EPRI

CONSUMER GUIDE TO COMMERCIAL AND INDUSTRIAL ON-ROAD ELECTRIC VEHICLES

MARCH 2022

WHY ELECTRIC?

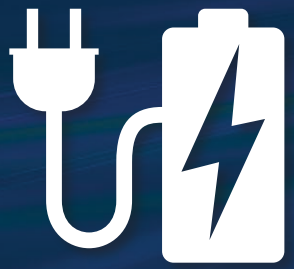
ELECTRIC TRANSPORTATION FOR BUSINESS

The Consumer Guide to Commercial and Industrial On-Road Electric Vehicles introduces the electric vehicles that are currently in use or can be used for commercial and industrial applications. Electricity currently moves materials, goods, and people through many means of transportation. The market for commercial and industrial electric vehicles and equipment has thrived for years and continues to accelerate due to the continuous technology innovation and market synergies.

This guide is organized by commercial and industrial market segment and type of equipment.

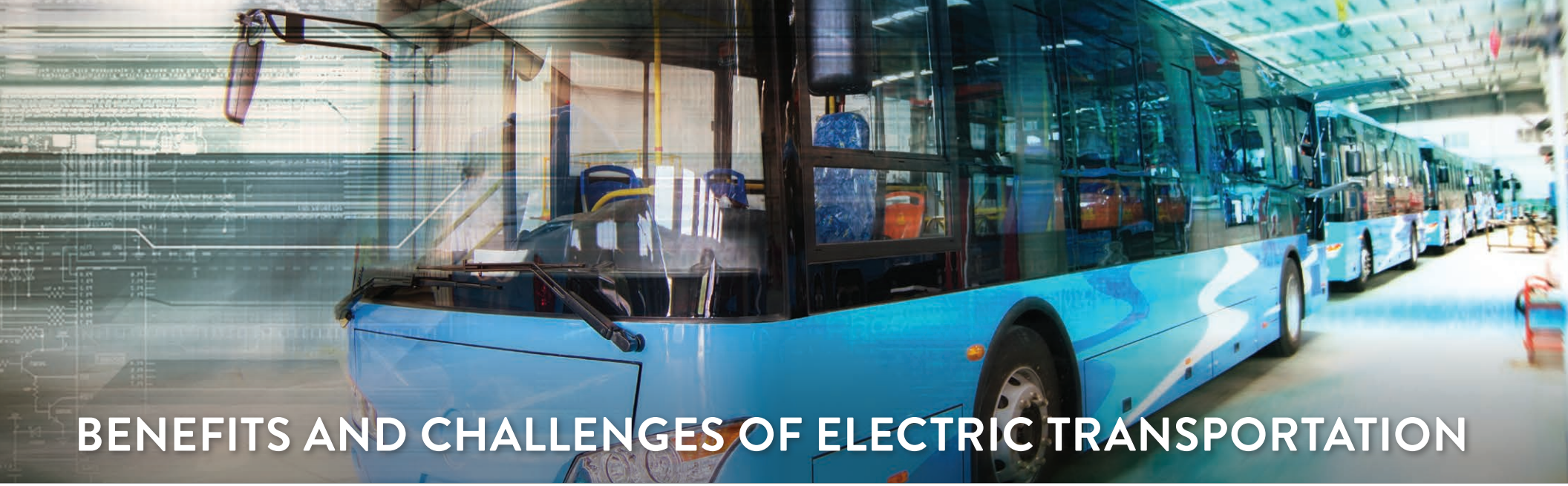
ELECTRIC VEHICLE CHARACTERISTICS

This guide highlights the two types of medium- and heavy-duty (MD/HD) electric vehicles that plug into the grid to charge their batteries. They are battery-electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs).



BEVs are electric vehicles in which the traditional combustion engine and transmission are replaced by batteries and electric motors. The battery size can vary just as tank sizes can vary in combustion vehicles. BEVs rely on electricity as fuel, so they have no tailpipe and no emissions.

Although less common, there are a few PHEVs available in the market. PHEVs pair an electric motor and battery with a combustion engine to propel the vehicle. Although tailpipe emissions continue to exist, they are reduced due to an existing electric range of the vehicle.



BENEFITS AND CHALLENGES OF ELECTRIC TRANSPORTATION

Electric commercial and industrial vehicles are currently competing with combustion vehicles. In some applications EVs can drive, lift, pull, and push as fast, and as far, as their combustion counterparts. Although the capital expenditure for EVs is higher, they cost less to operate per mile and produce lower or even no tailpipe emissions. Moreover, as employees adapt to the technology, they begin to prefer these vehicles and benefit from the quiet, emission- and vibration-free operation of electric vehicles.

Charging methods look different for unique use cases. Installing the necessary infrastructure and delivering required power levels is a challenge but when overcome, charging can be very easy and even automatic. Businesses who wish to make this process as seamless as possible must work hand in hand with their utility provider.

Switching to electricity as fuel can also decrease our reliance on foreign energy sources and reduce emissions. As local and national power generation grows cleaner, the broader public health and climate benefits accrue. Cutting vehicle emissions is especially critical in communities adjacent to heavily trafficked roadways.

VEHICLE PRODUCTION SCHEDULE

	2018	2020	2022	2024
Pick up Truck			PRODUCTION	
SUV		PRODUCTION		
Transit Bus		PRODUCTION		
School Bus	PRODUCTION			
Truck		PRODUCTION		
Refuse Truck			PRODUCTION	
Over the Road Tractor	DEMO			
Delivery Van		PRODUCTION		
Delivery Truck		PRODUCTION		
Fire Truck		DEMO		

ELECTRIC VEHICLE AVAILABILITY

Electric cars are available in almost every vehicle class. About 80 unique EV on-road commercial and industrial models by 49 manufacturers are expected to be available by 2023. EV range is increasing and costs are falling thanks to better batteries and components as well as growing production capacities. Vehicle ranges for BEVs can be as high as 350 miles. The range available for each vehicle varies depending on the vehicle type, battery size, weather, manufacturer and other factors.

Furthermore, EVs are available nationwide. However, in most cases for commercial and industrial applications, orders must be completed online or by directly contacting the sales department of the manufacturer.

Make	Model	Battery Size (kWh)	Reported Electric Range (mi)	PHEV/BEV	Horse Power (HP)	Year available
PICK UP TRUCK						
Alpha Motors*	Wolf	85	250	BEV	N/A	2023
Alpha Motors*	Wolf+	75	250	BEV	N/A	2023
Alpha Motors*	Superwolf	75	275	BEV	N/A	2023
Atlis*	XT Pickup	125	300	BEV	600	2022
Canoo*	Electric Pickup Truck	40	90	BEV	600	2023
Chevrolet	Silverado EV	200	400	BEV	664	2023
Ford	F-150 Lightning	170	230	BEV	563	2022
GMC	Hummer EV Pickup	200	350	BEV	1000	2022
Lordstown*	Endurance	109	250	BEV	600	2022
Rivian	R1T	135	314	BEV	835	2021
Tesla*	Cybertruck (single-motor)	100	250	BEV	302	2022
TRANSIT BUS						
BYD	K7M	215	158	BEV	410	2021
Gillig	Zero-Emission Low Floor Battery Electric Bus	444	150	BEV	469	2021
New Flyer	60' Xcelsior Charge	525	153	BEV	429	2021
New Flyer	40' Xcelecior Charge	350	174	BEV	214	2021
New Flyer	35' Xcelsior Charge	350	179	BEV	214	2021
NOVA	LFSe+	564	211	BEV	268	2021
Proterra	ZX5 Electric Transit Bus + 35-foot	225	240	BEV	500	2020
Proterra	ZX5 Electric Transit Bus + 40-foot	225	329	BEV	500	2020
SCHOOL BUS						
Arrival	The Arrival Bus	177	250	BEV	765	2022
Blue Bird	Vision Electric Type C Bus (V2G capable)	155	120	BEV	315	2018
Blue Bird	All American RE Electric Type D Bus (V2G capable)	155	120	BEV	315	2021
Blue Bird	Micro Bird G5 Electric Type A (V2G capable)	88	100	BEV	215	2021
Champion	All-Electric Shuttle Bus	127	105	BEV	394	2018
Collins	All-Electric School Bus Type A	127	105	BEV	394	2021
GreenPower	Beast School Bus Type D	194	140	BEV	469	2023
Lightning eMotors	E-450 Shuttle Bus	86	140	BEV	241	2021
Lightning eMotors	Lightning Electric Zero Emission F-550 Bus	128	100	BEV	241	2021
Lion Electric Co.	LionC	126	100	BEV	335	2022
Lion Electric Co.	LionA	84	75	BEV	215	2022
Lion Electric Co.	LionD	126	100	BEV	335	2022
Lion Electric Co.	LionM	160	150	BEV	215	2020
Metro Titan	All-Electric Shuttle Bus	127	105	BEV	394	2020
Navistar	IC Electric CE School Bus	105	70	BEV	335	2021
Thomas Built	Saf-T-Liner C2 Jouley	226	120	BEV	170	2022
Trans Tech	All-Electric School Bus Type A	127	105	BEV	394	2019
Turtletop	All-Electric Shuttle Bus	127	105	BEV	394	2020

** Watch for further development.*

Make	Model	Battery Size (kWh)	Reported Electric Range (mi)	PHEV/BEV	Horse Power (HP)	Year available
TRUCK						
California Truck Equipment Co.	All-Electric Work Truck	127	105	BEV	394	2021
Brightdrop	EV600	120	250	BEV	N/A	2022
Brightdrop	EV410	125	250	BEV	N/A	2023
GreenPower	EV Star CC	118	150	BEV	158	2021
Lion Electric Co.	Lion8 Bucket	252	130	BEV	470	2022
Peterbilt	579 EV	396	150	BEV	450	2021
Rockport	All-Electric Work Truck	127	105	BEV	394	2020
Winnebago	All-Electric Specialty Vehicle	127	105	BEV	308	2019
Zeus	Z-22	175	150	BEV	290	2022
REFUSE TRUCK						
BYD	8R	281	124	BEV	402	2021
BYD	6R	211	85	BEV	523	2020
Lion Electric Co.	Lion8 Refuse ASL	336	170	BEV	470	2020
Peterbilt	520EV	396	80	BEV	483	2020
OVER THE ROAD TRACTOR						
BYD	Q1A	217	150	BEV	241	2021
Freightliner	eCascadia	550	250	BEV	400	2021
Kenworth	T680E Tractor	396	150	BEV	670	2021
Nikola	TRE BEV Day Cab	753	350	BEV	645	2021
Tesla	Semi	600	300	BEV	1000	2022
Volvo	VNR Electric 6x2 Tractor	264	120	BEV	455	2021
DELIVERY VAN						
Ford	E-Transit	67	126	BEV	266	2022
Oshkosh Defense	Next Generation Delivery Vehicle	N/A	N/A	BEV	N/A	2023
Rivian	Commercial Van	N/A	N/A	BEV	N/A	2022
Workhorse	C-650	280	100	BEV	241	2020
DELIVERY TRUCK						
Freightliner	eM2	210	230	BEV	180	2021
Kenworth	K270E	141	100	BEV	469	2020
Kenworth	K370E	282	200	BEV	469	2020
Lion Electric Co.	Lion8(P)	336	170	BEV	470	2019
Lion Electric Co.	Lion6	252	180	BEV	335	2021
Peterbilt	220EV	141	100	BEV	207	2019
Rockport	All-Electric Box Truck	127	105	BEV	394	2020
Utilimaster	All-Electric Box Truck	127	105	BEV	394	2018
Volvo	VNR Electric 4x2 Straight	264	150	BEV	455	2021
FIRE TRUCK						
Oshkosh Truck Corp.	Pierce Volterra Electric Pumper	155		PHEV	350	

MOVING PEOPLE AND FLEETS


Photo Courtesy of Canoo


Photo Courtesy of Ford

Photo Courtesy of GM


Photo Courtesy of Chevrolet

ELECTRIC PICKUP TRUCKS

APPLICATION

Electric pickups are manufactured with the similar capabilities of their combustion counterparts. They are traditionally used for hauling, towing, and transporting materials; and their typical respective industries include construction, landscaping, and others.

TECHNOLOGY

It is expected that in 2023 there will be 15 electric pickup trucks available for purchase. Some pre-orders for these pickup trucks have already begun. The average range is 274 miles with an average reported power of 550 HP (410 kW).

CHARGING CAPABILITIES

DC fast charging and AC charging are both available with maximum 350 kW DC charging power and minimum 1.4 kW AC charging power. Charging capabilities vary across vehicles, so be sure to consider your own charging needs and preferences.

Vehicles that are used for the purpose of transporting people or used for fleets can be found in electric versions. Large orders for fleets can be made now and in the future, depending on the manufacturer of the vehicle. These vehicles generally include pickup trucks, sport utility vehicles (SUVs), transit buses, and school buses.

ELECTRIC TRANSIT BUSES

APPLICATION

Transit buses are vehicles designed to carry larger numbers of passengers and typically operate over fixed route distances with routine routes. They can serve this purpose for public transportation.

TECHNOLOGY

Electric transit buses are becoming more popular with time. Currently, there are over 150 locations that have deployed electric transit buses across the US and many more are expected to come. In 2021 alone, there were over 55 bus electrification projects that were awarded funding by the Federal Transit Administration. There are over 10 models currently available for pre-order with ranges varying from 75 to 200 miles.

CHARGING CAPABILITIES

Currently, electric transit buses generally charge with DC only, with DCFC used for both depot and on-route charging. Automated charging using a pantograph has become the preferred method for both depot and on-route charging.

FUN FACT: Battery powered vehicles date back all the way to 1832. [6]

Photo Courtesy of Lion Electric Co.

Photo Courtesy of Lion Electric Co.

ELECTRIC SCHOOL BUSES

APPLICATION

Routinely, school buses complete a morning route to pick up students and take them to school then go back to the depot. A second route is taken later in the day to drop off students and then they travel back to the depot once more. This makes school buses almost ideal as electric vehicles since they can charge for longer periods while the bus is not in use.

TECHNOLOGY

The average speed of school buses is about 10 miles per hour with a maximum speed of 65 miles per hour and a range up to 125 miles. There have been deployments of class 4 through 8 school buses in the US and there continues to be local, state, and other funding for electrification of school bus projects [8].

CHARGING CAPABILITIES

Due to their travel patterns charging is done in the depot while the vehicle is not in use. Usually, a Level 2 AC EVSE is all that is needed due to the extended length of available charge time, typically, DCFC is not required.

FUN FACT: Electric vehicles have higher torque at lower speeds, so they can tow, and haul much more compared to a conventional combustion vehicle. [11]

MOVING GOODS AND PEOPLE

Photo Courtesy of Lion Electric Co.

ELECTRIC TRUCKS

APPLICATION

These vehicles cover a wide range of applications as they can easily be modified to address hauling, transporting and towing needs. The electric "bucket" or "utility" truck is a common adaptation. This modification is intended to help elevate workers or materials with a hydraulic arm.

TECHNOLOGY

There are approximately 5 manufacturers with available electric trucks in classes 4 through 8 to choose from and modify. These vehicles have an average of 380 HP (283 kW) with a high of 483 HP (327 kW). Expected ranges are as high as 330 miles.

CHARGING CAPABILITIES

Trucks will have either AC, AC high power charging, or DCFC capabilities. Industry is currently working to define a megawatt class charging interface to support some high power/long range trucking applications.

For the transportation of goods and materials, vehicles must meet specific requirements such as high torque or power, range, cargo space, and other requirements. By 2023 these requirements will not only be met, but even surpassed by many of the upcoming electric vehicles. Each industry has a specific vehicle that more closely aligns with their transportation needs for goods and materials, and the vehicles include trucks, refuse trucks, over-the-road tractors, delivery vans, delivery trucks, and fire trucks.


Photo Courtesy of BYD

ELECTRIC REFUSE TRUCKS

APPLICATION

Refuse trucks, also known as "garbage trucks", are used in the collection of waste in the sanitation industry. These vehicles use hydraulics to collect solid waste then transport it to landfills, recycling centers, composting establishments, or other designated facilities.

TECHNOLOGY

By 2023, it is expected that there will be about 7 models in the classes 6 through 8 of refuse trucks available for order and pre-order. The vehicle average torque is 1817 lb-ft (2464 Nm) and average electric range of 185 miles with a reported maximum of 250 miles. It is important to note that refuse truck range is heavily impacted by how often it loads and unloads.

CHARGING CAPABILITIES

DCFC is expected to be required for refuse trucks. Typically, on route the speed is minimal with many stops for pickup. Deadheads to and from the residential areas and the waste drop off will require significant energy. Larger battery packs will be required, therefore requiring more charge power.

FUN FACT: Electric trucks can be over 20 percent less expensive than diesel-fueled trucks and reduce emissions by almost 50 percent.[4]

ELECTRIC OVER-THE-ROAD TRACTORS (OTR)

APPLICATION

"Over-the-road" tractors are large vehicles that are often referred to as "tractor-trailer trucks" or "semi-trailer trucks". These vehicles service short- and long-haul deliveries. The initial market will be catering to relatively shorter routes such as those used in steel mills. Trucks suited for longer routes will be available once en-route fueling stations are more readily available.

TECHNOLOGY

These larger vehicles are representative of class 7 and 8 vehicles. Four of these are expected to hit the market by 2023 with ranges of up to 350 miles.

CHARGING CAPABILITIES

Only DCFC will be available for these vehicles, since these vehicles take longer routes and can be on the road for many days at a time.

Photo Courtesy of Canoo

Photo Courtesy of Ram

ELECTRIC DELIVERY VANS

APPLICATION

Delivery vans have an enclosed space where goods can be transported, then delivered to consumers. These vans do not commonly have rear side windows and no rear seating. Delivery vans also have relatively shorter route distances and deliver small packages.

TECHNOLOGY

Due to their relatively shorter route distances, the average range in current and expected vehicle by 2023 is 113 miles. Currently, there are only two expected EV delivery vans by 2023 (Workhorse and Oshkosh Defense).

CHARGING CAPABILITIES

AC or DC charging is available. The delivery vans available by 2023 are expected to have the capacity to fast charge at 280 kW.

FUN FACT: 15 states in total have signed a statement of intent to get for zero emission bus and trucks by 2050. [1]

Photo Courtesy of Freightliner

ELECTRIC DELIVERY TRUCKS

APPLICATION

Delivery trucks are comprised of box trucks and straight trucks. These vehicles have enclosed cargo spaces to transport goods. These vehicles are larger than delivery vans and have more cargo space.

TECHNOLOGY

Seven models are expected to be available by 2023. Similar to vans, delivery trucks routes are shorter. The average electric range is about 160 miles with some vehicles having up to 230 miles to accommodate larger route distances.

CHARGING CAPABILITIES

Electric delivery trucks are capable of AC charging or DCFC up to 350 kW.

ELECTRIC FIRE TRUCK

APPLICATION

Fire trucks are used to transport trained fire fighters, trained paramedics, and essential equipment. Equipment can include water, hoses, medical supplies, and many other tools.

TECHNOLOGY

It is reported that the only electric fire truck in North America, deployed in Madison, Wisconsin, has a range that was designed for the square footage of the city it serves. Although the range is not reported on the manufacturer's website, they claim that this electric fire truck has fulfilled the city's needs.

OTHER CAPABILITIES

The fire truck is a PHEV; hence fuel and electricity are used. DCFC is available.

FUN FACT: Almost 500 electric deployments of MDHD exist in the US. [12]

FREQUENTLY ASKED QUESTIONS

WHAT ARE KILOWATTS AND KILOWATT-HOURS, ANYWAY?

A kilowatt (kW) is a measure of power. A kilowatt-hour (kWh) is a measure of energy, or how much power is used over time. An EV battery's size, measured in kWh, tells you how much energy it may contain and therefore how far the EV can go. The rate at which you use (and recharge) the battery is expressed in kW.

To understand their relationship, think of a hose and a bucket. Power (kW) is comparable to the rate of water flowing through the hose. Energy (kWh) is much like the amount of water that collects in the bucket over time (Figure 2a).

Figure 2a. *Power (kW) is comparable to the rate of water flowing through the hose. Energy (kWh) is much like the amount of water that collects in the bucket over time.*

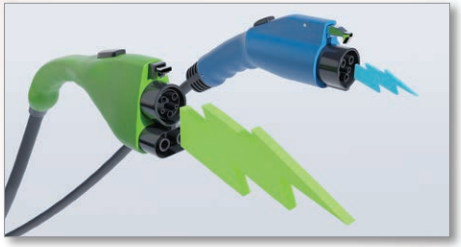
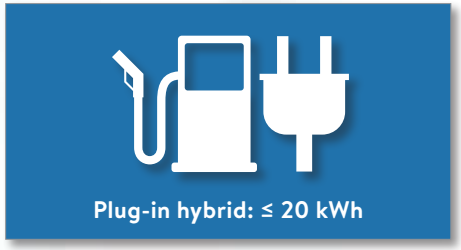
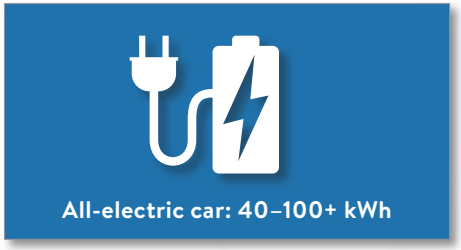


Figure 2b. *With high charging power (high kW), the car's battery fills faster than with low charging power (low kW).*

How do kilowatt-hours compare to gallons of gasoline?

Just as internal combustion cars have different size gas tanks, EVs have different size batteries. The amount of energy stored in a typical EV battery varies:





The distance the energy takes you in your EV depends on your battery size, how you drive, and factors such as weather. Driving fast, uphill, having a "lead foot," or running the heat or air-conditioning in your EV increase energy use. Conversely, making frequent stops or driving downhill can add energy to your battery.

Explain kilowatts and EV charging.

Continuing our hose analogy, just as more water would travel through a garden hose than a drinking straw, with EV charging, the amount of energy that can be added to your battery over time depends on the charging rate or power (kW) (Figure 2b). With high charging power (high kW), the car's battery fills faster than with low charging power (low kW). The car, not the charging station, determines the charging power.

Even if a public charging station can provide a high rate of power, such as 250 kW DC, only a few of today's EVs can accept that rate. Most current all-electric cars accept less than 150 kW DC, and most plug-in hybrids accept much lower rates, around 3.3 kW AC. Rapid industry advances are leading to cars that can accept high power rates and chargers that can supply that power.

CHARGING PRIMER

AC VERSUS DC CHARGING

Both AC and DC charging are methods of fueling EVs that address various range needs. However, based on factors such as travel distance and time to charge, one charging method may be better than another (Figure 1).

AC charging can be done at three different power levels: Level 1 (120 V and less than 1.9 kW), Level 2 (208 V or 240 V and less than 19.2 kW)), and 3-phase AC charging (J3068). High Frequency AC wireless (inductive) charging is also available. Level 1 charging has the slower charge time of the two but is used for convenience since it is portable and used with 120-volt receptacles.

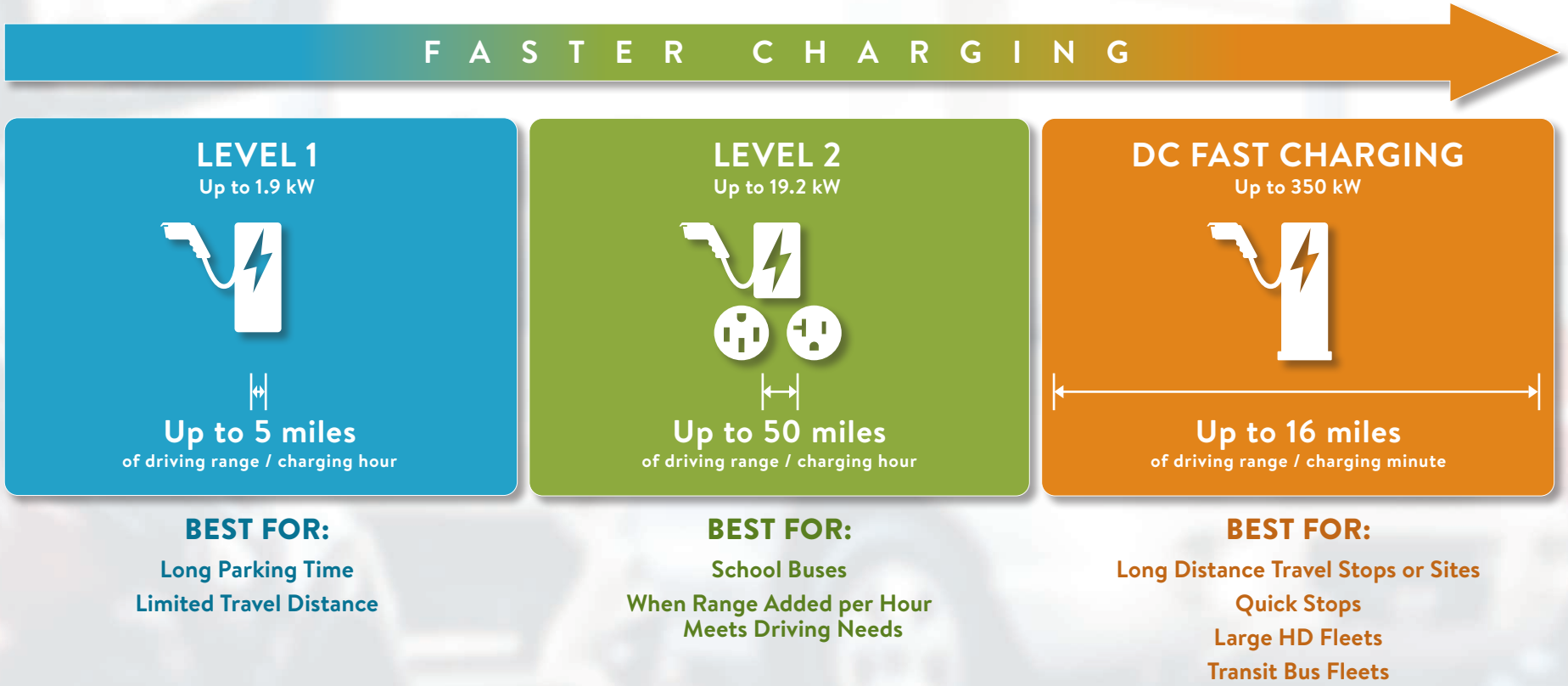


Figure 1. *Charging locations, levels, and range replenished*[1]

[1] *The amount of range replenished at all charging levels may vary beyond the numbers shown, depending on the charger type and vehicle. Most current US DC fast chargers offer a maximum power level of 50 kW–150 kW. Tesla Superchargers offer 120 kW–150 kW, and V3 Superchargers offer up to 250 kW. Some stations from Electrify America and other networks offer higher power, roughly 250 kW in some locations, and multiple networks promise to offer 350 kW and higher DC fast chargers for future vehicles that can take advantage of them.*

Level 2 charging is a better fit for commercial/industrial applications where EVs may be parked for hours at a time. However, compared to Level 1 charging, Level 2 charging requires more electrical capacity and additional oversight. Because it can be networked (for easily trackable and manageable charging), Level 2 charging proves more appealing to fleets and businesses.

3-phase AC charging (SAE J3068) is available at power levels up to 166 kW (600 Vac). Standard contacts (less than 63 A at 3-phase and less than 70 A at single-phase) and advanced contacts (less than 160 A) are also available.

DC charging—more commonly referred to as DC fast charging (DCFC)—can operate at higher power levels than both AC Level 1 and AC Level 2 charging and can add more range at faster rates. DCFC is better suited for long distance travel to sites, quick stops, and HD fleets. These EVSEs have higher buildout and maintenance costs and require a larger supply of electricity (Figure 1). DC charging can also take place both manually via connector and/or automatically with a pantograph.

DCFC is increasing to higher power levels through megawatt charging (MC) for fleets. MC is an upcoming solution to charging that is specific to MD/HD vehicles. The requirements and specifications for a megawatt class connector interface (one variation of which is called the Megawatt Charging System or MCS) are still being discussed with hopes to introduce it to the market sometime in 2022.

HOW MUCH DOES IT COST TO CHARGE?

EV charging rates can vary locally and statewide based on factors such as time-of-use (TOU), consumption (i.e., the amount of electricity needed per mile of travel), location, charging behavior, and ambient temperatures. Charging is priced by session, energy utilization (kWh), and duration. Charging by time can result in larger fees due to additional fees such as parking and session fees.

U.S. commercial rates for electricity are $0.111 per kWh on average. The efficiency of fuel coupled with a vehicle's energy consumption ratio (ECR) (the ratio of miles per gallon of fuel to miles per gallon of fuel-equivalent) is what is used to calculate the approximate cost to charge an EV (Table 1). With commercial rates in mind, the cost to charge an EV is approximately $1 per gallon of fuel-equivalent

Table 1. *Cost to Charge by Vehicle Type* [2]

Vehicle Type	Est Energy Consumption Ratio	Average Fuel Economy (miles per gallon of diesel)	Est cost ($) per mile (diesel)	Est cost ($) per gallon of diesel equivalent
Combination Long-haul Truck	2.5	6.88	$0.21	$1.41
Combination Short-haul Truck	3.5	6.88	$0.15	$1.01
Light Commercial Truck	3.5	18.52	$0.05	$1.01
Refuse Truck	3.5	2.68	$0.38	$1.01
School Bus	5.0	6.56	$0.11	$0.71
Single Unit Short-haul Truck	3.5	6.88	$0.15	$1.01
Transit Bus	5.0	3.45	$0.21	$0.71

[2] *The energy consumption ratios included in the table above are approximate calculations. The calculations for "Average Cost to Charge" assume: an average US commercial electricity rate of $0.111 (ElectricRate Electricity Rates By State (Updated October 2021)); a fuel economy of 33.7 kWh/gallon of gasoline using a conversion factor of lower heating values (U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Fueleconomy.gov Top Ten); a fuel of economy of 31.8 kWh/gallon of diesel (U.S. Environmental Protection Agency, Miscellaneous Data and Conversion Factors); and average fuel economies (U.S. Department of Energy Alternative Fuels Data Center, Average Fuel Economy by Major Vehicle Category).*

PUBLIC CHARGING

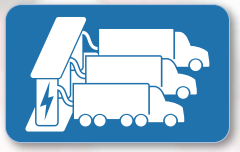
AC Level 2 public EVSEs are available at some workplaces and retail locations. DCFCs are also publicly available and can be found near shopping centers and along heavily-trafficked highway corridors at travel centers. High power DCFCs are also more suitable for MD/HD vehicles. However, there is no guarantee that public charging will be available and in working condition at any given time.

Challenges Related to Public Charging:

- The lack of available public charging could increase the amount of time in which vehicles are idle (or not operating).
- You run the risk of paying higher wholesale prices to charge your fleet.
  - Transit agencies may have to restructure when switching to electricity as a fuel. Demand charges that were initially waived can lead to higher costs (though less maintenance will be required). Additional training may be required to avoid this discrepancy.
- Pull-through stations may be needed.
  - The distance between a charge port and the EVSE may be too long for the cord to reach (especially with a 57' trailer).

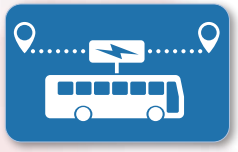
Fleet managers who work directly with the charger original equipment manufacturer (OEMs) can avoid some of these charging challenges as they would be able to specify where they would like charging locations placed as well as specific spatial and technical needs of the fleet.

CHARGING OPTIONS FOR FLEETS



Depot Charging (Conductive and Inductive Charging)

Depot charging occurs at a physical location or site and can begin at about 30 kW. Both DCFC and AC charging are appropriate for this method of charging. Shorter routes can result in cheaper costs to charge compared to on-route charging. However, shorter routes can also result in more traffic on those routes. Additionally, finding the space required to install a physical depot can be a challenge.



On-Route Charging (Conductive and Inductive Charging)

On-route charging (between 350 and 500 kW) can be complemented by depot charging. On-route charging is a quick and suitable option because it takes less time for these vehicles to complete routes. A single on-route site could replace multiple depot sites if placed strategically.

On-route charging could also allow for multiple routes to use the same on-route systems. However, consideration should also be given to effects of installation on traffic and bike lanes. On-route charging also allows for shorter charging durations in which charging can be conductive or inductive. Batteries usually do not require a full charge when on-route and smaller batteries can be used.

Smart Charging

Smart charging is often referred to as managed charging. This method allows for the energy consumption of EVs to be monitored, optimized, and managed. With smart charging, the power necessary to charge an EV can be stopped or delayed.

In the case of fleets, smart charging allows the customer to reduce the peak power demand at their site. A charge management system at the site level would allow for this to be possible.

Charging Considerations

The best methodology for charging varies by use-case. When thinking about charging methods, it is important to consider the route distance needed to get the vehicle to the charger.

Route distance, temperature, terrain, load, and other environmental factors can affect the actual range. The range can increase or decrease depending on your driving patterns as well. For example, stop and go driving in a heavily trafficked area can increase the range expected.

CHARGING CAN BE EASY

EVs offer many environmental benefits and charging them is both a clean and easy process. Access to both public and on-site charging gives more options for fleet managers with diverse range needs to consider. As charging infrastructure continues to be built out and improved, the process of operating and managing charging sites will also improve – along with the user experience.

The installation of charging infrastructure involves many steps and must adhere to various regulations. If interested in installing charging infrastructure in your service territory, talk to the local utility to see what steps may be required.

MORE INFORMATION

ADDITIONAL EPRI RESOURCES:

3002021789, EPRI Consumer Guide to Electric Vehicles, *July 2021*
https://www.epri.com/research/products/000000003002021789

3002020009, EPRI Technology Overview: On Route Charging, *February 2021*
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3002012412, Quick Insight: All-Electric Semi-Trucks, *March 2018*
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3002004898, Commercial and Industrial Guide to Electric Transportation, *February 2015*
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OTHER RESOURCES:

1. California Air Resource Board, release number 20-18
https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification
2. ChargePoint, DC Fast Charging: How Businesses Can Benefit
https://www.chargepoint.com/blog/dc-fast-charging-how-businesses-can-benefit/
3. CharIN e.V., Megawatt Charging System (MCS)
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4. Dong-Yeon Lee, Valerie M. Thomas and Marilyn A. Brown, Electric Urban Delivery Trucks: Energy Use, Greenhouse Gas Emissions, and Cost Effectiveness
https://pubs.acs.org/doi/10.1021/es400179w
5. Joule, Levelized Cost of Charging Electric Vehicles in the United States
https://www.cell.com/joule/pdfExtended/S2542-4351(20)30231-2
6. Encyclopedia of Cleveland History, Otis Elevator Company
https://case.edu/ech/articles/o/otis-elevator-company
7. Energies, Combining Ad Hoc Text Mining and Descriptive Analytics to Investigate Public EV Charging Prices in the United States
https://www.mdpi.com/1996-1073/14/17/5240/htm
8. Federal Transit Administration Fiscal Year 2021 Low or No-Emission (Low-No) Bus Program Projects
https://www.transit.dot.gov/funding/grants/fiscal-year-2021-low-or-no-emission-low-no-bus-program-projects
9. U.S. Department of Energy (DOE) Alternative Fuels Data Center, Charging Plug-In Electric Vehicles at Home
https://afdc.energy.gov/fuels/electricity_charging_home.html
10. U.S. Department of Energy Office of Energy Efficiency & Renewable Energy fuel economy information
https://www.fueleconomy.gov/feg/topten.jsp
11. U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Electric Vehicle Basics
https://afdc.energy.gov/files/u/publication/electric_vehicles.pdf
12. Environmental Defense Fund Electric Fleet Deployment & Commitment List
https://blogs.edf.org/energyexchange/2021/07/28/edf-analysis-finds-american-fleets-are-embracing-electric-trucks/
13. U.S. Environmental Protection Agency (EPA), Miscellaneous Data and Conversion Factors
https://www3.epa.gov/ttnchie1/ap42/appendix/appa.pdf
14. ElectricRate, Electricity Rates by State
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15. U.S. Department of Energy Alternative Fuels Data Center, Average Fuel Economy by Major Vehicle Type
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About EPRI

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.

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