Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: Third Quarter 2022

Abby Brown,[1] Jeff Cappellucci,[1] Emily White,[2]
Alexia Heinrich,[2] and Emma Cost[2]

1 National Renewable Energy Laboratory
2 ICF Inc.

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
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List of Acronyms

AFDC	Alternative Fuels Data Center
AMPUP	AmpUp network
API	application programming interface
BIL	Bipartisan Infrastructure Law
BN	Blink network
CCS	Combined Charging System, a connector type for DC fast charging
CHAdeMO	a connector type for DC fast charging
CHARGELAB	ChargeLab network
CPN	ChargePoint network
DAC	disadvantaged community
DC	direct current
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
E85	ethanol blend containing 51% to 83% ethanol, depending on geography and season
EA	Electrify America network
EV	electric vehicle, including all-electric and plug-in hybrid electric vehicles
EVC	EV Connect network
EVCS	EV Charging Solutions network
EVGATEWAY	evGateway network
EVN	EVgo network
EVRANGE	EV Range network
EVSE	electric vehicle supply equipment
EVSP	electric vehicle service provider
FCN	Francis Energy network
FLO	FLO network
FPLEV	FPL EVolution network
HD	heavy duty
J1772	the connector type for Level 1 and Level 2 charging
IRA	Inflation Reduction Act
L1	Level 1
L2	Level 2
LD	light duty
LIVINGSTON	Livingston Energy Group network
MD	medium duty
NEVI	National Electric Vehicle Infrastructure
NON	non-networked
NREL	National Renewable Energy Laboratory
OC	OpConnect network
OCPI	Open Charge Point Interface
POWERFLEX	PowerFlex network
Q1	quarter 1, or first quarter of the calendar year
Q2	quarter 2, or second quarter of the calendar year

Q3	quarter 3, or third quarter of the calendar year
Q4	quarter 4, or fourth quarter of the calendar year
RIVIAN_ADVENTURE	Rivian Adventure Network
RIVIAN_WAYPOINTS	Rivian Waypoints network
SCN	SemaConnect network
SHELL_RECHARGE	Shell Recharge network
SWTCH	SWTCH Energy network
TESLA	Tesla Supercharger network
TESLAD	Tesla Destination network
UNIVERSAL	Universal EV Chargers network
VLTA	Volta network
WEB	Webasto network
ZEFNET	ZEF Energy network

Executive Summary

The amount of electric vehicle (EV) charging infrastructure continues to rapidly grow. Using data from the U.S. Department of Energy's (DOE's) Alternative Fueling Station Locator (AFDC 2022b), this report provides a snapshot of the state of EV charging infrastructure in the United States in the third calendar quarter of 2022 (Q3 2022) by charging level, network, and location. Additionally, this report measures the current state of charging infrastructure compared with two different 2030 infrastructure requirement scenarios. This information is intended to help transportation planners, policymakers, researchers, infrastructure developers, and others understand the rapidly changing landscape of EV charging infrastructure. This is the eleventh report in a series. Reports from previous quarters can be found in the Alternative Fuels Data Center (AFDC) and National Renewable Energy Laboratory (NREL) publication databases, as well as the AFDC Charging Infrastructure Trends page (https://afdc.energy.gov/fuels/electricity_infrastructure_trends.html).

In Q3 2022, the number of electric vehicle supply equipment (EVSE) ports in the Station Locator grew by 5.0%, or 7,034 EVSE ports. Public EVSE ports grew by 5.5%, or 6,653 EVSE ports, bringing the total number of public ports in the Station Locator to 128,431 and accounting for the majority of ports in the Station Locator (Figure ES-1). Private EVSE ports increased by 2.0%, or 381 ports. The Northeast region had the largest increase in public charging infrastructure in Q3 (11.7%), though California, which has almost one-third of the country's public charging infrastructure, continues to lead the country in the number of public ports.

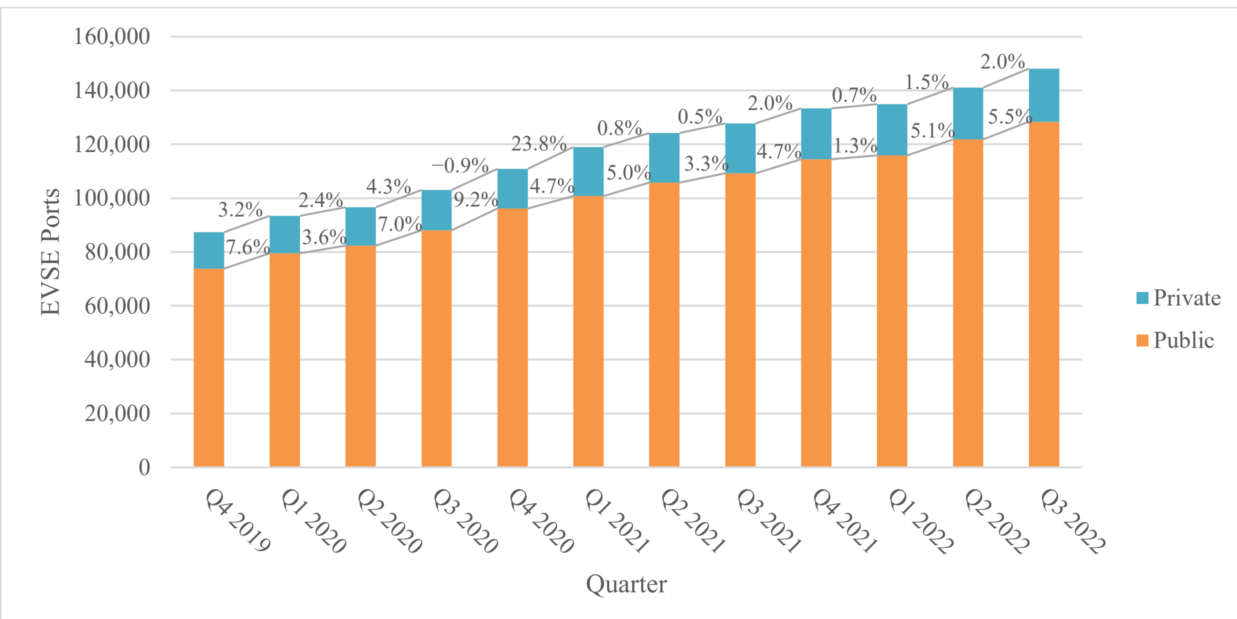

Figure ES-1. Quarterly growth of EVSE ports by access.

Note: The percentages in this figure indicate the percent growth between each quarter.

Of public EVSE ports, direct-current (DC) fast EVSE ports increased by the greatest percentage (6.9%) in Q3, while Level 1 EVSE ports decreased by 0.4% (Figure ES-2).

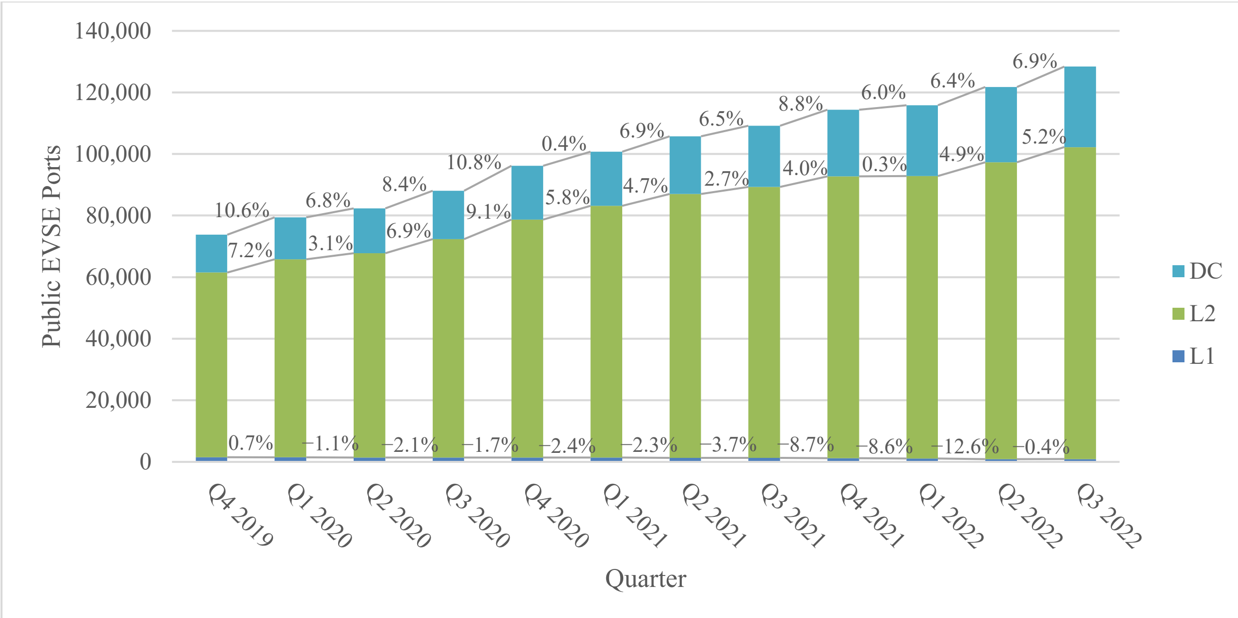

Figure ES-2. Quarterly growth of public EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q3, there were 41 public legacy EVSE ports in the Station Locator. Additionally, the percentages in this figure indicate the percent growth between each quarter.

DC fast EVSE ports have the highest power output and therefore provide the most charge in the least amount of time. Building out the country's network of public DC fast chargers is critical to supporting EV adoption in the United States, and it is therefore important to highlight trends in the growth of DC fast EVSE ports in the Station Locator. The power output of DC fast EVSE ports ranges from 24 kW to 350 kW. DC fast EVSE ports with power outputs of 50 kW and 150 kW are common, though the number of DC fast EVSE ports higher power levels are steadily increasing. (Figure ES-3).

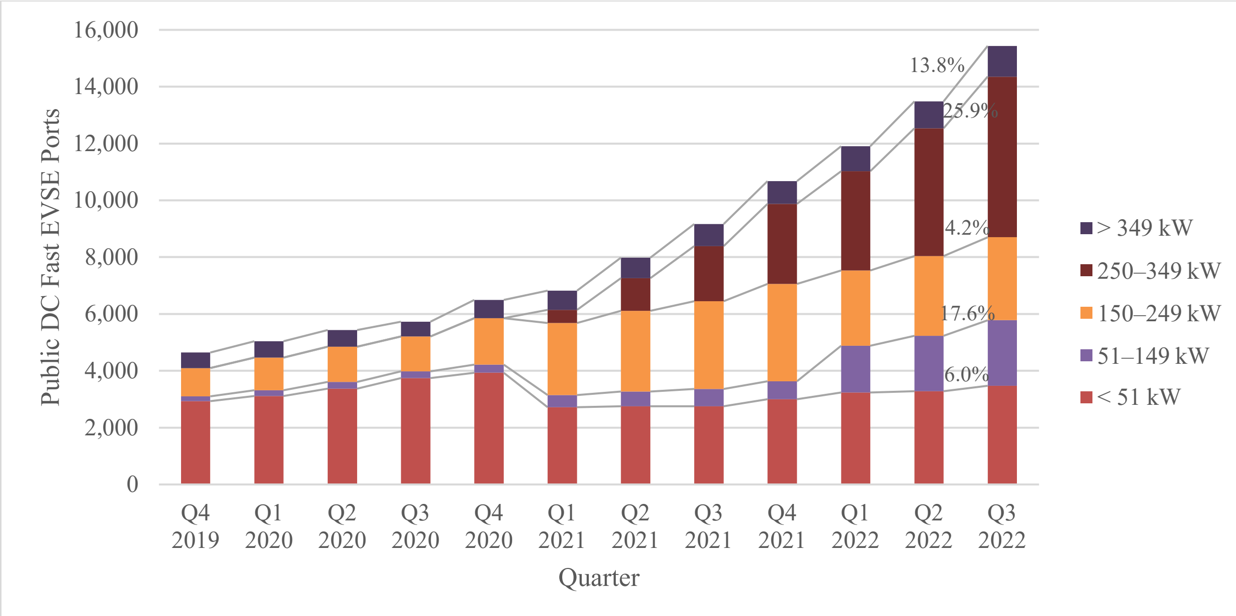

Figure ES-3. Quarterly growth of public DC fast EVSE ports by power output.

Note: The percentages in this figure indicate the percent growth between each quarter. For an explanation of the changes seen in Q1 2021, see the Q1 2021 report (Brown, Schayowitz, and Klotz 2021).

When comparing the current rate of deployment of public charging infrastructure with the Biden administration's goal of reaching 500,000 EVSE ports in the United States by 2030, it is clear the pace of installations will need to significantly increase. To meet the administration's 2030 goal, an average of 12,813 public EVSE port installations will be needed each quarter for the next 8 years, equating to an average quarterly growth rate of 4.6%. This is substantially higher than the average of 4,963 public EVSE ports installed each quarter since the start of 2020, when this report series began.

NREL's *National Plug-In Electric Vehicle Infrastructure Analysis* estimated the United States would require 27,500 DC fast and 601,000 Level 2 public and workplace EVSE ports to support a scenario of 15 million EVs on the road by 2030 (Wood et al. 2017). Based on this analysis, 95.2% and 18.5% of the required DC fast and Level 2 EVSE ports, respectively, have been installed as of Q3 2022. However, the majority (58.7%) of public DC fast EVSE ports in the Station Locator are on the Tesla network and are therefore only readily accessible to Tesla drivers. When Tesla EVSE ports are removed, this decreases to 39.5% and 16.6%, respectively, of the projected need.

Atlas Public Policy's *U.S. Passenger Vehicle Electrification Infrastructure Assessment* estimated that an additional 252,000 DC fast and 244,000 Level 2 public and workplace EVSE ports would be required by 2030 to support a scenario where 100% of passenger vehicle sales are electric by 2035 (McKenzie and Nigro 2021). Based on this assessment, the number of DC fast and Level 2 EVSE ports is 9.7% and 33.2%, respectively, of the way toward meeting 2030 infrastructure requirements. This decreases to 4.2% and 30.9%, respectively, when Tesla EVSE ports are removed.

If there are additional metrics that readers are interested in seeing, please email suggestions to the authors at TechnicalResponse@icf.com.

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1 Importance of Tracking Electric Vehicle Charging Infrastructure Trends

The U.S. Department of Energy's (DOE's) Alternative Fuels Data Center (AFDC) launched in 1991 in response to the Alternative Motor Fuels Act of 1988 and the Clean Air Act Amendments of 1990 (AFDC 2022a). Originally, it served as a hard copy resource for alternative fuel performance data, and then became an internet resource in 1995. Since then, the AFDC has evolved dramatically into a robust online resource that provides a broad range of information on alternative fuels and advanced transportation technologies, including fueling and charging station data. In 2017, the National Renewable Energy Laboratory (NREL) partnered with National Resources Canada to expand the data set to include the location of alternative fuel stations across Canada as the Electric Charging and Alternative Fueling Stations Locator, or *Localisateur de stations de recharge et de stations de ravitaillement en carburants de remplacement* (Levene et al. 2019). The Station Locator database now includes information on public and private nonresidential alternative fueling stations in the United States and Canada. The database currently tracks ethanol (E85), biodiesel, compressed natural gas, electric vehicle (EV) charging, hydrogen, liquefied natural gas, and propane stations.

Although historical data for all fuel types in the Station Locator are available, it is especially important to take an in-depth look at EV charging due to rapidly changing technology and growing infrastructure. This trend is likely to continue given the Joseph R. Biden administration's goal of building a national EV charging network of up to 500,000 EV charging stations by 2030 and the newly available funds from the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) to support this goal. Using Station Locator data, this report explores the growth of both public and private EV charging infrastructure in the United States for the third calendar quarter of 2022 (Q3 2022). This is the eleventh report in a series. Reports from previous quarters can be found in the AFDC and NREL publication databases, as well as the AFDC Charging Infrastructure Trends page (https://afdc.energy.gov/fuels/electricity_infrastructure_trends.html).

It is important to state these reports reflect a snapshot of the number of available and temporarily unavailable (i.e., unavailable for use for an extended period due to maintenance) electric vehicle supply equipment (EVSE) ports in the Station Locator at the end of each quarter. Therefore, notable changes may be attributed to the manual data collection process, as new manually added EVSE ports are counted in the quarter in which they are added to the Station Locator as opposed to when the infrastructure was installed.

1.1 EV Charging Data Fields

Current charging infrastructure in the Station Locator is classified into the following categories:

- **Public:** A broad category that includes EV charging located in publicly accessible areas or along highway corridors. Public EV charging infrastructure is generally accessible to any EV driver, though this includes some stations with certain qualifications, such as stations that are made available to the public after business hours or stations that require payment through a specific application. Additionally, stations that are reserved for patrons of a business, such as guests of a hotel, visitors of a museum, or customers of a retail store, are classified as public restricted access.

- **Workplace:** EV charging intended to provide charging to employees during the workday. Workplace charging infrastructure is accessible only to employees of a business and is therefore classified as private in the Station Locator.
- **Commercial/Fleet:** EV charging intended to provide charging for electric fleet vehicles, including municipal/private fleets, car sharing, and transportation network companies. Fleet charging infrastructure is classified as private in the Station Locator.

The Station Locator does not maintain data on single-family residential charging and has minimal, yet expanding, data on charging at multifamily housing. EV charging infrastructure at multifamily housing is also classified as private in the Station Locator. See Section 2.2.3 for additional details.

In 2019, the Station Locator team transitioned its counting logic to align with the hierarchy defined in the Open Charge Point Interface (OCPI) protocol: station locations, EVSE ports, and connectors (EVRoaming Foundation 2020), as shown in Figure 1 and described below. Therefore, the Station Locator counts the number of EVSE ports at each station location.

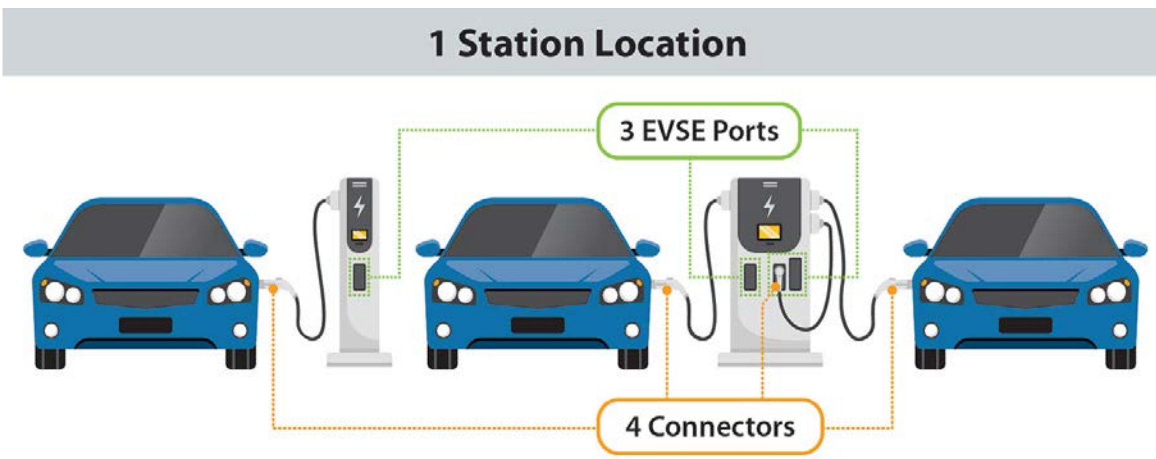

Figure 1. EV charging infrastructure hierarchy.

Source: AFDC (2022d)

The following fuel-specific fields are tracked in the Station Locator for EV charging stations (AFDC 2022c):

- EV charging information:
  - Station location: A site with one or more EVSE ports located at the same address.
  - EVSE port count: The number of outlets or ports available to charge a vehicle (i.e., the number of vehicles that can simultaneously charge at a charging station).
  - EVSE port type:

  - Level 1 (L1): 120 V; 1 hour of charging = 5 miles of range[1]
  - Level 2 (L2): 240 V; 1 hour of charging = 25 miles of range[2]
  - Direct-current (DC) fast: 480+ V; 30 minutes of charging = 100–200+ miles of range[3]
- Connectors (number and type): What is plugged into a vehicle to charge it. Multiple connectors and connector types can be available on one EVSE port, but only one vehicle will charge at a time.
  - NEMA: for Level 1 charging[4]
  - J1772: for Level 1 and Level 2 charging
  - Combined Charging System (CCS): for DC fast charging for most vehicle models[5]
  - CHAdeMO: for DC fast charging for select vehicle models
  - Tesla: for all charging levels for Tesla vehicles
- Network
- Manufacturer
- Power output (kW)

- Open date
- Workplace
- Pricing
- On-site renewable electricity source.

These fields and the associated definitions are used in the analysis that follows.

1.2 Projecting Future Charging Infrastructure Needs

The Biden administration set an early goal of building a network of up to 500,000 public EVSE ports in the United States by 2030.[6] To put this goal into context, the number of public EVSE ports in the Station Locator has grown by an average of 4,963 EVSE ports per quarter since the start of 2020, when this report series began. In order to reach 500,000 EVSE ports by 2030, an average of 12,813 public EVSE port installations will be required each quarter for the next 8 years, equating to an average quarterly growth rate of 4.6%, indicating that the pace of installations will need to increase significantly.

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[1] This assumes a power output of 1.9 kW. The actual range per hour of charging depends on the power capacity of the EVSE port and the efficiency of the vehicle being charged.
[2] This assumes a power output of 6.6 kW. The actual range per hour of charging depends on the power capacity of the EVSE port and the efficiency of the vehicle being charged.
[3] The power output of DC fast EVSE ports varies greatly. The actual range per hour of charging depends on the power capacity of the EVSE port and the efficiency of the vehicle being charged.
[4] Most, if not all, EVs will come with a Level 1 cordset, so no additional charging equipment is required. On one end of the cord is a standard NEMA connector (for example, a NEMA 5-15, which is a common three-prong household plug), and on the other end is an SAE J1772 standard connector (often referred to simply as J1772). The J1772 connector plugs into the car's J1772 charge port, and the NEMA connector plugs into a standard NEMA wall outlet.
[5] The CCS connector is a standard developed by SAE, similar to the J1772 standard.
[6] The goal includes installing 500,000 public charging stations by 2030 but does not specifically outline whether a charging station means a location or an EVSE port, as defined in Section 1.1. For the purposes of this report, it was assumed that charging station refers to a single-port charger, and therefore 500,000 EVSE ports.

The Bipartisan Infrastructure Law (H.R. 3684), which President Biden signed into law on November 15, 2021, formally established the National Electric Vehicle Infrastructure (NEVI) Formula Grant Program and the Discretionary Grant Program for Charging and Fueling Infrastructure (The White House 2022). These programs will provide states with $7.5 billion (collectively) in funds to begin building the network of 500,000 public EVSE ports, though it will not necessarily fund all the infrastructure required to meet the Biden administration's goal. This goal does not differentiate between DC fast and L2 EVSE ports, and these programs do not dictate how many DC fast versus Level 2 EVSE ports will be funded. However, the NEVI Formula Grant Program will initially be focused on building out charging infrastructure along the interstate highway system with DC fast EVSE ports, and the Discretionary Grant Program is expected to fund both DC fast and Level 2 EVSE ports (Federal Highway Administration 2022c).

Two studies with different EV projection scenarios offer insight into how much public and workplace DC fast and Level 2 charging might be required in the United States to support a growing fleet of light-duty EVs. The first study, NREL's 2017 *National Plug-In Electric Vehicle Infrastructure Analysis*, estimates that a total of 27,500 DC fast EVSE ports and 601,000 Level 2 EVSE ports would be required across the United States to support 15 million light-duty EVs by 2030 (Wood et al. 2017). This equates to 1.8 DC fast EVSE ports per 1,000 EVs and 40.1 Level 2 EVSE ports per 1,000 EVs. The second study, Atlas Public Policy's 2021 *U.S. Passenger Vehicle Electrification Infrastructure Assessment*, assumes that 100% of passenger vehicle sales will be electric by 2035, which would result in approximately 57.5 million light-duty EVs by 2030 (McKenzie and Nigro 2021). To support these EVs, this study estimates that an additional 252,000 DC fast EVSE ports and 244,000 Level 2 EVSE ports would be required. Using the number of installations as of Q1 2021 as a baseline, this results in approximately 269,558 DC fast EVSE ports and 335,266 Level 2 EVSE ports by 2030 and equates to 4.7 DC fast EVSE ports per 1,000 EVs and 5.8 Level 2 EVSE ports per 1,000 EVs. For a more detailed discussion of these studies and the different assumptions used to arrive at their respective infrastructure projections, see the Q3 2021 report (Brown, Schayowitz, and Klotz 2022).

As of Q3 2022, there were 26,188 public and workplace DC fast EVSE ports and 111,171 public and workplace Level 2 EVSE ports available in the United States (Figure 2). Based on NREL's analysis, the number of DC fast and Level 2 EVSE ports installed is 95.2% and 18.5%, respectively, of the way toward meeting projected 2030 infrastructure requirements to support 15 million EVs (Figure 2). Based on Atlas' assessment, the number of DC fast and Level 2 EVSE ports is 9.7% and 33.2%, respectively, of the way toward meeting projected 2030 infrastructure requirements to support 57.5 million EVs (Figure 2). It is important to note that 58.7% of public DC fast EVSE ports in the Station Locator are on the Tesla Supercharger network and are therefore only readily accessible to Tesla drivers.[7] Additionally, as of September 30, 2022, approximately 47% of EVs on the road were Teslas (Experian Information Solutions 2022b). When public Tesla EVSE ports are excluded, the number of DC fast and Level 2 EVSE ports currently installed decreases to 39.5% and 16.6%, respectively, of the way toward meeting NREL's projected infrastructure requirements, and 4.2% and 30.9%, respectively, toward meeting Atlas' projected infrastructure requirements.

[7] Tesla has suggested in some comments that it may open its network to non-Tesla drivers in exchange for federal funding (Loveday 2022).

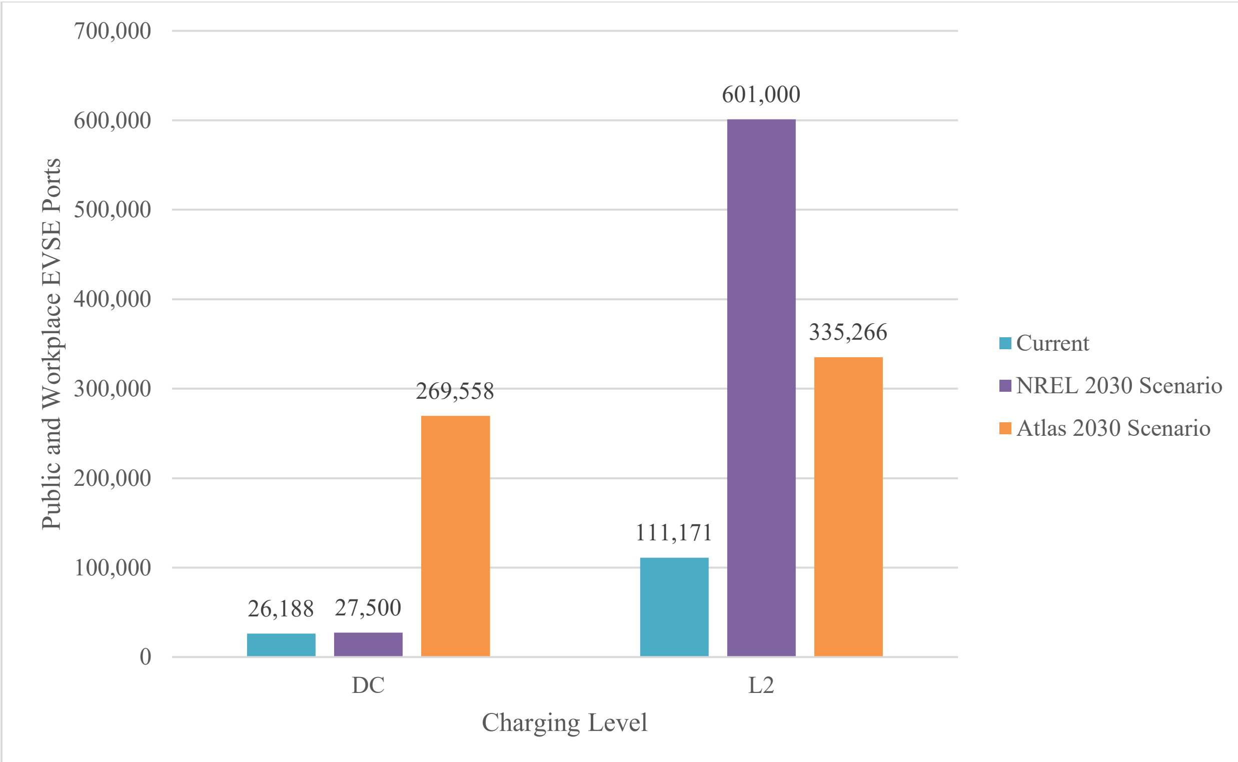

Figure 2. Current availability of public and workplace charging versus two scenarios of 2030 infrastructure requirements in the United States.

There were approximately 2.8 million EVs on the road in the United States as of June 30, 2022 (Experian Information Solutions 2022b). The ratios of DC fast and Level 2 public and workplace EVSE ports per 1,000 EVs in Q3 were 9.1 and 38.5, respectively (Table 1). These ratios decrease to 3.8 and 34.6, respectively, when Tesla EVSE ports are excluded (Table 1). Using NREL and Atlas' estimated ratios of the number of DC fast and Level 2 EVSE ports per 1,000 EVs as a proxy for how much infrastructure is sufficient to meet charging needs in 2030, Table 1 suggests that, as of Q3, public and workplace DC fast EVSE ports are keeping up with current charging needs in terms of the total amount of infrastructure currently available. Public and workplace Level 2 EVSE ports, on the other hand, have been below NREL's estimated ratio of EVSE ports per 1,000 EVs since Q2 2022. Level 2 EVSE ports have continued to steadily increase each quarter since the start of 2020; however, the number of EV registrations has grown at a faster rate each quarter since the start of 2021, causing the ratio of Level 2 EVSE ports per 1,000 EVs to decrease. For example, the number of registered EVs grew by 8.6% in Q3 while the number of public Level 2 EVSE ports grew by 5.2%. Although roughly 19% of the 15 million light-duty EVs in NREL's analysis and roughly 5% of the 57.5 million light-duty EVs in Atlas' assessment were on the road as of Q3, resulting in a relatively high ratio of EVSE ports to EVs, this ratio will continue to decrease unless infrastructure growth is able to keep pace.

Table 1. Current Public and Workplace EVSE per 1,000 EVs Versus Two Scenarios of 2030 Infrastructure Requirements in the United States

Port Level	EVSE per 1,000 EVs in Q3 2022 (including Tesla)	EVSE per 1,000 EVs in Q3 2022 (excluding Tesla)	NREL – EVSE per 1,000 EVs Needed in 2030 To Support 15 Million EVs	Atlas – EVSE per 1,000 EVs Needed in 2030 To Support 57.5 Million EVs
DC Fast	9.1	3.8	1.8	4.7
Level 2	38.5	34.6	40.1	5.8

2 Electric Vehicle Charging Infrastructure Trends

The purpose of this report is to identify EV charging infrastructure trends for Q3 of 2022. In Q3, the number of EVSE ports in the Station Locator grew by 5.0%, or 7,034 EVSE ports. Public EVSE ports grew by 5.5%, or 6,653 ports, and account for the majority of EVSE ports in the Station Locator (Figure 3). Private EVSE ports increased by 2.0%, or 381 EVSE ports. As of Q3, 86.7% of EVSE ports in the Station Locator were public and 13.3% were private, compared with 84.5% public and 15.5% private in Q4 2019.

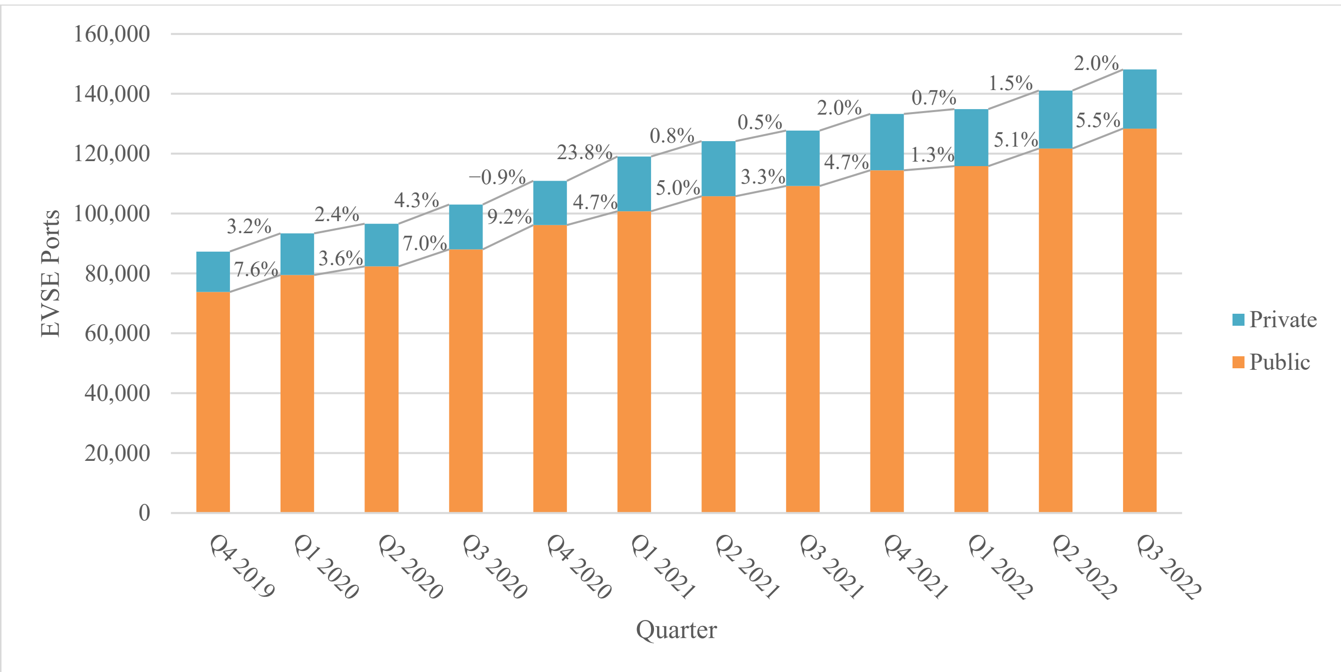

Figure 3. Quarterly growth of EVSE ports by access.

Note: The percentages in this figure indicate the percent growth between each quarter.

The following sections break down the growth of public and private EVSE ports further to highlight what types of EV infrastructure grew in Q3 and where EV infrastructure has grown geographically. Because the number of EVSE ports represents the number of vehicles that can charge simultaneously at an EV charging station, the remainder of this report will focus on EVSE port growth.

2.1 Public Charging Trends

As previously mentioned, public EV charging refers to EV charging stations that are available to all EV drivers and located in publicly accessible locations, such as commercial locations or along highway corridors. In Q3, the number of public EVSE ports in the Station Locator increased by 6,653, bringing the total number of public EVSE ports in the Station Locator to 128,431 and representing a 5.5% increase since Q2 2022. The following sections break down the growth of public EVSE ports by charging level, network, region, and state.

2.1.1 By Charging Level

As shown in Figure 4, the majority of public EVSE ports in the Station Locator are Level 2, followed by DC fast and Level 1. However, similar to the last several quarters, DC fast EVSE ports increased by the greatest percentage (6.9%) in Q3 (Figure 4). DC fast EVSE ports made up 20.4% of public EVSE ports as of Q3 2022 compared with 16.7% in Q4 2019.

Similar to previous quarters, Level 1 EVSE ports decreased by 0.4% (Figure 4). The decrease in Level 1 EVSE ports can be attributed to the removal of non-networked Level 1 EVSE ports from the Station Locator.

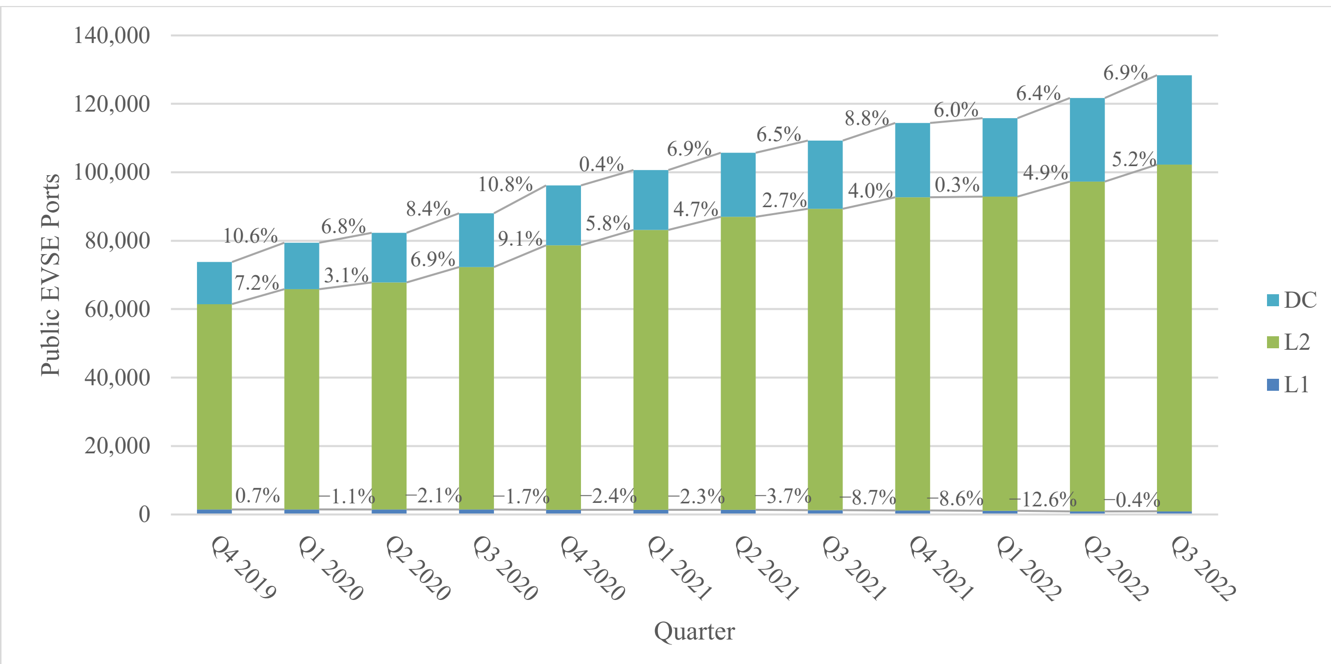

Figure 4. Quarterly growth of public EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q3, there were 41 public legacy EVSE ports in the Station Locator. Additionally, the percentages in this figure indicate the percent growth between each quarter.

When compared with Level 1 and Level 2 EVSE ports, DC fast EVSE ports have the highest power output and therefore provide the most charge in the least amount of time. Building out the country's network of public DC fast chargers is critical to supporting EV adoption in the United States, and it is therefore important to highlight trends in the growth of DC fast EVSE ports in the Station Locator. Whereas the power output for Level 1 EVSE ports is about 1 kW, and Level 2 EVSE ports can operate at up to 19 kW, the power output of DC fast EVSE ports ranges from

24 kW to 350 kW. DC fast EVSE ports with power outputs of 50 kW and 150 kW are common, though the number of DC fast EVSE ports higher power levels are steadily increasing, as seen in Figure 5.

It is important to point out that of the 26,130 public DC fast EVSE ports in the Station Locator, power output data are currently available for 59.1%; Figure 5 is therefore based on power output data for 15,435 DC fast EVSE ports, up from 4,644 in Q4 2019. Additionally, if a DC fast EVSE port has two connectors with different power outputs, only the maximum power output is counted in Figure 5. NREL is in the process of integrating updated OCPI-based application programming interfaces (APIs) to streamline the collection of power output data and create a more complete data set, as well as making power data publicly available for CCS and CHAdeMO connectors.

As shown in Figure 5, the number of EVSE ports with a power output between 250 and 349 kW grew by the largest percentage in Q3 (25.9%). This growth can be attributed to the addition of 1,112 new Tesla Supercharger installations with a power output of 250 kW. The growth in extreme fast charging infrastructure (>349 kW) is primarily attributable to new Electrify America, EVgo, and Rivian Adventure Network installations.

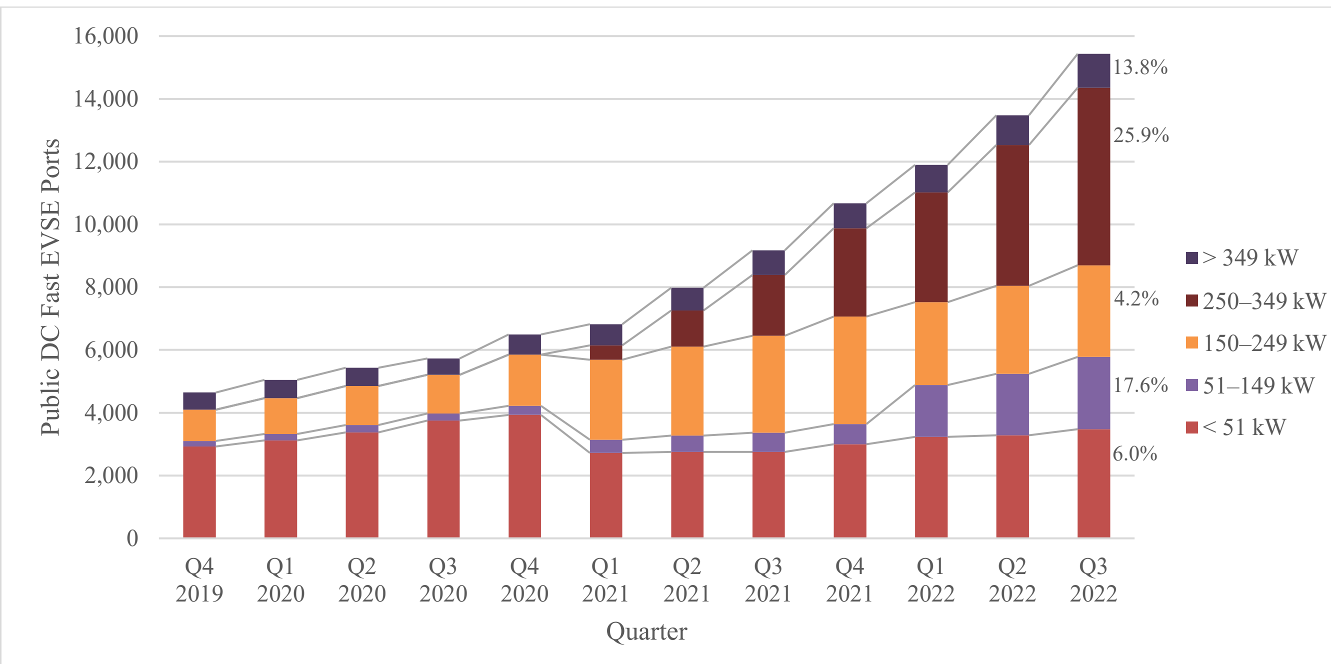

Figure 5. Quarterly growth of public DC fast EVSE ports by power output.

Note: The percentages in this figure indicate the percent growth between each quarter. For an explanation of the changes seen in Q1 2021, see the Q1 2021 report (Brown, Schayowitz, and Klotz 2021).

Finally, there are currently three types of connectors available for DC fast chargers: CHAdeMO, CCS, and Tesla. As noted in Section 1.1, not all EVs are compatible with each connector type. Most EV models entering the market today can charge using the CCS connector, while the all-electric Nissan LEAF and Mitsubishi Outlander plug-in hybrid electric vehicles are the only models still available in the United States with the CHAdeMO connector standard. Only Tesla vehicles can charge with the Tesla connector. Although Tesla vehicles do not have a CHAdeMO charge port and do not come with a CHAdeMO adapter, Tesla does sell an adapter that allows Tesla vehicles to charge at non-Tesla DC fast chargers with a CHAdeMO connector. Additionally, Tesla is in the process of making a CCS adapter for Tesla vehicles.

As of September 30, 2022, approximately 69% of registered all-electric vehicles in the United States were Teslas and therefore compatible with the Tesla connector, 24% of registered all-electric vehicles were compatible with the CCS connector, and 7% were compatible with the CHAdeMO connector (Experian Information Solutions 2022b).[8] Of the 31,433 DC fast connectors in the Station Locator as of Q3, Tesla connectors grew by the largest percentage (7.8%), followed by CCS connectors (7.1%) (Figure 6). Despite CHAdeMO-compatible vehicles making up the smallest percentage of registered EVs, the number of CHAdeMO connectors in the Station Locator continued to grow (by 6.0%) in Q3. One possible reason for the continued growth of CHAdeMO connectors is that, historically, some grant and incentive programs have required that public DC fast stations have both CHAdeMO and CCS connectors available to be eligible for funding. However, CHAdeMO connectors continue to make up a smaller share of public DC fast connectors each quarter. In Q4 2019, CHAdeMO connectors made up 22.1% compared with 20.9% in Q3 2022. Similarly, Tesla connectors made up 49.6% of public DC fast connectors in Q4 2019 compared with 48.8% in Q3 2022. The share of CCS connectors, on the other hand, has continued to grow, from 28.3% in Q4 2019 to 30.2% in Q3 2022.

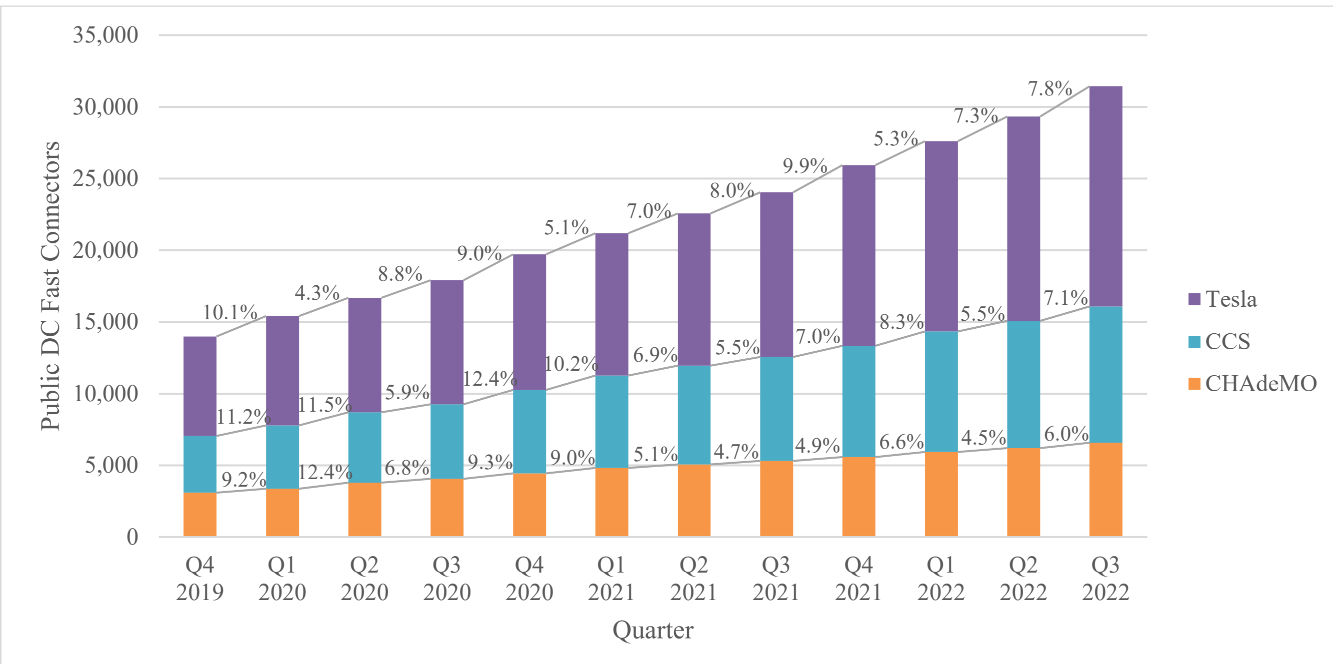

Figure 6. Quarterly growth of public DC fast connectors by type.

Note: The percentages in this figure indicate the percent growth between each quarter.

2.1.2 By Network

As with previous quarters, the ChargePoint network continued to account for the largest number of public EVSE ports (41.2%) in the Station Locator in Q3, and Level 2 EVSE ports continued to

[8] These figures exclude plug-in hybrid electric vehicles since most are not compatible with DC fast EVSE ports.

make up the majority of ChargePoint's network (Figure 7). This holds true for many of the networks in the Station Locator, except for the Electrify America, EVgo, Francis Energy, FPL EVolution, Rivian Adventure Network, and Tesla Supercharger networks. These networks are predominantly, if not completely, made up of DC fast EVSE ports. Of the networks with DC fast EVSE ports, Tesla Supercharger had the largest share of public DC fast EVSE ports (58.7%) in Q3, followed by Electrify America (13.5%) and EVgo (8.6%) (Figure 8).

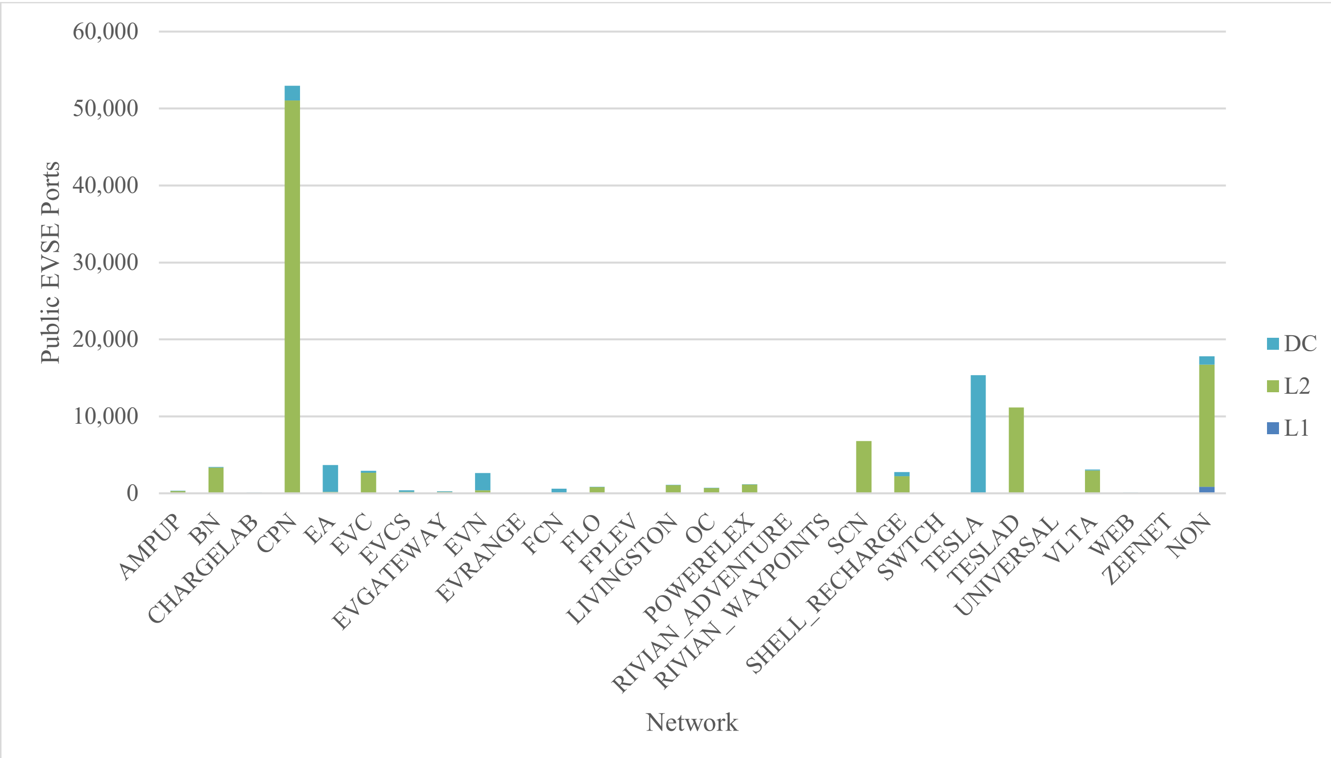

Figure 7. Breakdown of public EVSE ports by network and charging level in Q3 2022

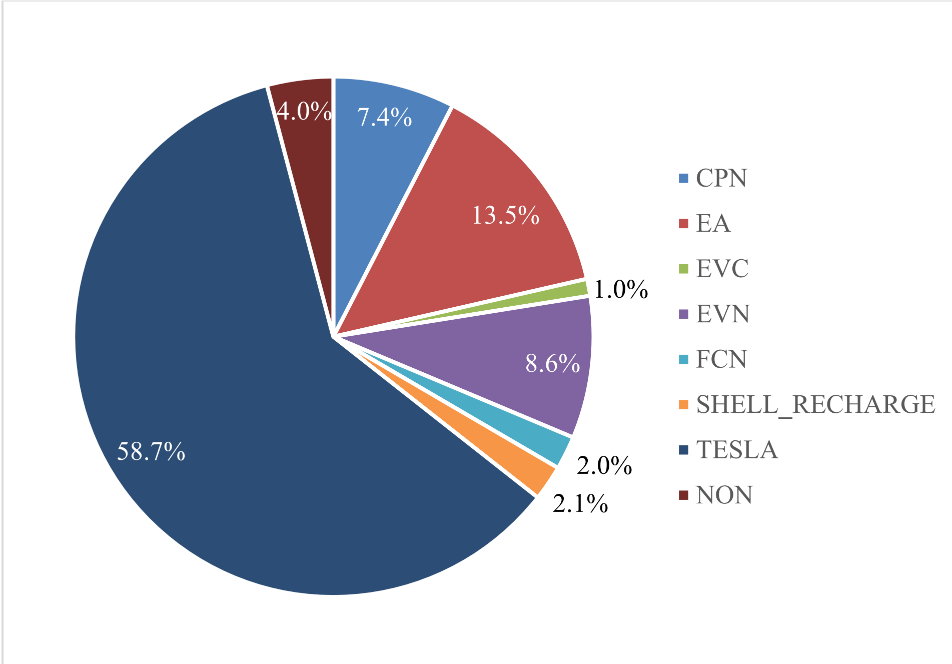

Figure 8. Breakdown of public DC fast EVSE ports by network in Q3 2022.

Note: Figure excludes networks that make up less than 1% of public DC fast EVSE ports.

Figure 9 shows the growth of each network in Q3, and Table 2 includes the percent growth of each network over the last four quarters. The growth of many networks in Q3 2022 was largely a result of the Station Locator's manual data collection process, as noted in Section 1. For example, the networks with some of the biggest percent increases were due to large updates shared by these networks in Q3, including AmpUp (61.9%), ChargeLab (1180.0%), evGateway (80.5%), and Livingston Energy Group (287.4%). The 21.2% increase of EVSE ports on the FLO network, on the other hand, was not a result of the manual data collection process, as FLO's station data are imported and updated on a nightly basis via an API (see the end of this section for networks updated via an API). Similar to Q2, this increase can primarily be attributed to new Level 2 installations in Los Angeles, California. See the Q2 2022 report for a discussion of FLO's deployment efforts in Los Angeles (Brown et al. 2022).

Rivian Waypoints, Rivian Adventure Network, SWTCH Energy, and ZEF Energy also increased by a large percentage in Q3; however, the number of EVSE ports on each network in Q2 was relatively small, and the absolute growth on each of these networks in Q3 did not exceed 20 EVSE ports.

The number of EVSE ports on the EV Connect, EV Charging Solutions, Francis Energy, Shell Recharge (formerly Greenlots), and Tesla Destination networks decreased in Q3. EV Connect's API was integrated with the Station Locator in September, resulting in the removal of stations that had been decommissioned since the last manual update that the Station Locator received from EV Connect. The decrease on Shell Recharge's network is attributable to a decrease of Level 2 EVSE. Finally, the decrease on the EV Charging Solutions, Francis Energy, and Tesla Destination networks was a result of database maintenance, including identifying and removing duplicate station records and ensuring that manually added station records were properly adhering to the OCPI protocol.

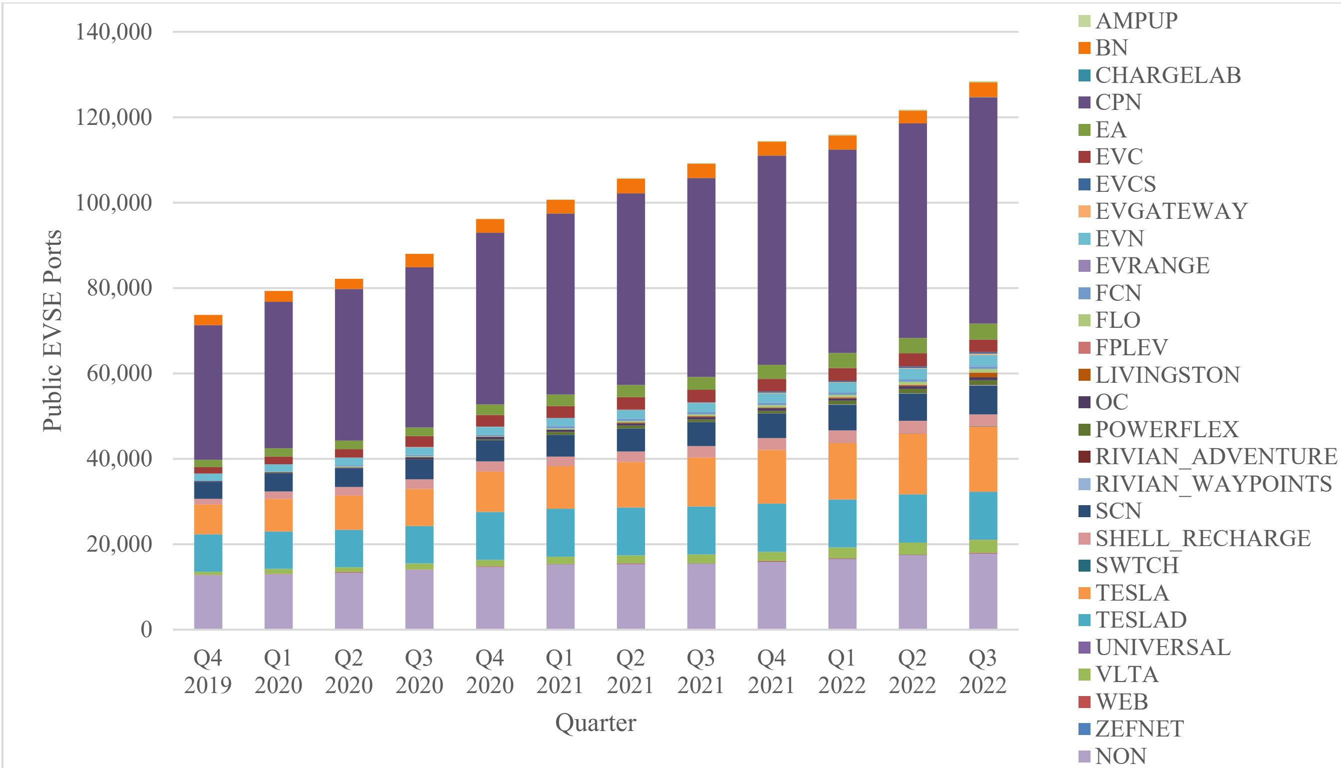

Figure 9. Quarterly growth of public EVSE ports by network

Table 2. Growth of Public EVSE Ports by Network Over the Last Four Quarters

Network	Q4 2021 Growth	Q1 2022 Growth	Q2 2022 Growth	Q3 2022 Growth
AmpUp	3.6%	2.3%	10.7%	61.9%
Blink	−1.1%	−0.5%	−8.1%	13.2%
ChargeLab	0.0%	0.0%	0.0%	1180.0%
ChargePoint	5.1%	−2.6%	5.4%	5.4%
Electrify America	8.1%	6.0%	4.0%	2.6%
EV Connect	1.6%	1.2%	0.3%	−2.4%
EV Charging Solutions	409.7%	3.2%	23.3%	−3.5%
evGateway	12.2%	8.2%	25.2%	80.5%
EVgo	5.2%	3.2%	8.5%	9.1%
EV Range	N/A	N/A	N/A	N/A
Francis	0.5%	0.0%	0.0%	−1.4%
FLO	20.3%	11.6%	30.2%	21.2%
FPL EVolution	0.0%	760.0%	−22.1%	0.0%
Livingston Energy Group	0.0%	0.0%	47.9%	287.4%
OpConnect	1.5%	−7.0%	6.4%	11.5%
PowerFlex	0.0%	42.8%	17.8%	7.8%
Rivian Adventure Network	N/A	N/A	N/A	161.5%
Rivian Waypoints	N/A	N/A	64.3%	30.4%
SemaConnect	3.2%	3.6%	6.7%	5.7%
Shell Recharge	5.1%	5.8%	1.2%	−6.4%
SWTCH Energy	N/A	N/A	−13.3%	46.2%
Tesla Supercharger	9.9%	5.3%	7.4%	7.8%
Tesla Destination	0.0%	0.0%	0.5%	−1.3%
Universal EV Chargers	N/A	N/A	N/A	N/A
Volta	5.8%	13.4%	11.9%	9.5%
Webasto	0.0%	0.0%	0.0%	0.0%
ZEF Energy	0.0%	16.7%	0.0%	85.7%
Non-networked	3.1%	4.3%	5.2%	2.3%
Total	**4.7%**	**1.3%**	**5.1%**	**5.5%**

The Station Locator team works with most major electric vehicle service providers (EVSPs) to collect EV charging infrastructure data for the Station Locator. Currently, the Station Locator includes stations on the 27 networks listed below, 12 of which update on a nightly basis via an API (those with asterisks). EV Range and Universal EV Chargers are new to the Station Locator as of Q3. In addition, the Station Locator contains non-networked (NON) station data, which include stations that were previously networked.

- AmpUp (AMPUP)
- Blink (BN)*
- ChargeLab (CHARGELAB)
- ChargePoint (CPN)*
- Electrify America (EA)*
- EV Connect (EVC)*
- EV Charging Solutions (EVCS)
- evGateway (EVGATEWAY)
- EVgo (EVN)*
- EV Range (EVRANGE)
- Francis Energy (FCN)
- FLO (FLO)*
- FPL EVolution (FPLEV)
- Livingston Energy Group (LIVINGSTON)
- OpConnect (OC)*
- PowerFlex (POWERFLEX)
- Rivian Adventure Network (RIVIAN_ADVENTURE)*
- Rivian Waypoints (RIVIAN_WAYPOINTS)*
- SemaConnect (SCN)*
- Shell Recharge (SHELL_RECHARGE)*
- SWTCH Energy (SWTCH)
- Tesla Supercharger (TESLA)
- Tesla Destination (TESLAD)
- Universal EV Chargers (UNIVERSAL)
- Volta (VLTA)
- Webasto (WEB)*
- ZEF Energy (ZEFNET)

2.1.3 By Region

As shown in Figure 10, the California region continues to have the largest share of the country's public EVSE ports (29.8%). However, the Northeast region grew by the largest percentage in Q3 (11.7%) primarily as a result of new Level 2 installations. With the exception of the Northeast and Mid-Atlantic regions, DC fast EVSE ports grew at a faster rate than Level 2 EVSE ports in each region in Q3, with the Southeast region seeing the largest percentage growth in DC fast EVSE for the third quarter in a row (Table 3).

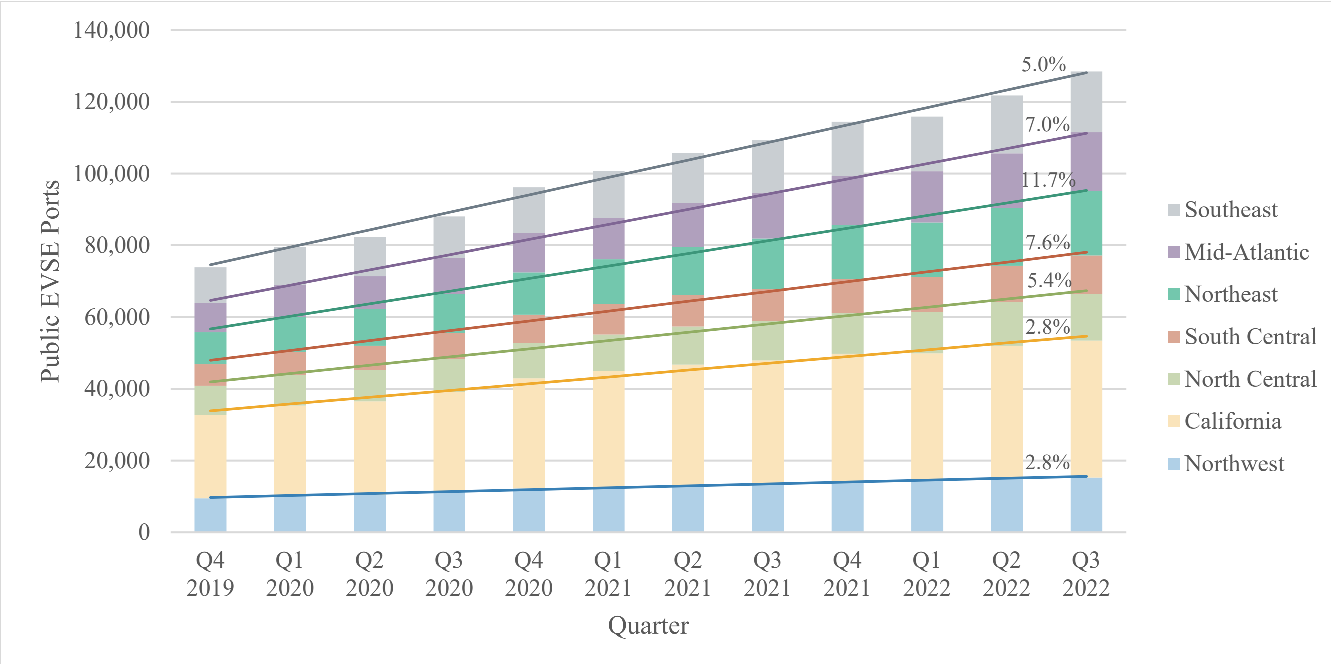

Figure 10. Quarterly growth of public EVSE ports by Clean Cities region.

Note: The percentages in this figure indicate the percent growth between each quarter.

Table 3. Growth of Public Level 2 and DC Fast EVSE Ports by Clean Cities Region in Q3 2022

Clean Cities Region	Level 2 EVSE Port Growth	DC Fast EVSE Port Growth
California	1.9%	6.5%
Mid-Atlantic	7.5%	5.2%
North Central	4.3%	8.9%
Northeast	12.8%	7.7%
Northwest	2.7%	3.2%
Southeast	4.0%	9.0%
South Central	7.3%	8.6%

The growth of public EV charging infrastructure across the country was analyzed by dividing the country into the same seven regions used by the Clean Cities Coalition Network (Figure 11) (Clean Cities Coalition Network 2022a). See the Q1 2020 report for more information about the Clean Cities Coalition Network (Brown et al. 2020).

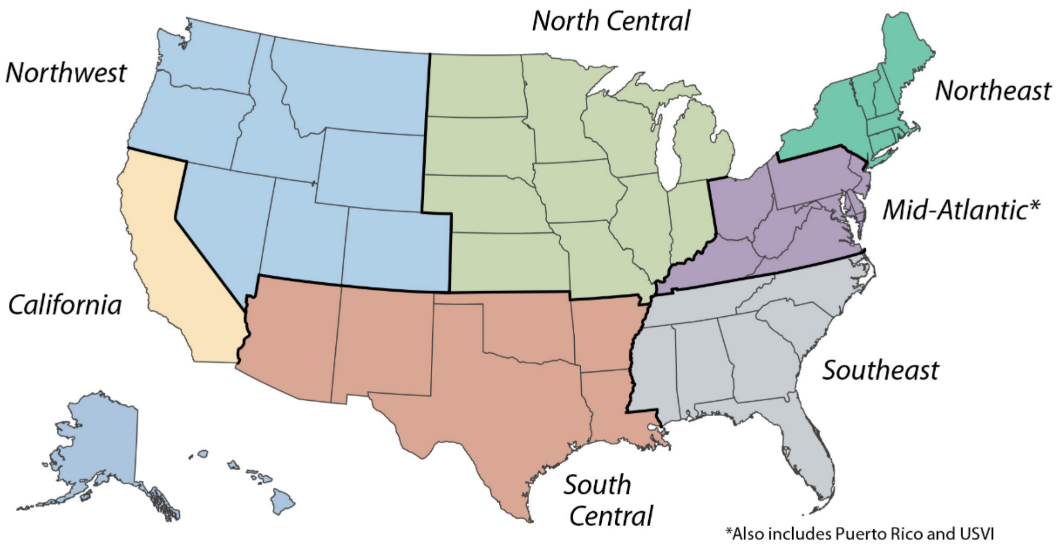

Figure 11. Clean Cities regions.

Source: Clean Cities Coalition Network (2022b)

2.1.4 By State

In Q3, the five states that had the largest percent growth of EVSE ports per 100 EVs were New York, New Jersey, Nebraska, West Virginia, and Arkansas, all of which outpaced the growth in the United States as a whole (Table 4). The growth in New York and New Jersey is primarily driven by installations of new Level 2 EVSE ports. In New York, the majority of these new installations are on the Livingston Energy Group (46.5%), EV Connect (18.5%), and ChargePoint (12.8%) networks, and 14% are non-networked. Since 2020, the New York State Energy and Research Development Authority (NYSERDA) has been funding public Level 2 installations across the state through its Charge Ready NY program, which is a contributor to this growth (NYSERDA 2022). The Station Locator team expects to see the number of public Level 2 EVSE in New York increase as more stations funded by the Charge Ready NY program come online.

Table 4. Top Five States With the Largest Growth of EVSE Ports per 100 EVs in Q3 2022[9]

State	EVSE Ports per 100 EVs in Q2 2022	EVSE Ports per 100 EVs in Q3 2022	Growth of EVSE Ports per 100 EVs in Q3 2022
New York	7.5	9.1	20.9%
New Jersey	2.9	3.3	14.8%
Nebraska	8.5	9.5	12.4%
West Virginia	14.3	16.1	12.3%
Arkansas	11.4	12.8	11.6%

To track the growth of EVSE ports by state, the Station Locator team calculated the number of public EVSE ports per 100 light-duty EV registrations in each state. The team chose this metric to compare charging infrastructure development across states on a basis that accounts for differing EV deployments by state. Washington, D.C., is considered a state for the purpose of

[9] See Appendix A for the growth of EVSE ports per 100 EVs in all states in Q3.

this analysis, and the vehicle registration data are based on Experian's registration information as of December 31, 2021 (Experian Information Solutions 2022a).

2.1.5 By Housing Density

To better understand where EV charging infrastructure is being deployed, the Station Locator team analyzed the growth of EVSE ports in urban, suburban, and rural areas across the United States. As shown in Figure 12, public EVSE ports are predominantly located in suburban census tracts, followed by urban and rural tracts. Although Level 2 EVSE ports grew by the largest percentage in suburban areas (5.4%) compared with rural and urban areas, DC fast EVSE ports saw the opposite, with the greatest growth occurring in rural and urban areas (8.5% and 7.2%, respectively). Finally, Level 1 EVSE ports continued their decline, with the largest percent decrease in rural areas.

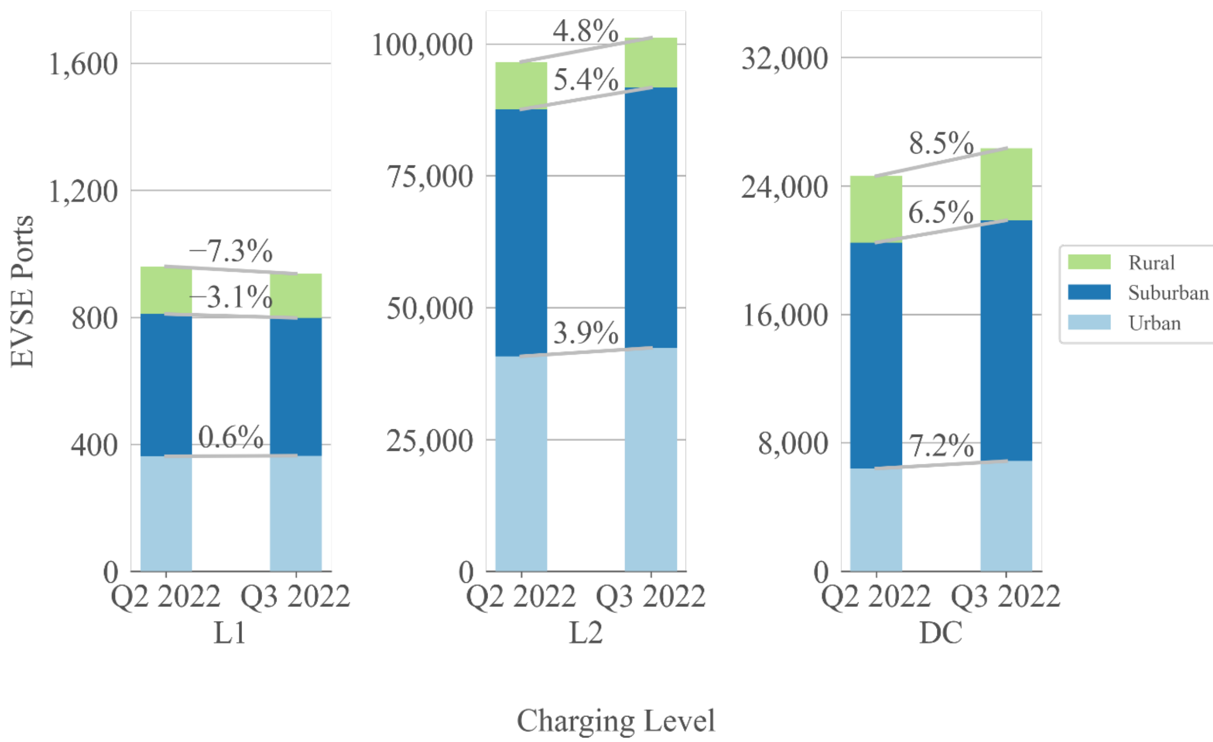

Figure 12. Q3 2022 growth of public EVSE ports by neighborhood type and charging level.

Note: These graphs are not to scale.

The Station Locator team used the U.S. Department of Housing and Urban Development's Urbanization Perceptions Small Area Index for this analysis. The index classifies census tracts as urban, suburban, or rural based on how American Housing Survey respondents described their neighborhood (U.S. Department of Housing and Urban Development Office of Policy Development and Research 2022). Based on the survey, approximately 27% of census tracts are urban, 52% are suburban, and 21% are rural. However, urban census tracts take up only approximately 1.3% of the United States' land area, whereas suburban and rural tracts take up 6.2% and 92.6%, respectively.

2.1.6 By Disadvantaged Community Designation

President Biden issued Executive Order 14008 early in his presidency to ensure that the benefits of his administration's climate investments flow to communities that have been historically underserved and disproportionately burdened by climate change, pollution, and environmental hazards (Argonne National Laboratory 2022). The Justice40 Initiative, which came out of Executive Order 14008, directs 40% of the overall benefits of certain federal investments, including the NEVI Formula Grant Program, to disadvantaged communities (DACs). Although charging infrastructure funded by the NEVI Formula Grant Program has not yet been deployed, this section focuses on the growth of EVSE ports in both DACs and non-DACs for comparison. The map in Figure 13 shows the census tracts classified as DACs across the United States.

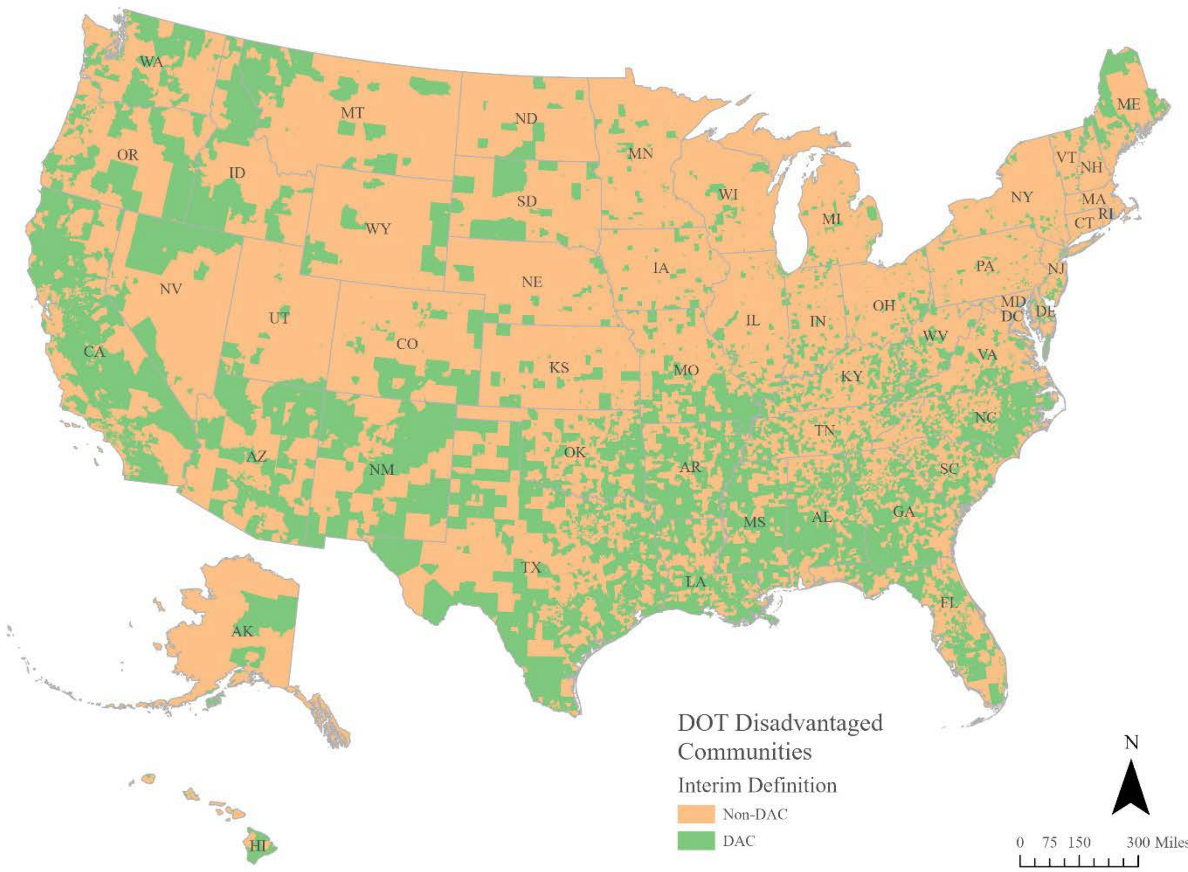

Figure 13. Display of the disadvantaged communities across the United States.

Note: Alaska and Hawaii are not to scale.

Overall, 32.9% of public EVSE ports across all charging levels are in DACs. As shown in Figure 14, Level 1 EVSE ports decreased by 3.6% in DACs in Q3, while Level 2 EVSE ports increased 3.6%. DC fast EVSE ports grew by the largest percentage, with a 7.4% increase in Q3.

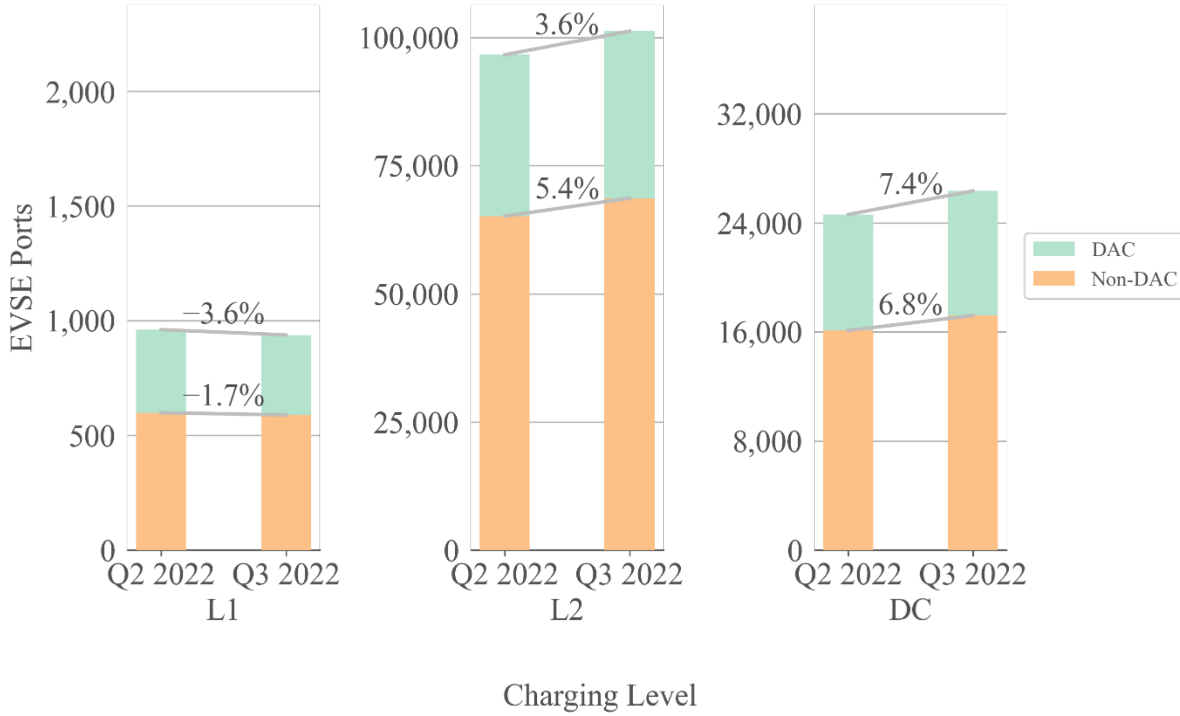

Figure 14. Q3 2022 growth of public EVSE ports by DAC designation and charging level.

Note: These graphs are not to scale.

The Station Locator team used a joint interim guidance map for DACs developed by DOE and the U.S. Department of Transportation (DOT) for the NEVI Formula Grant Program for this section of the analysis. GIS shapefiles with this data is hosted by Argonne National Laboratory (Argonne National Laboratory 2022). The DAC shapefile was prepared by aggregating several social, economic, and environmental features into a spatial data set. There are two interim definitions for DACs: one from DOE and one from DOT. This analysis uses the latter, which accounts for 22 census tract-level indicators under six categories of transportation disadvantage: transportation access, health, environment, economic, resilience, and social (U.S. Department of Transportation 2022).

2.2 Private Charging Trends

In Q3, the number of private EVSE ports in the Station Locator increased by 381, bringing the total number to 19,690 and representing a 2.0% increase since Q2 2022. The following sections break down the growth of private EVSE ports by level, as well as by three specific types: workplace, multifamily housing, and fleet charging.

Private EV charging refers to EV charging stations that are available only to certain drivers for specific purposes, such as charging for transit fleets or employee-only charging at workplaces. Although the Station Locator team proactively seeks out new station openings to include, the opening of private workplace charging stations may not necessarily be shared publicly. The Station Locator team therefore relies on Clean Cities coalitions, industry partners, and Station Locator users to share this information. Due to the challenge in collecting these data, private, nonresidential charging stations are likely underrepresented in the Station Locator; however, the Station Locator team is continually working to improve data collection in these areas.

2.2.1 By Charging Level

As shown in Figure 15, the majority of private EVSE ports in the Station Locator are Level 2. However, the share of private Level 2 EVSE ports in the Station Locator has generally been decreasing: Level 2 EVSE ports made up 90.2% of private EVSE ports in Q4 2019 compared with 87.2% in Q3 2022. Meanwhile, private DC fast EVSE ports grew by the largest percentage (8.4%), representing the addition of 25 EVSE ports (Figure 15). Keeping with historical trends, the share of private DC fast EVSE ports has continued to increase, from 0.8% of private EVSE ports in Q4 2019 to 1.6% in Q3 2022.

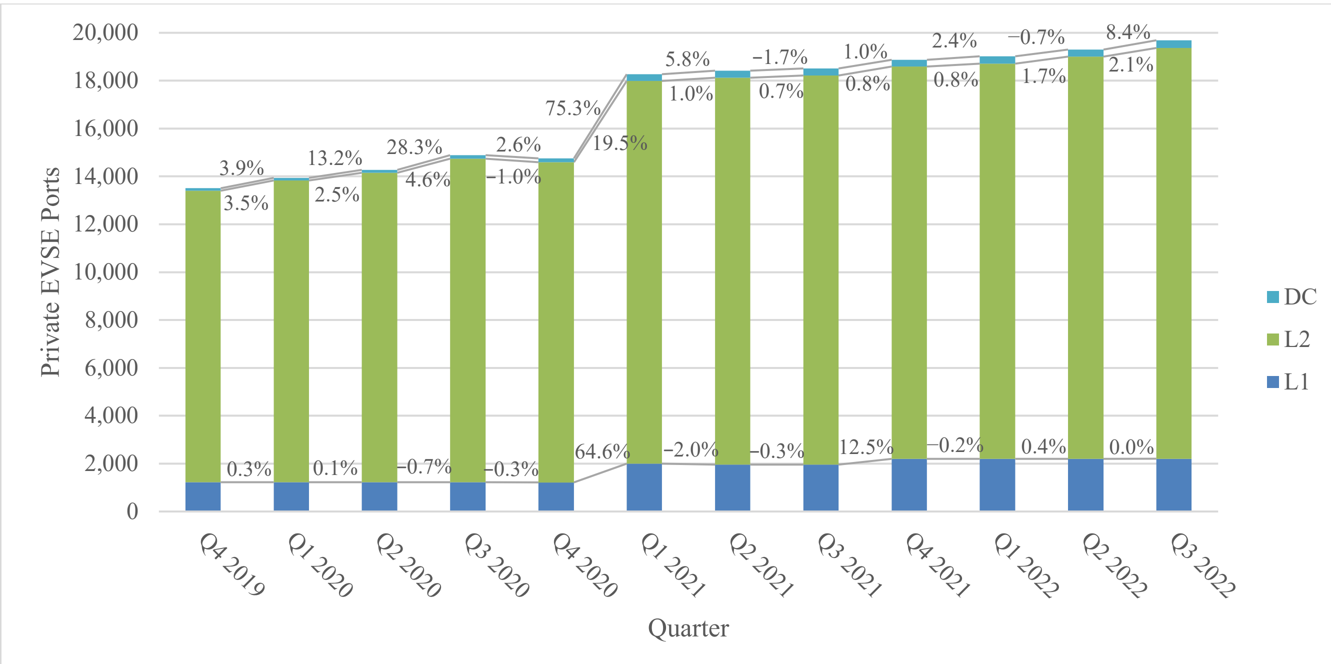

Figure 15. Quarterly growth of private EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q3, there were three private legacy EVSE ports in the Station Locator. Additionally, the percentages in this figure indicate the percent growth between each quarter. Finally, the large increase in private stations in Q1 2021 is primarily attributed to the addition of federally-owned EV charging stations from NREL's Federal Fleets team.

2.2.2 Workplace Charging

Workplace EV charging infrastructure includes charging stations that are private and designated for employee use only. The majority of private workplace EVSE ports in the Station Locator are Level 2 (Figure 16), which is to be expected because employees use workplace chargers while they are parked at work for an extended period and therefore do not necessarily need rapid charging.

By the end of Q3, there were 10,278 workplace EVSE ports in the Station Locator, representing 52.2% of private EVSE ports. Compared to last quarter, workplace EVSE increased by 133 ports (1.3%) in Q3. The increase in workplace charging EVSE in Q3 is attributable to the addition of

ChargePoint Level 2 EVSE ports at Bank of America locations, primarily in California and North Carolina.

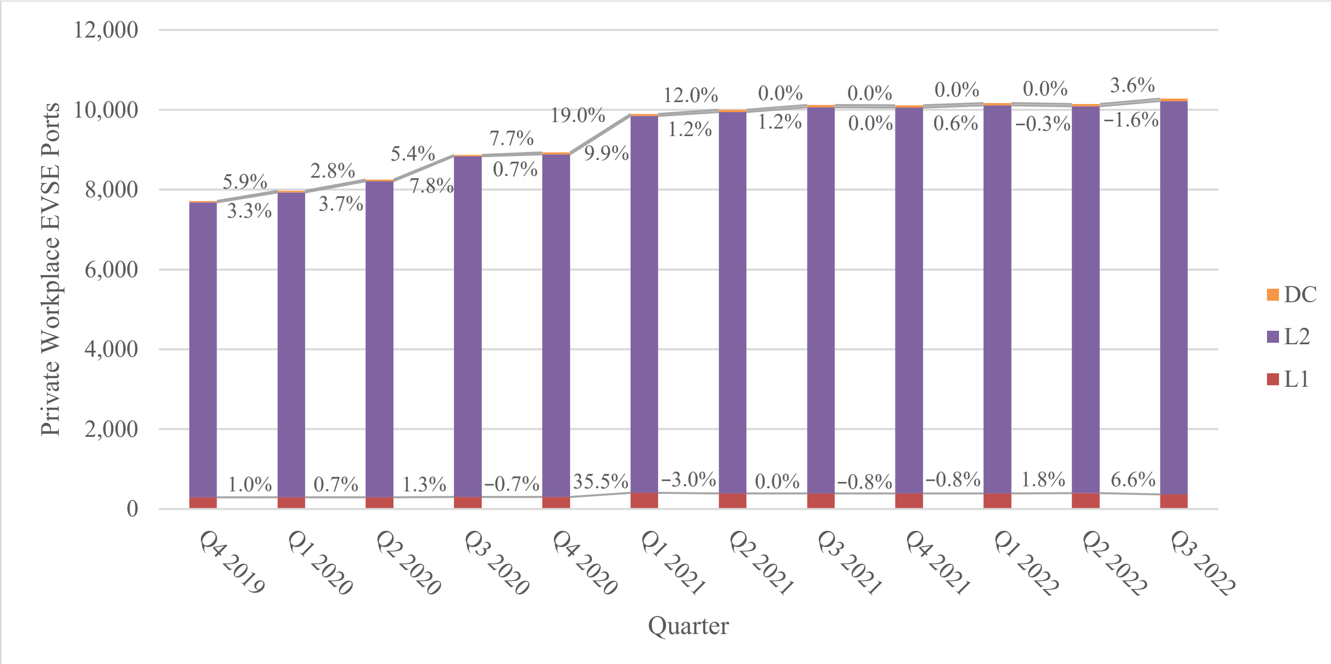

Figure 16. Quarterly growth of private workplace EVSE ports by charging level.

Note: The percentages in this figure indicate the percent growth between each quarter.

2.2.3 Multifamily Housing Charging

The Station Locator team continues to focus efforts on capturing private charging infrastructure installed at multifamily housing that is available for resident use only. As shown in Figure 17, multifamily housing EVSE ports in the Station Locator are either Level 1 or Level 2. In Q3, there was an increase of 8.0% in EVSE ports at multifamily housing, bringing the total number of EVSE ports to 1,179 compared with 1,092 in Q2 2022 (Figure 17). The EVSE ports added in Q3 were primarily ChargePoint Level 2 EVSE ports in California. Overall, EVSE ports at multifamily housing represent 6.0% of private EVSE ports in the Station Locator.

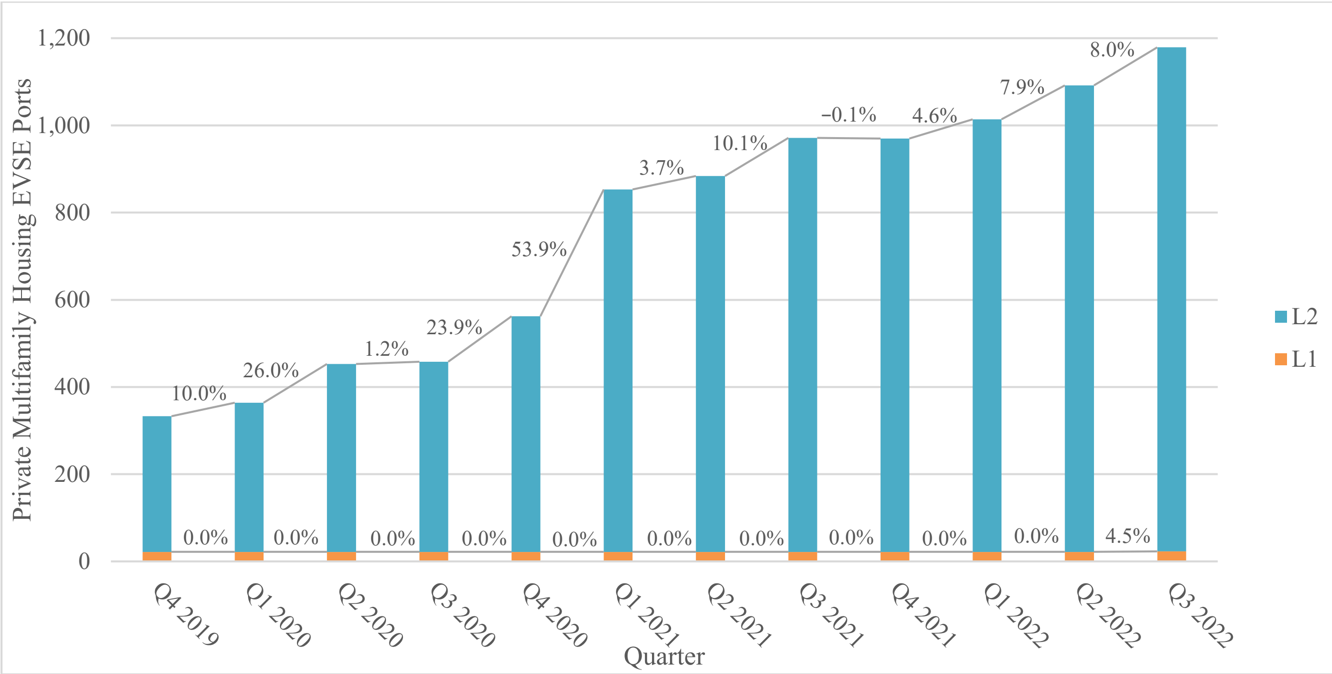

Figure 17. Quarterly growth of private multifamily housing EVSE ports by charging level.

Note: The percentages in this figure indicate the percent growth between each quarter.

2.2.4 Fleet Charging

The Station Locator team collects data on whether stations are dedicated fleet charging stations, and if so, what types of vehicles charge at the station based on the Federal Highway Administration weight class (i.e., light-duty [LD], medium-duty [MD], or heavy-duty [HD] vehicles). As of Q3, the team has collected this information for 88.8% of private EVSE ports in the Station Locator, of which 44.7% are being used for fleet charging purposes. Note that some fleet EVSE ports are also used by employees and are therefore counted as workplace EVSE ports in Section 2.2.2 as well.

Figure 18 shows the breakdown of these EVSE ports by fleet type and charging level. The fleet type indicates the largest vehicle type that uses the station as of Q3 based on the types of vehicles in the fleet, though smaller vehicle types may charge at the station as well. The majority of EVs on the road are LD vehicles, such as sedans, SUVs, and pickup trucks; unsurprisingly, the majority of fleet-charging EVSE ports are used to charge LD vehicles (Figure 18). Additionally, the majority of fleet-charging EVSE ports are Level 2 (Figure 18).

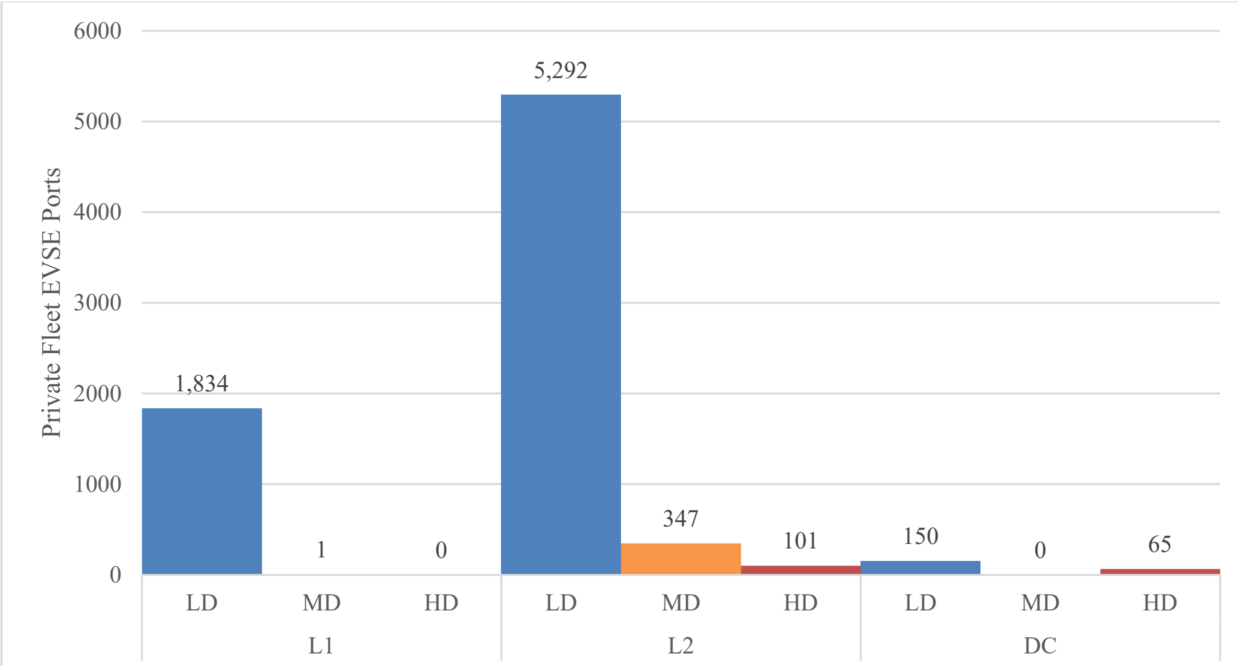

Figure 18. Breakdown of private fleet EVSE ports by charging level and fleet type in Q3 2022

The Station Locator team continues to expand its private fleet data collection efforts, especially for fleets that are installing charging infrastructure for MD and HD vehicles such as school bus fleets and public transit fleets. Additionally, the Station Locator team is tracking the development of MD and HD charging infrastructure and will collect additional data, such as new connector types, as the technology evolves and is deployed.

3 Developments That Could Impact Future Quarters

On August 16, 2022, the Inflation Reduction Act was signed into law. The IRA is the largest climate investment in United States history and dedicates $370 billion to reducing harmful emissions and battling climate change, including further supporting the Biden administration's goal of expanding access to EV charging (Rom 2022). Notably, the IRA extends the Alternative Fuel Refueling Property Credit with new eligibility requirements, supports charging infrastructure development by establishing the U.S. Department of Transportation's Neighborhood Access and Equity Grant Program, and creates a grant program for zero-emission heavy-duty vehicles and infrastructure that will be administered by the U.S. Environmental Protection Agency (AFDC 2022f). These investments will expand the nationwide EV charging network and availability of charging stations for EV drivers.

While the IRA was the industry's major focus during Q3, the NEVI Formula Grant Program reached an important milestone. First, the sixth round of the Federal Highway Administration's Alternative Fuel Corridors designations was announced in July. With the passing of the BIL, the significance of Alternative Fuel Corridors has grown, as they are tied to funding eligibility for the NEVI Formula Grant Program. After this round, all 50 states, Washington, D.C., and Puerto Rico now have Alternative Fuel Corridor designations, which will accelerate the availability of EV charging stations nationwide. This round of designations includes 177 EV corridor-pending and six EV corridor-ready highways. To date, the Federal Highway Administration has made a total of 1,549 designations throughout the six nomination rounds (Federal Highway Administration 2022a).

Second, all 50 states plus Washington, D.C., and Puerto Rico had their Electric Vehicle Infrastructure Deployment Plans, required as part of the NEVI Formula Grant Program, approved in Q3. All states now officially have access to Fiscal Year 2022 and 2023 NEVI formula funding, totaling more than $1.5 billion to deploy EV charging stations along designated EV charging corridors. State plans for EV charging and state funding apportionments are detailed on the Joint Office of Energy and Transportation website (Federal Highway Administration 2022b).

States also continued to push forward policies in Q3 to support the U.S. EV market. For example, Massachusetts passed House Bill 5060, which includes several EV related mandates, including ending sales of new non-zero-emission vehicles in the state by the end of 2035, requiring the Massachusetts Bay Transportation Authority bus fleet to be zero-emission by the end of 2040, and updating state building codes to mandate EV-ready parking spaces. Additionally, Vermont set aside millions of dollars of funding from House Bill 736, the state's largest transportation bill in state history, for the installation of DC fast charging stations along state highways and charging stations at workplaces and multifamily housing. Lastly, California scaled up their light-duty zero-emission vehicle sales requirement to meet the Advanced Clean Cars II standards, which requires an increasing percentage of new vehicle sales to be zero-emission and plug-in hybrid EVs, beginning at 35% for model year 2026 and up to 100% by model year 2035 (AFDC 2022e).

Finally, the Station Locator data collection and management processes will continue to impact future EVSE port counts as well. As noted in Section 1.1, the Station Locator team transitioned its counting logic in 2019 to align with the hierarchy defined in the OCPI protocol: station locations, EVSE ports, and connectors (EVRoaming Foundation 2020). The Station Locator therefore counts the number of EVSE ports at each station location. As of Q3, all manually collected data, as well as EVSE ports on the ChargePoint, Electrify America, EV Connect, EVgo, Shell Recharge, OpConnect, and Rivian networks, are counted according to the OCPI logic. Additionally, NREL is continuously working with EVSPs to add new APIs to the Station Locator and successfully integrated EV Connect's API in Q3. Finally, the Station Locator team is making a concerted effort to collect power data for all DC fast EVSE ports and may add new fields to the Station Locator to support BIL funding initiatives. This new information will continue to make the Station Locator as useful as possible to stakeholders and allow for additional analysis for these reports.

4 Conclusion

This report examines the growth of EV infrastructure in the Station Locator, including the growth of public EV charging by charging level, network, region, and state, and the growth of private EV charging by charging level and use type (i.e., workplace, multifamily housing, and fleet) in Q3 2022. With such rapid growth and change in EV charging infrastructure, the information presented in this report is intended to help readers understand how and where the infrastructure is developing, where there may be areas of opportunity, and whether development is keeping pace with projected charging demand and national targets.

As of the end of Q3, Level 2 EVSE ports accounted for the majority of both public and private EVSE ports in the Station Locator (78.9% and 87.2% respectively). Overall, there was a 5.0% increase in the number of EVSE ports in the Station Locator. Although public Level 2 EVSE ports grew by the largest number in Q3, public DC fast EVSE ports grew at the fastest rate (6.9%). California continues to lead the country in terms of the total number of public EVSE ports available (38,226), though public charging infrastructure grew by the largest percentage in the Northeast region in Q3 (11.7%).

Based on NREL's 2017 analysis that estimated the number of public and workplace EVSE ports required to support a scenario in which there are 15 million EVs on the road by 2030, the number of DC fast and Level 2 EVSE ports as of Q3 are 95.2% and 18.5%, respectively, of the projected 2030 needs. However, the majority (58.7%) of public DC fast EVSE ports in the Station Locator are on the Tesla network and are therefore only readily accessible to Tesla drivers. When Tesla EVSE ports are removed, this decreases to 39.5% and 16.6%, respectively, of the projected need. Based on Atlas' 2021 assessment that estimated the number of public and workplace EVSE ports required in a scenario in which 100% of passenger vehicle sales are electric by 2035, the number of DC fast and Level 2 EVSE ports as of Q3 is 9.7% and 33.2%, respectively, of the projected 2030 needs. This decreases to 4.2% and 30.9%, respectively, when Tesla EVSE ports are removed.

When comparing the current rate of deployment of public charging infrastructure with the Biden administration's goal of reaching 500,000 EVSE ports in the United States by 2030, it is clear that the pace of installations will need to significantly increase in order to meet the administration's goal. Since the start of 2020, an average of 4,963 public EVSE ports have been installed each quarter. To meet the Biden administration's goal by 2030, an average of 12,813 public EVSE port installations will be required each quarter for the next 8 years, equating to an average quarterly growth rate of 4.6%.

If there are additional metrics that readers are interested in seeing, please email suggestions to the authors at TechnicalResponse@icf.com.

References

Alternative Fuels Data Center (AFDC). 2022a. "About the Alternative Fuels Data Center." Accessed Nov. 11, 2022. https://afdc.energy.gov/about.html.

———. 2022b. "Alternative Fueling Station Locator." Accessed Nov. 11, 2022. https://afdc.energy.gov/stations/#/find/nearest.

———. 2022c. "Data Included in the Alternative Fueling Station Data." Accessed Nov. 11, 2022. https://afdc.energy.gov/data_download/alt_fuel_stations_format.

———. 2022d. "Developing Infrastructure to Charge Plug-In Electric Vehicles." Accessed Nov. 11, 2022. https://afdc.energy.gov/fuels/electricity_infrastructure.html.

———. 2022e. "Light-Duty Zero Emission Vehicle (ZEV) Sales Requirement." Accessed Oct. 24, 2022. https://afdc.energy.gov/laws/12515.

———. 2022f. "Public Law 117-169." Accessed Nov. 11, 2022. https://afdc.energy.gov/laws/search?keyword=Public+Law+117-169.

Argonne National Laboratory. 2022. "Electric Vehicle Charging Equity Considerations." Accessed Dec. 5, 2022. https://www.anl.gov/esia/electric-vehicle-charging-equity-considerations.

Brown, Abby, Alexis Schayowitz, and Emily Klotz. 2021. *Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: First Quarter 2021*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5400-80684. https://www.nrel.gov/docs/fy21osti/80684.pdf.

———. 2022. *Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: Third Quarter 2021*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5400-81775. https://www.nrel.gov/docs/fy22osti/81775.pdf.

Brown, Abby, Jeff Cappellucci, Emily White, Alexia Heinrich, and Emma Cost. 2022. *Electric Vehicle Charging Infrastructure Trends From the Alternative Fueling Station Locator: Second Quarter 2022*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5400-84263. www.nrel.gov/docs/fy23osti/84263.pdf.

Brown, Abby, Stephen Lommele, Alexis Schayowitz, and Emily Klotz. 2020. *Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: First Quarter 2020*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5400-77508. www.nrel.gov/docs/fy20osti/77508.pdf.

Clean Cities Coalition Network. 2022a. "About Clean Cities." Accessed Nov. 11, 2022. https://cleancities.energy.gov/about/.

———. 2022b. "Technology Integration Program Contacts." Accessed Nov. 11, 2022. https://cleancities.energy.gov/contacts/?open=regional#headingregionalManagers.

EVRoaming Foundation. 2020. *OCPI 2.2: Open Charge Point Interface*. Document Version 2.2-d2. https://evroaming.org/app/uploads/2020/06/OCPI-2.2-d2.pdf.

Experian Information Solutions. 2022a. *Derived 2021 annual registration counts by the National Renewable Energy Laboratory.* Golden, Colorado: National Renewable Energy Laboratory.

Experian Information Solutions. 2022b. *Derived Q2 2022 registration counts by the National Renewable Energy Laboratory.* Golden, Colorado: National Renewable Energy Laboratory.

Federal Highway Administration. 2022a. "Alternative Fuel Corridors Round 6 Memorandum." July 5, 2022. https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/afc_6_designation_memo.cfm.

———. 2022b. "Historic Step: All Fifty States Plus D.C. and Puerto Rico Greenlit to Move EV Charging Networks Forward, Covering 75,000 Miles of Highway." Sept. 27, 2022. https://www.transportation.gov/briefing-room/historic-step-all-fifty-states-plus-dc-and-puerto-rico-greenlit-move-ev-charging.

———. 2022c. *National Electric Vehicle Infrastructure Formula Program: Bipartisan Infrastructure Law*. Washington, D.C.: Federal Highway Administration. https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/90d_nevi_formula_program_guidance.pdf.

Levene, Johanna, Stephen Lommele, Robert Eger, and Wendy Dafoe. 2019. "Developing a Comprehensive Database of Alternative Fuel Station Locations across Canada and the United States of America." In *Canadian Transportation Research Forum 54th Annual Conference Proceedings*.

Loveday, Steven. 2022. "Tesla May Seek Federal Funds To Open Supercharger Network To Public." *InsideEVs*, March 1, 2022. https://insideevs.com/news/570704/tesla-federal-funds-us-supercharger-public-use/.

McKenzie, Lucy and Nick Nigro. 2021. *U.S. Passenger Vehicle Electrification Infrastructure Assessment.* Washington, D.C.: Atlas Public Policy. https://atlaspolicy.com/wp-content/uploads/2021/04/2021-04-21_US_Electrification_Infrastructure_Assessment.pdf.

New York State Energy Research and Development Authority (NYSERDA). 2022. "Charge Ready NY." Accessed Nov. 11, 2022. https://www.nyserda.ny.gov/All-Programs/ChargeNY/Charge-Electric/Charging-Station-Programs/Charge-Ready-NY.

Rom, Tony. 2022. "House passes Inflation Reduction Act, sending climate and health bill to Biden." *Washington Post*, Aug. 12, 2022. https://www.washingtonpost.com/us-policy/2022/08/12/inflation-reduction-act-house-vote/.

The White House. 2022. *Building a Better America: A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners.* Washington, D.C.: The White House. https://www.whitehouse.gov/wp-content/uploads/2022/01/BUILDING-A-BETTER-AMERICA_FINAL.pdf.

U.S. Department of Housing and Urban Development Office of Policy Development and Research. 2022. "Urbanization Perceptions Small Area Index." Last updated Jan. 21, 2022. https://hudgis-hud.opendata.arcgis.com/datasets/HUD::urbanization-perceptions-small-area-index/about.

U.S. Department of Transportation. 2022. "Justice40 Initiative." Last updated Nov. 30, 2022. https://www.transportation.gov/equity-Justice40.

Wood, Eric, Clément Rames, Matteo Muratori, Sesha Raghavan, and Marc Melaina. 2017. *National Plug-In Electric Vehicle Infrastructure Analysis.* Washington, D.C.: U.S. Department of Energy Office of Energy Efficiency & Renewable Energy. DOE/GO-102017-5040. https://www.nrel.gov/docs/fy17osti/69031.pdf.

Appendix A. EVSE Ports Growth by State

Table A-1. Q3 2022 Growth of Public EVSE Ports per 100 EVs by State

State	EVSE Ports per 100 EVs in Q2 2022	EVSE Ports per 100 EVs in Q3 2022	Growth of EVSE Ports per 100 EVs in Q3 2022
AK	5.3	5.3	0.0%
AL	7.6	8.0	4.6%
AR	11.4	12.8	11.6%
AZ	4.0	4.3	7.2%
CA	4.2	4.4	2.8%
CO	7.0	7.4	5.5%
CT	5.8	6.0	3.7%
DC	12.2	12.4	2.0%
DE	6.4	6.0	−6.6%
FL	5.1	5.4	5.6%
GA	8.1	8.6	5.7%
HI	4.2	4.4	2.8%
IA	8.4	9.0	6.0%
ID	4.5	4.6	1.5%
IL	4.6	4.7	3.9%
IN	5.2	5.5	5.5%
KS	12.2	12.7	4.1%
KY	7.4	7.7	4.2%
LA	7.2	7.7	7.0%
MA	9.4	9.9	5.4%
MD	7.8	8.3	6.7%
ME	10.7	11.1	3.9%
MI	6.5	6.9	6.7%
MN	5.3	5.7	6.9%
MO	12.3	12.6	2.5%
MS	12.0	12.4	3.8%
MT	8.8	9.1	3.8%
NC	6.7	7.0	4.0%
ND	20.5	21.3	3.8%
NE	8.5	9.5	12.4%
NH	4.9	5.2	6.7%
NJ	2.9	3.3	14.8%

State	EVSE Ports per 100 EVs in Q2 2022	EVSE Ports per 100 EVs in Q3 2022	Growth of EVSE Ports per 100 EVs in Q3 2022
NM	6.6	6.9	5.0%
NV	6.3	6.4	2.1%
NY	7.5	9.1	20.9%
OH	6.7	7.2	6.3%
OK	7.4	7.2	−2.7%
OR	4.6	4.7	1.6%
PA	6.3	6.8	8.8%
RI	12.4	13.2	5.7%
SC	7.4	7.7	4.0%
SD	11.9	12.5	5.6%
TN	7.6	7.8	3.5%
TX	4.9	5.3	9.6%
UT	7.8	7.7	−0.6%
VA	6.5	6.7	3.7%
VT	13.4	13.1	−2.6%
WA	4.4	4.5	3.0%
WI	5.5	6.0	8.7%
WV	14.3	16.1	12.3%
WY	19.6	20.0	2.2%

Appendix B. EV Charging Data Sources

As previously mentioned, the Station Locator has been collecting data on alternative fueling stations since the 1990s and therefore has historical EV charging station data for several years that can serve as a baseline for more analysis. See the first report in this series for the growth of EVSE ports and EV charging stations in the Station Locator from January 2010 through January 2020 (Brown et al. 2020).

NREL and its data collection contractor and collaborator, ICF, use a variety of methods to gather and verify EV charging data in the Station Locator. EVSPs, responsible for managing a network of EV charging stations (Figure B-1), share data directly with the Station Locator team and are the largest data source for EV charging in the Station Locator. In addition, data are collected through industry outreach efforts, contributions from Clean Cities directors, and other manual methods.

Non-Networked Stations
Non-networked EV charging stations are not connected to the internet and provide basic charging functionality without advanced communications capabilities. Because of this, non-networked charging is generally free or offered as an amenity for those who pay for parking or to access a business.
Networked Stations
Networked EV charging stations are connected to the internet via a cable or wireless technology and can communicate with the back-end computer system of an EVSP. Being connected to a network lets station owners or site hosts manage who can access stations and control how much it costs drivers to charge their vehicle. An EVSP typically manages a group of networked EV charging stations, otherwise known as a network, and may use its communication capabilities to communicate directly with drivers, other EVSPs, or utilities; monitor and share real-time station status; broadcast location information; collect and store usage data; control access; or facilitate payment. For a group of networked EV charging stations to be considered a network, it cannot be considered part of another network and it must have a dedictaed platform that allows users to locate EV charging stations as well as initiate and pay for charging events.

Figure B-1. Non-networked vs. networked EV charging stations

B.1 Data From Charging Network APIs

Prior to 2014, NREL manually collected all EV charging data, including EV charging stations managed by EVSPs. In 2014, to keep up with the rapid growth of charging infrastructure, NREL began incorporating daily updates on networked charging station data directly from EVSPs, when available. NREL does this by accessing the network's API and importing each network's API data into the database. Using APIs ensures the efficiency, accuracy, and completeness of the data are maintained.

Figure B-2 shows a timeline of the integration of the network APIs into the Station Locator data management process. In Q3, EV Connect's API was integrated into the Station Locator. OCPI-based APIs that have been integrated into the Station Locator are also shown in Figure B-2. See Section 1.1 for more information on the OCPI protocol.

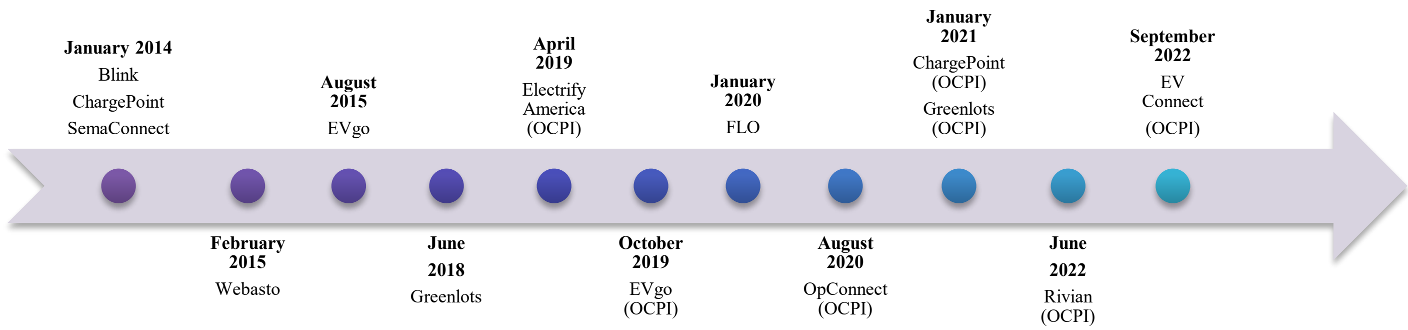

Figure B-2. Timeline of API integrations in the Station Locator

As of the end of Q3, there were 54,136 available and temporarily available public and private charging stations in the database, which are available on the Station Locator or accessible via API or data download (Alternative Fuels Data Center 2022b). Of those, approximately 77% are automatically updated daily via EVSP-provided APIs, whereas the rest are managed and updated manually.

The Station Locator team is working with additional EVSPs to access and integrate existing APIs or provide them with best practices on developing an API if they have not yet automated their data sharing. This will help ensure station data are as current and accurate as possible, while also increasing the efficiency of the EV charging data update process.

B.2 Manually Collected Data

For non-networked (i.e., not connected to the internet) EV charging stations, data sources include trade media, Clean Cities directors, a "Submit New Station" form on the Station Locator website, EV charging station manufacturers, electric utilities, original equipment manufacturers, state and municipal governments, private companies, and others. The Station Locator team regularly monitors news outlets for press releases on new EV charging station openings and seeks out more information, as appropriate, to confirm and add the EV charging data to the Station Locator.

The Station Locator team also receives semiregular data in the form of spreadsheets from EVSPs that have networked stations but do not currently have an API available. These EVSPs include, but are not limited to, Tesla and Volta. In Q3, the Station Locator team received an updated list of stations from AmpUp, ChargeLab, evGateway, Livingston Energy Group, and Volta. Additionally, the team receives regular updates from Chargeway that include stations on all networks. The team is greatly appreciative of our partners' continued collaboration and willingness to share regular data updates.

Finally, Clean Cities coalitions (see Section 2.1.3) proactively provide information on station updates and additions throughout the year. Coalitions also serve as a valuable on-the-ground resource for stations that ICF is not able to confirm through normal station confirmation processes. Unconfirmed stations are sent to coalitions throughout the year for confirmation; if the coalition is not able to provide any additional information, the station is subsequently removed from the Station Locator.