vehicle is connected to another electric vehicle to transfer or receive electricity.

Volumetric energy density: Potential energy in a given volume of fuel.

Water (H_2O): A colorless, transparent, odorless, tasteless liquid compound of hydrogen and oxygen. The liquid form of steam and ice. Fresh water at atmospheric pressure is used as a standard for describing the relative density of liquids, the standard for liquid capacity, and the standard for fluid flow. The melting and boiling points of water are the basis for the Celsius temperature system. Water is the only byproduct of the combination of hydrogen and oxygen and is produced during the burning of any hydrocarbon. Water is the only substance that expands on freezing as well as by heating and has a maximum density at 4°C.

Watt (W): A unit of power equal to one Joule of work performed per second; 746 watts is the equivalent of one horsepower. The watt is named for James Watt, Scottish engineer (1736–1819) and pioneer in steam engine design.

Wt.%: The term wt.% (abbreviation for weight percent) is widely used in hydrogen storage research to denote the amount of hydrogen stored on a weight basis, and the term mass % is also occasionally used. The term can be used for materials that store hydrogen or for the entire storage system (e.g., material or compressed/liquid hydrogen as well as the tank and other equipment required to contain the hydrogen such as insulation, valves, regulators, etc.). For example, 6 wt.% on a system-basis means that 6% of the entire system by weight is hydrogen. On a material basis, the wt.% is the mass of hydrogen divided by the mass of material plus hydrogen.

Zero emission bus (ZEB): A bus that emits no tailpipe pollutants from the onboard source of power.

Zero emission vehicle (ZEV): A vehicle that emits no tailpipe pollutants from the onboard source of power.

Most glossary definitions were sourced from information at www.energy.gov/eere/fuelcells/glossary.

Additional Resources:

https://getelectricvehicle.com/awd-electric-cars/

https://getelectricvehicle.com/kw-vs-kwh-a-vs-ah-how-are-they-related-to-an-electric-vehicle/

https://afdc.energy.gov/vehicles/electric_basics_ev.html

https://www.energy.gov/eere/fuelcells/glossary

https://evreporter.com/ev-powertrain-components/#:~:text=What%20is%20Powertrain%3F,deliver%20it%20to%20the%20wheels.

https://www.techtarget.com/whatis/definition/electric-vehicle-charging-station

https://www.autocarindia.com/car-news/mild-strong-and-plug-in-hybrid-tech-explained-425231

https://www.virta.global/vehicle-to-grid-v2g#:~:text=What%20is%20V2G%20and%20V2X,battery%20of%20an%20electric%20car.

https://www.indra.co.uk/v2h

https://insideevs.com/features/510095/acb-ev-ccs/

https://www.pge.com/pge_global/common/pdfs/solar-and-vehicles/your-options/clean-vehicles/charging-stations/ev-fleet-program/PGE_EV-Fleet-Guidebook.pdf

Appendix B | Fleet Plan

Vehicle ID	Make	Model	Vehicle Type	Length	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	FY 32	FY 33	FY 34	FY 35	FY 36	FY 37	FY 38	FY 39	FY 40
B0134	El Dorado	Aerotech 240	Cutaway	25'	●											◆					
B0135	Ford	E450	Cutaway	25'	●											◆					
B0137	El Dorado	Aerotech 240	Cutaway	25'	●											◆					
B0139	Ford	E450	Cutaway	25'	●											◆					
B0142	Ford	E450	Cutaway	25'	●											◆					
B0143	Ford	BU	Cutaway	25'	●											◆					
B0902	Chevrolet	Aerolite	Cutaway	32'		●											◆				
B0904	Chevrolet	Aerolite	Cutaway	32'		●											◆				
B0906	Chevrolet	Aerolite	Cutaway	32'		●											◆				
B1160	El Dorado	Aerotech	Cutaway	22'					◆												
B1161	El Dorado	Aerotech	Cutaway	22'					◆												
B1162	El Dorado	Aerotech	Cutaway	22'					◆												
B1163	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1164	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1165	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1166	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1167	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1168	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1169	El Dorado	Aerotech	Cutaway	22'		●											◆				
B1171	El Dorado	Aerotech	Cutaway	22'			◆														
B1201	Ford	Aerotech 220	Cutaway	22'			◆														
B1202	Ford	Aerotech 220	Cutaway	22'			◆														
B1203	Ford	Aerotech 220	Cutaway	22'			●											◆			

● Conventional fuel ◆ Battery-electric ■ Battery-electric conversion ○ Hydrogen

Vehicle ID	Make	Model	Vehicle Type	Length	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	FY 32	FY 33	FY 34	FY 35	FY 36	FY 37	FY 38	FY 39	FY 40
B1204	Ford	Aerotech 220	Cutaway	22'			●											◆			
B1272	El Dorado	Aerotech	Cutaway	22'			●											○			
B1273	El Dorado	Aerotech	Cutaway	22'			●											○			
B1340	El Dorado	Axess	Standard	35'			●												◆		
B1350	El Dorado	Axess	Standard	35'			●												◆		
B1351	El Dorado	Axess	Standard	35'				◆													
B1420	El Dorado	Axess	Standard	35'				◆													
B1421	El Dorado	Axess	Standard	35'				◆													
B1501	El Dorado	Aerotech	Cutaway	22'				◆													
B1502	El Dorado	Aerotech	Cutaway	22'				●												○	
B1503	El Dorado	Aerotech	Cutaway	22'				●												○	
B1504	El Dorado	Aerotech	Cutaway	22'				●												○	
B1505	El Dorado	Aerotech	Cutaway	22'				●												○	
B1540	El Dorado	Axess	Standard	40'				●													○
B1541	El Dorado	Axess	Standard	40'				●													○
B1542	El Dorado	Axess	Standard	40'						○											
B1543	El Dorado	Axess	Standard	40'						○											
B1544	El Dorado	Axess	Standard	40'						○											
B1545	El Dorado	Axess	Standard	40'						○											
B1546	El Dorado	Axess	Standard	40'						○											
B1547	El Dorado	XHF	Standard	35'							◆										
B1548	El Dorado	XHF	Standard	35'							◆										
B1549	El Dorado	XHF	Standard	35'							◆										

● Conventional fuel ◆ Battery-electric ■ Battery-electric conversion ○ Hydrogen

Vehicle ID	Make	Model	Vehicle Type	Length	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	FY 32	FY 33	FY 34	FY 35	FY 36	FY 37	FY 38	FY 39	FY 40
B1550	El Dorado	XHF	Standard	35'							◆										
B1701	Ford	Starcraft	Cutaway	22'					◆												
B1702	Ford	Starcraft	Cutaway	22'					◆												
B1747	El Dorado	Axess	Standard	40'			■														
B1748	El Dorado	Axess	Standard	40'			■														
B1749	El Dorado	Axess	Standard	40'				■													
B1750	El Dorado	Axess	Standard	40'				■													
B1902	Startrans	Freightliner	Cutaway	32'									◆								
B1903	Startrans	Freightliner	Cutaway	32'									◆								
B1904	Ford	Senator II	Cutaway	22'							◆										
B1905	Ford	Senator II	Cutaway	22'							◆										
B2102	Ford	Startrans	Cutaway	22'									◆								
New			Cutaway	32'									◆								
New			Cutaway	32'									◆								
New			Cutaway	32'									◆								
New			Standard	40'											◆						
New			Standard	40'											◆						
New			Standard	40'												◆					
New			Standard	40'												◆					
New			Cutaway	22'															◆		
New			Cutaway	22'															◆		
New			Cutaway	22'															◆		
New			Cutaway	22'															◆		

● Conventional fuel ◆ Battery-electric ■ Battery-electric conversion ○ Hydrogen

Vehicle ID	Make	Model	Vehicle Type	Length	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	FY 32	FY 33	FY 34	FY 35	FY 36	FY 37	FY 38	FY 39	FY 40
New			Cutaway	22'															◆		
New			Cutaway	22'															◆		
New			Cutaway	22'																◆	
New			Cutaway	22'																◆	
New			Cutaway	22'																◆	

● Conventional fuel ◆ Battery-electric ■ Battery-electric conversion ○ Hydrogen

Appendix C | Training Programs

Aside from OEMs, there are also a number of training and education opportunities available through trade schools, colleges, and other private programs. While most do have a cost, offerings include online/virtual and in-person/hands-on options. Several of these are detailed below.

Organization	Training Available	Format	Location	Timeframe	Cost
American Public Transportation Association	Zero-Emission Bus Planning and Deployment: Session 1	Webinar	Virtual	90 minutes	$49 members/ $99 non-members
American Public Transportation Association	Zero-Emission Bus Planning and Deployment: Session 2	Webinar	Virtual	90 minutes	$49 members/ $99 non-members
American Public Transportation Association	Defining Workforce Needs to Support Bus Fleet Electrification	Webinar	Virtual	90 minutes	$49 members/ $99 non-members
California Transit Training Consortium	EV Transit Bus Safety Awareness and Familiarization	Self-paced online	Virtual	2 weeks	$650
California Transit Training Consortium	Basic, General, and Advanced tracks for electric and hybrid vehicles	In-person and distance learning	Various	Various	
College of the Sequoias	Electric Vehicle Safety and Service	In-person	Visalia, CA	3 weeks (most recently in July 2022)	$25 in 2022

Organization	Training Available	Format	Location	Timeframe	Cost
International Transportation Learning Center	BEB Familiarization Webinar – Session 1: BEB Overview[9]	Online	Virtual	100 minutes	Free
International Transportation Learning Center	BEB Familiarization Webinar – Session 2: High Voltage Safety Considerations	Online	Virtual	96 minutes	Free
International Transportation Learning Center	BEB Familiarization Webinar – Session 3: Battery Charging Approaches	Online	Virtual	114 minutes	Free
Los Angeles Trade-Tech	Hybrid & Electric Plug-In Vehicle Technology Certificate	In-person	Los Angeles	12 units	$46 per unit + fees
New Flyer (customers only)	Electrical Technician Training Program (ETTP) – Electrical Technician I and II certification)				
Proterra (customers only)	Operator training	In-person	On-site	16-24 hours	Part of a service package
Proterra (customers only)	Vehicle maintenance	In-person	On-site	32-48 hours	Part of a service package
Proterra (customers only)	Charger maintenance	In-person	On-site	8-16 hours	Part of a service package
Transit Workforce Center	ZEB Maintenance Training Materials (prepares technicians for OEM training)	Classroom materials, instructional videos, etc.		Available in late 2022	

[9] Materials can be downloaded at https://www.transittraining.net/courseware/details/battery-electric-bus-familiarization (all three webinars). Includes links and downloads for webinars, slides and presenters' notes, tests, and test answers.

Organization	Training Available	Format	Location	Timeframe	Cost
Weber State University	Phase I – High Voltage Safety Training	Self-paced online	Virtual	Over 14 days (7 hours)	$375
Weber State University	Phase II – Hybrid and Electric-Vehicle Systems	Self-paced online	Virtual	Over 60 days (21 hours)	$735
Weber State University	Phase III – Hybrid and Electric-Vehicle Boot Camp	In-person	Layton, UT	1 week (35 hours)	$1,575
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Leadership and Employee Relations	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Zero-Emission Bus Overview	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Zero-Emission Bus Operations	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Zero-Emission Bus Maintenance	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Financial Management	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Zero-Emission Bus Procurement	In-person	Thousand Palms, CA		
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Zero-Emission Bus Policies and Regulations	In-person	Thousand Palms, CA		

Organization	Training Available	Format	Location	Timeframe	Cost
West Coast Center of Excellence in Zero Emission Technology (CoEZET) (SunLine)	Planning for ZEB Operations	In-person	Thousand Palms, CA		
Zero Emission Bus Resource Alliance (ZEBRA)	Membership provides access to technical presentations, roundtable meetings, advocacy efforts, etc. Access to West Coast CoEZET resources.	Various	Various	Annual agency membership	$3,000