Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: First Quarter 2023

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

1 National Renewable Energy Laboratory
2 ICF Inc.

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Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

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Technical Report
NREL/TP-5400-86446
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List of Acronyms

AFDC	Alternative Fuels Data Center
AMPUP	AmpUp network
API	application programming interface
BN	Blink network
CCS	Combined Charging System; a connector type for DC fast charging
CFI	Charging and Fueling Infrastructure
CHAdeMO	a connector type for DC fast charging
CHARGELAB	ChargeLab network
CHARGEUP	ChargeUp network
CIRCLE_K	Circle K network
CPN	ChargePoint network
DAC	disadvantaged community
DC	direct current
DOE	U.S. Department of Energy
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
FLASH	FLASH network
FLO	FLO network
FPLEV	FPL EVolution network
GRAVITI_ENERGY	Graviti Energy network
J1772	the connector type for Level 1 and Level 2 charging
L1	Level 1
L2	Level 2
LIVINGSTON	Livingston Energy Group network
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
RED_E	Red E Charging network

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

Electric vehicle (EV) charging infrastructure continues to rapidly change and grow. Using data from the U.S. Department of Energy's (DOE's) Alternative Fueling Station Locator (AFDC 2023b), this report provides a snapshot of the state of EV charging infrastructure in the United States in the first calendar quarter of 2023 (Q1 2023) by charging level, network, and location. Additionally, this report measures the current state of charging infrastructure compared with a federal infrastructure requirement scenario. 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 thirteenth 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 Q1 2023, the number of electric vehicle supply equipment (EVSE) ports in the Station Locator grew by 3.2%, or 5,047 EVSE ports. Public EVSE ports grew by 4.0%, or 5,394 EVSE ports, bringing the total number of public ports in the Station Locator to 141,907 and accounting for the majority of ports in the Station Locator (Figure ES-1). Private EVSE ports decreased by 1.7%, or 347 ports. The South Central region had the largest increase in public charging infrastructure in Q1 (7.9%), 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.

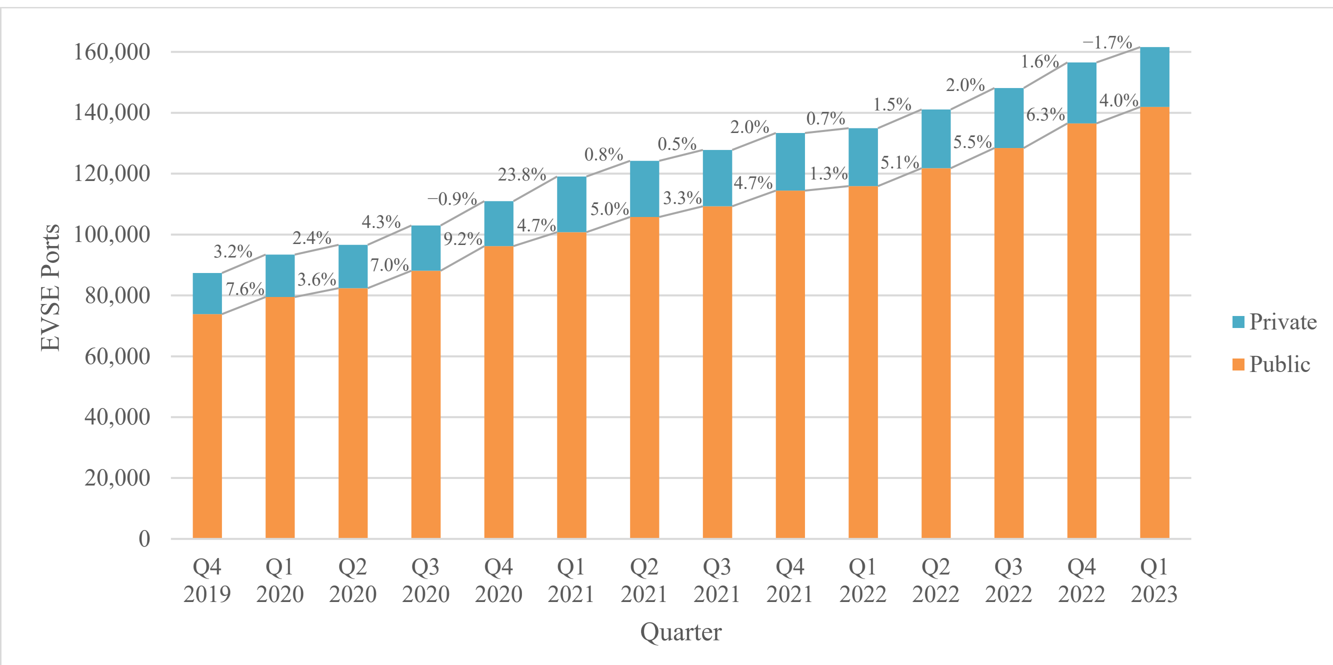

Figure ES-1. Quarterly growth of EVSE ports by access.

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 (7.6%) in Q1 (Figure ES-2).

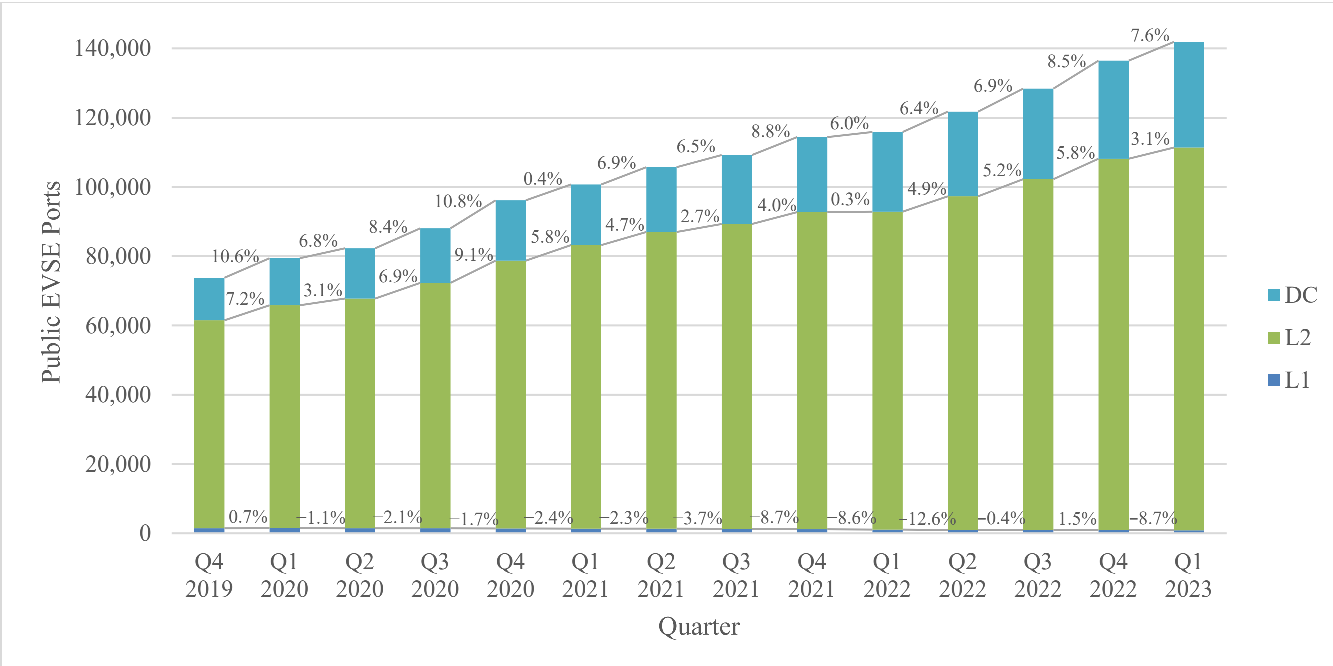

Figure ES-2. Quarterly growth of public EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q1, there were 30 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 at higher power levels is steadily increasing (Figure ES-3).

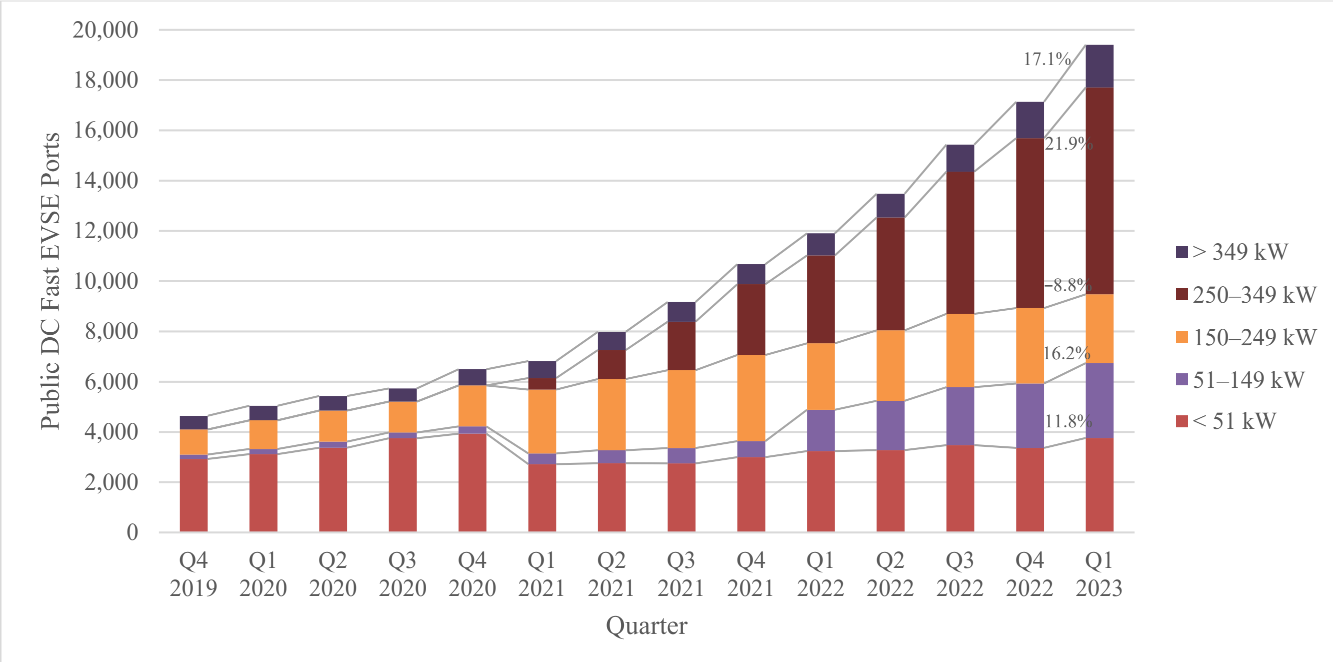

Figure ES-3. Quarterly growth of public DC fast EVSE ports by power output.

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).

NREL's report *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure* estimates the United States would require 182,000 DC fast EVSE ports with a power output of 150 kW or greater and 1,067,000 Level 2 public EVSE ports to support a scenario of 33 million EVs on the road by 2030 (Wood et al. 2023). Based on this analysis, the number of DC fast and Level 2 EVSE ports is 7.0% and 10.4%, respectively, of the way toward meeting projected 2030 requirements. However, it is important to note that 60.9% of public DC fast EVSE ports and 9.0% of public Level 2 EVSE ports in the Station Locator are on the Tesla Supercharger and Destination networks, respectively, and are therefore only readily accessible to Tesla vehicles. When public Tesla-only EVSE ports are excluded, the number of DC fast and Level 2 EVSE ports currently installed decreases to 4,421 (2.4%) and 100,580 (9.4%), respectively.

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) 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.

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 2023a). 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 Fuelling 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 federal government's goal of building a national EV charging network of 500,000 electric vehicle supply equipment (EVSE) ports by 2030 and the newly available funds from the Bipartisan Infrastructure Law and Inflation Reduction Act 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 first calendar quarter of 2023 (Q1 2023). This is the thirteenth 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) 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.

The Station Locator counting logic aligns 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.

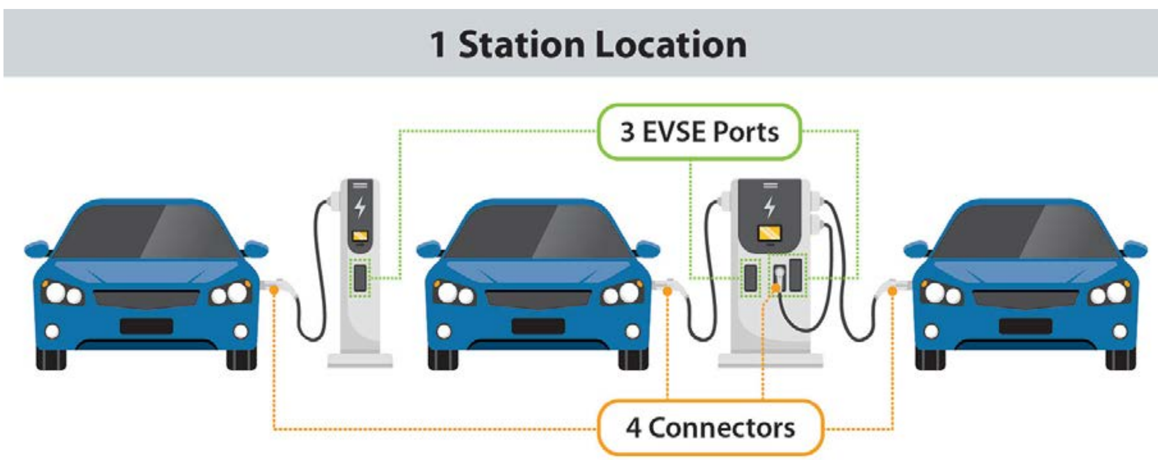

Figure 1. EV charging infrastructure hierarchy.

Source: AFDC (2023d)

The following fuel-specific fields are tracked in the Station Locator for EV charging stations (AFDC 2023c):

- 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 simultaneously charge vehicles. An EVSE port provides power to charge only one vehicle at a time even though it may have multiple connectors. The unit that houses EVSE ports is sometimes called a charging post, which can have one or more EVSE ports.
  - EVSE port type:

- Level 1 (L1): 120 V; 1 hour of charging = 5 miles of range[1]
  - Note: The Station Locator counts standard 120 V outlets as Level 1 EVSE ports only if the outlet is specifically designated for EV charging.
- 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

"Executive Order 14037: Strengthening American Leadership in Clean Cars and Trucks," issued in August 2021, requires that 50% of all new passenger vehicles and light trucks sold in the United States be zero-emission vehicles, including EVs and fuel cell electric vehicles, by 2030 (Executive Office of the President 2021). NREL's report *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure* projects that there will be 33 million EVs on the road by 2030 (Wood et al. 2023).[6] Using NREL's EVI-Pro, EVI-RoadTrip, and EVI-OnDemand modeling tools, as well as assumptions on vehicle adoption,

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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] Previous versions of this report referenced different projections from 2017 and 2021.

fleet composition (90% all-electric vehicles and 10% plug-in hybrid electric vehicles by 2030), technology attributes, and driving and charging behavior (90% of EVs have reliable access to residential charging by 2030, and therefore most charging occurs at home), the NREL report estimates that approximately 28 million EVSE ports—including 1.2 million public EVSE ports and 26.8 million private EVSE ports—will be required by 2030 to support this fleet. The remainder of this section focuses on how today's public charging infrastructure measures up against the needed public infrastructure in this baseline scenario.[7]

The 1.2 million public EVSE ports modeled by NREL include 182,000 DC fast EVSE ports with a power output of 150 kW or greater, and 1,067,000 Level 2 EVSE ports (Wood et al. 2023). As of Q1, there were 12,665 public DC fast EVSE ports with a power output of 150 kW or greater and 110,502 public Level 2 EVSE ports in the Station Locator.[8] Based on NREL's analysis, the number of DC fast and Level 2 EVSE ports is 7.0% and 10.4%, respectively, of the way toward meeting projected 2030 requirements. However, it is important to note that 60.9% of public DC fast EVSE ports and 9.0% of public Level 2 EVSE ports in the Station Locator are on the Tesla Supercharger and Destination networks, respectively, and are therefore only readily accessible to Tesla vehicles.[9] When public Tesla-only EVSE ports are excluded, the number of DC fast and Level 2 EVSE ports currently installed decreases to 4,421 (2.4%) and 100,580 (9.4%), respectively (Figure 2). Although Tesla has begun opening up its Supercharger and Destination networks to non-Tesla vehicles and plans to make 7,500 of its EVSE ports, including 3,500 Superchargers, accessible to all vehicles by the end of 2024, only a small portion of these ports were open as of Q1, which had very little impact on these figures (The White House 2023a).

[7] Wood et al.'s private infrastructure scenario includes EVSE ports at single-family residences, which, as noted in Section 1.1, are not tracked in the Station Locator. Further, as discussed in Section 2.2, private EV charging data in the Station Locator may be underrepresented. Given the Station Locator's robust public EV charging data set, this section focuses on Wood et al.'s public infrastructure scenario only.

[8] As discussed in Section 2.1.1, power output data are currently only available for 63.3% of public DC fast EVSE ports in the Station Locator. Therefore, the number of DC fast EVSE ports with a power output of 150 kW or greater is likely underrepresented.

[9] As of March 31, 2023, 47% of EVs on the road are Teslas (Experian Information Solutions 2023b).

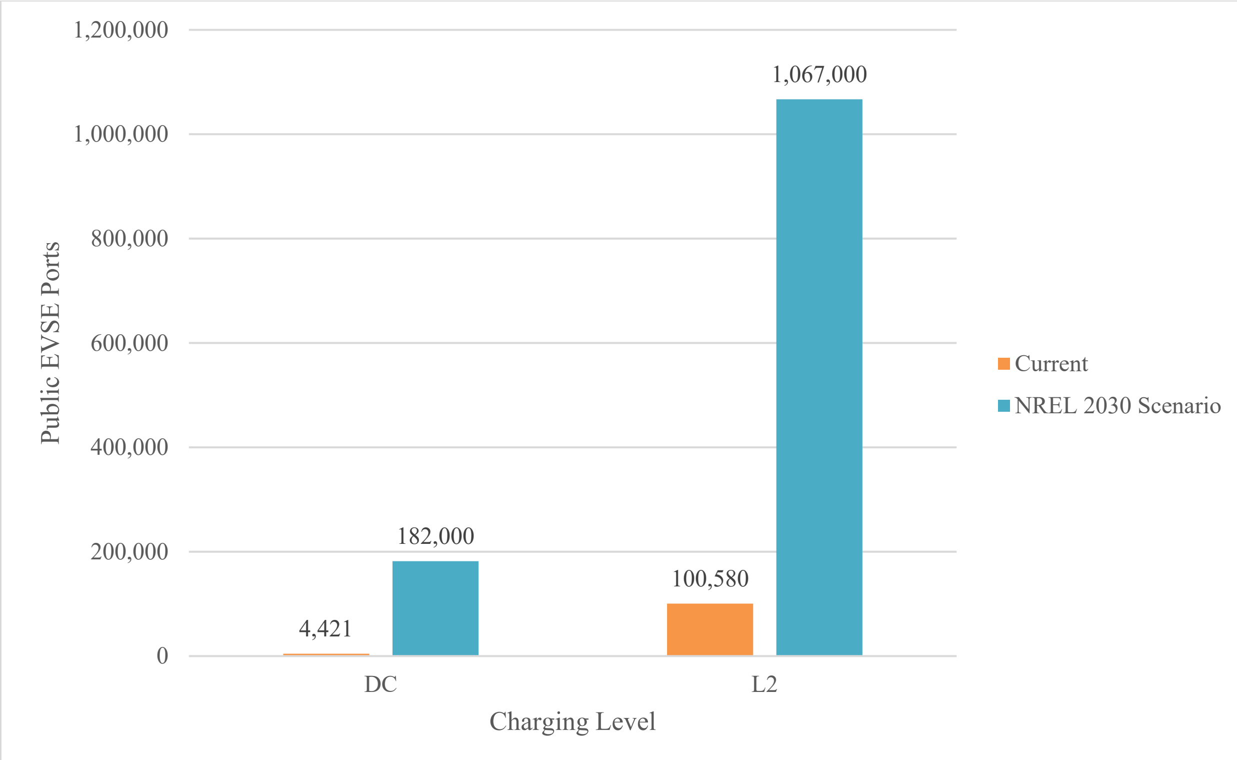

Figure 2. Current availability of public charging (excluding Tesla-only) versus NREL's scenario of 2030 public infrastructure requirements in the United States

Wood et al.'s baseline scenario also estimates that by 2030, there will need to be 0.6 public DC fast EVSE ports and 3.2 public Level 2 EVSE ports per 100 EVs. There were approximately 3.4 million EVs on the road in the United States as of March 31, 2023 (Experian Information Solutions 2023b). The ratios of public DC fast and Level 2 EVSE ports per 100 EVs in Q1 were 0.4 and 3.2, respectively, including Tesla-only EVSE ports (Table 1). Using Wood et al.'s estimated ratios of the number of public DC fast and Level 2 EVSE ports per 100 EVs as a proxy for how much infrastructure is sufficient to meet charging needs in 2030, Table 1 suggests that as of Q1, public DC fast EVSE port deployment currently falls short, while Level EVSE port deployment is keeping up with charging needs based on the number of EVs currently on the road. However, roughly 10% of the 33 million light-duty EVs in NREL's analysis were on the road as of Q1. As the number of EV registrations continues to grow at a faster rate each quarter, and especially if EV adoption levels increase in line with Wood et. al's study, public EVSE installations will need to ramp up considerably to keep up with demand.

Table 1. Current Public EVSE per 100 EVs Versus NREL's Scenario of 2030 Infrastructure Requirements in the United States

Port Level	EVSE per 100 EVs in Q1 2023	EVSE per 100 EVs Needed in 2030 To Support 33 Million EVs
DC fast	0.4	0.6
Level 2	3.2	3.2

2 Electric Vehicle Charging Infrastructure Trends

The purpose of this report is to identify EV charging infrastructure trends for Q1 of 2023. In Q1, the number of EVSE ports in the Station Locator grew by 3.2%, or 5,047 EVSE ports. Public EVSE ports grew by 4.0%, or 5,394 ports, and account for the majority of EVSE ports in the Station Locator (Figure 3). Private EVSE ports decreased by 1.7%, or 347 EVSE ports. As of Q1, there was a total of 161,562 EVSE ports in the Station Locator, compared with 87,352 EVSE ports in Q4 2019.

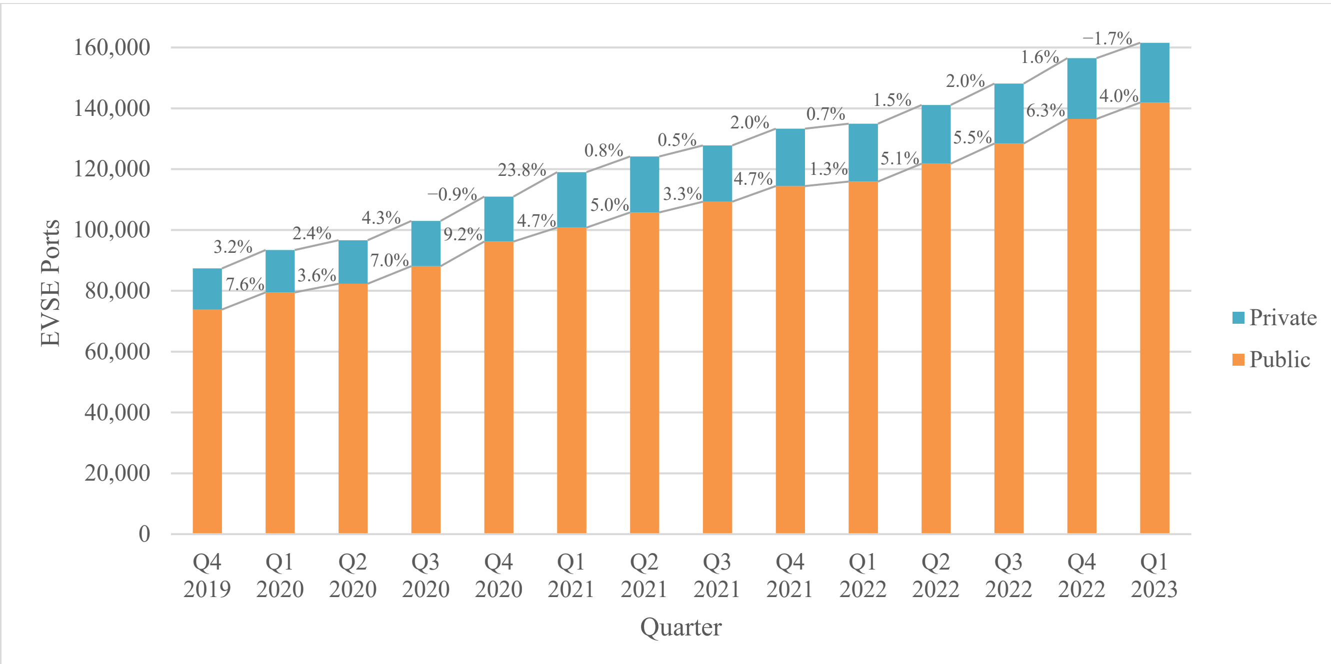

Figure 3. Quarterly growth of EVSE ports by access.

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 Q1 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 Q1, the number of public EVSE ports in the Station Locator increased by 5,047, bringing the total number of public EVSE ports in the Station Locator to 141,907 and representing a 4.0% increase since Q4 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, DC fast EVSE ports have increased by the greatest percentage compared to other charging levels in almost every quarter since Q4 2019 (Figure 4). DC fast EVSE ports made up 21.5% of public EVSE ports as of Q1 2023, compared with 16.7% in Q4 2019. Level 1 EVSE ports decreased by 8.7% in Q1, primarily driven by the removal of older (i.e., opened more than 5 years ago), non-networked EVSE ports.

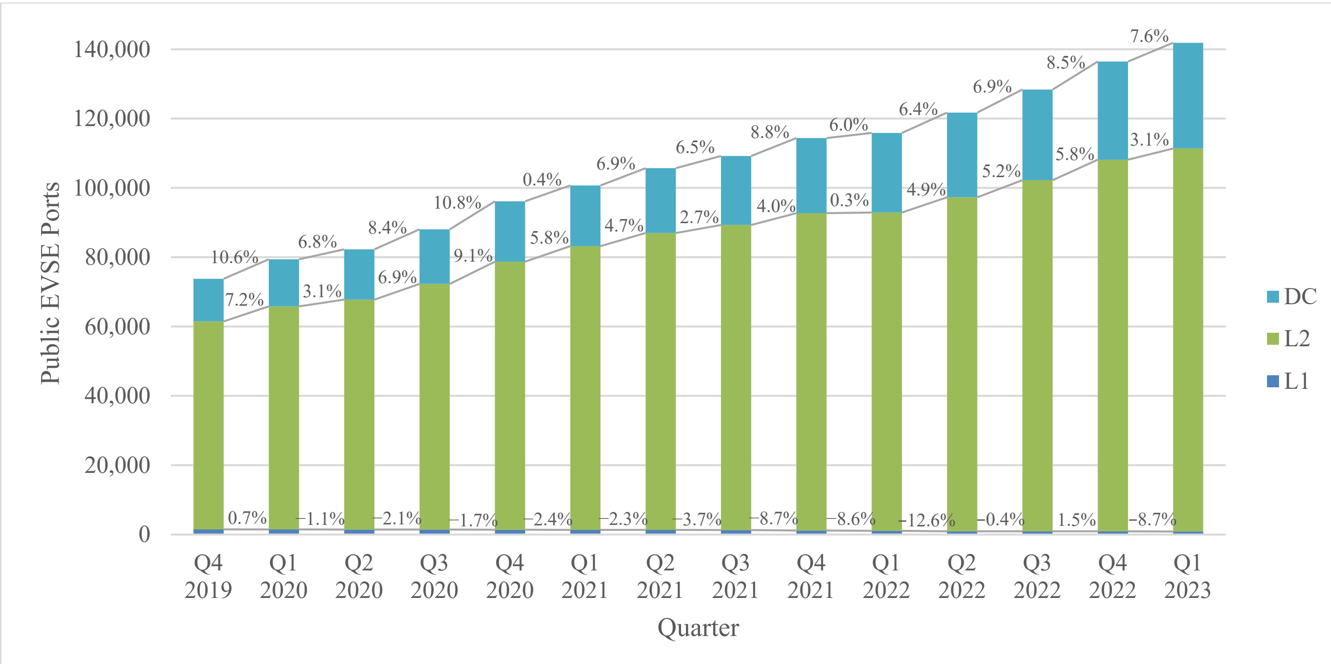

Figure 4. Quarterly growth of public EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q1, there were 30 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 1-2 kW, and Level 2 EVSE ports can operate at up to 19 kW, the power output of DC fast EVSE ports ranges from 24 to 350+ kW. DC fast EVSE ports with power outputs of 50 and 150 kW are common, though the number of DC fast EVSE ports at higher power levels are steadily increasing, as seen in Figure 5.

Of the 30,504 public DC fast EVSE ports in the Station Locator, power output data are currently available for 63.6%; Figure 6 is therefore based on power output data for 19,406 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.

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 Q1 (21.9%). This growth is due to new Tesla Supercharger installations with a power output of 250 kW. The decrease in the number of EVSE ports with a power output between 150 and 249 kW is primarily attributed to Electrify America temporarily reducing the power output of more than 300 of its 150-kW EVSE ports to 50 kW while maintenance or upgrades are being performed. These EVSE ports will be returned to 150 kW once maintenance is complete. These reports represent a snapshot of the available EVSE ports in the Station Locator at the end of each quarter, and because these power adjustments are captured in the Station Locator, the Station Locator team expects to continue to see fluctuations like this.

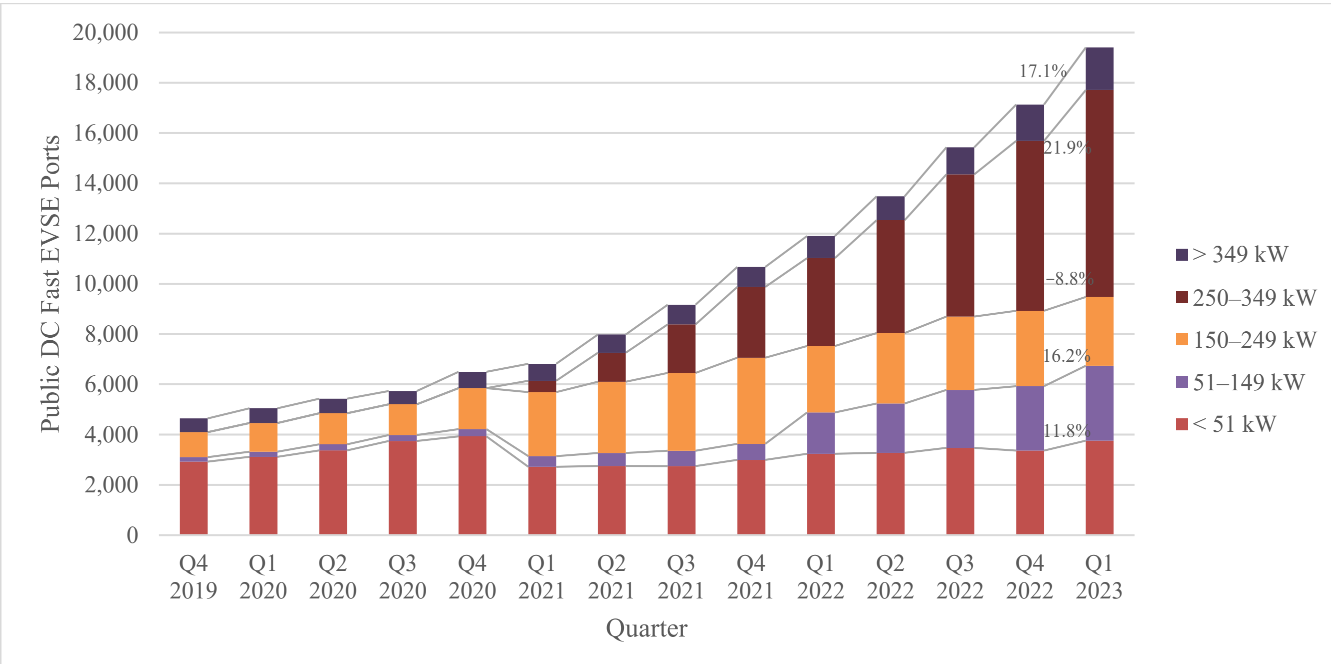

Figure 5. Quarterly growth of public DC fast EVSE ports by power output.

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. Currently, only Tesla vehicles can charge with the Tesla connector. Although Tesla vehicles do not have a CCS nor a CHAdeMO charge port and do not come with a CCS nor a CHAdeMO adapter, Tesla does sell adapters that allow Tesla vehicles to charge at non-Tesla DC fast chargers with a CCS or a CHAdeMO connector. Additionally, as discussed in Section 1.2, Tesla has recently launched the Magic Dock at several Tesla Supercharger stations, which allows non-Tesla vehicles with the CCS standard to charge at Tesla Superchargers.

As of March 31, 2023, approximately 67% of registered all-electric vehicles in the United States were Teslas and therefore compatible with the Tesla connector, 27% were compatible with the CCS connector, and 6% were compatible with the CHAdeMO connector (Experian Information

Solutions 2023b).[10] Of the 36,518 DC fast connectors in the Station Locator as of Q1, Tesla connectors grew by the largest percentage (8.6%), followed by CCS connectors (7.8%) (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 (4.7%) in Q1. 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 19.6% in Q1 2023.

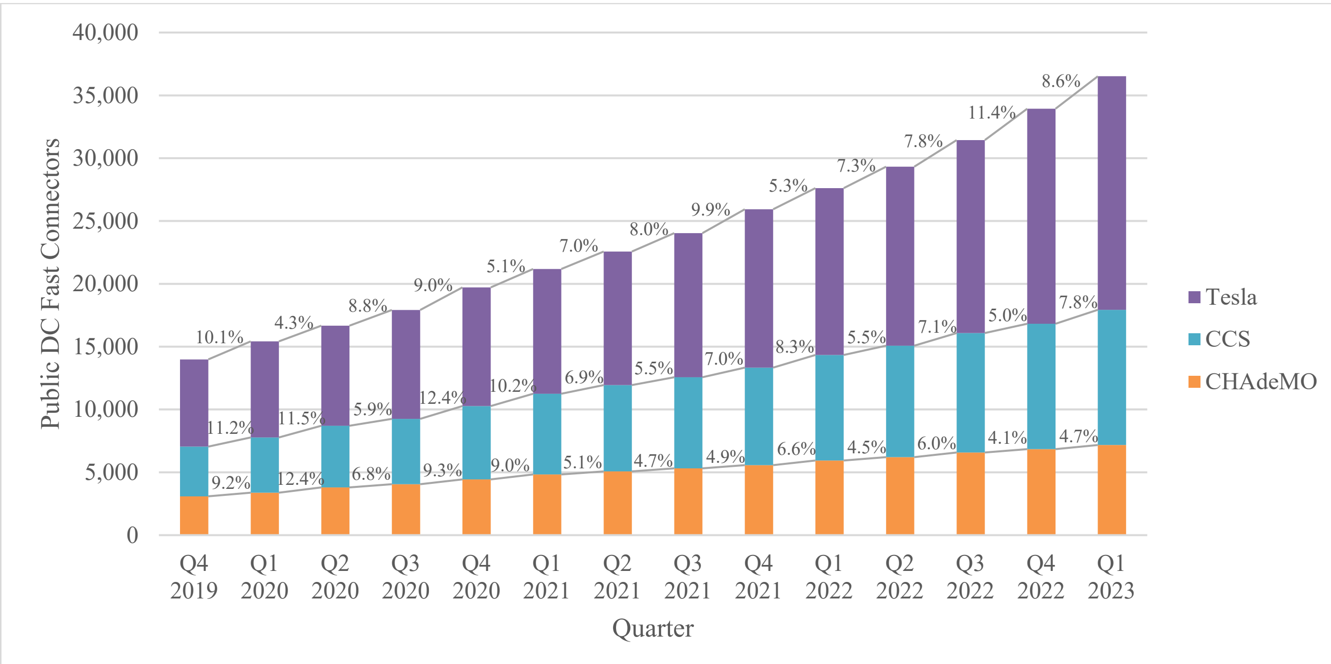

Figure 6. Quarterly growth of public DC fast connectors by type.

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 (41.0%) in the Station Locator in Q1, and Level 2 EVSE ports continued to 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 (60.9%) in Q1, followed by Electrify America (12.0%) and EVgo (8.5%) (Figure 8).

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

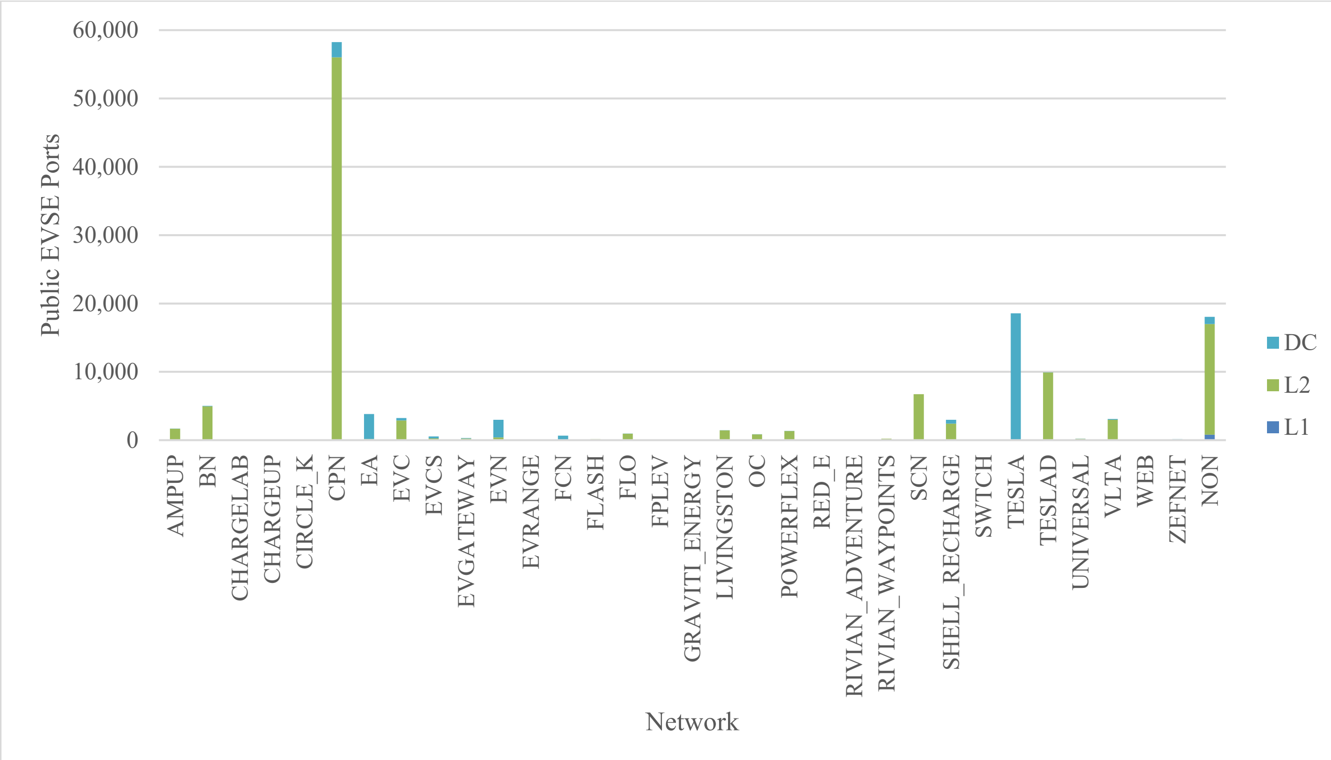

Figure 7. Breakdown of public EVSE ports by network and charging level in Q1 2023

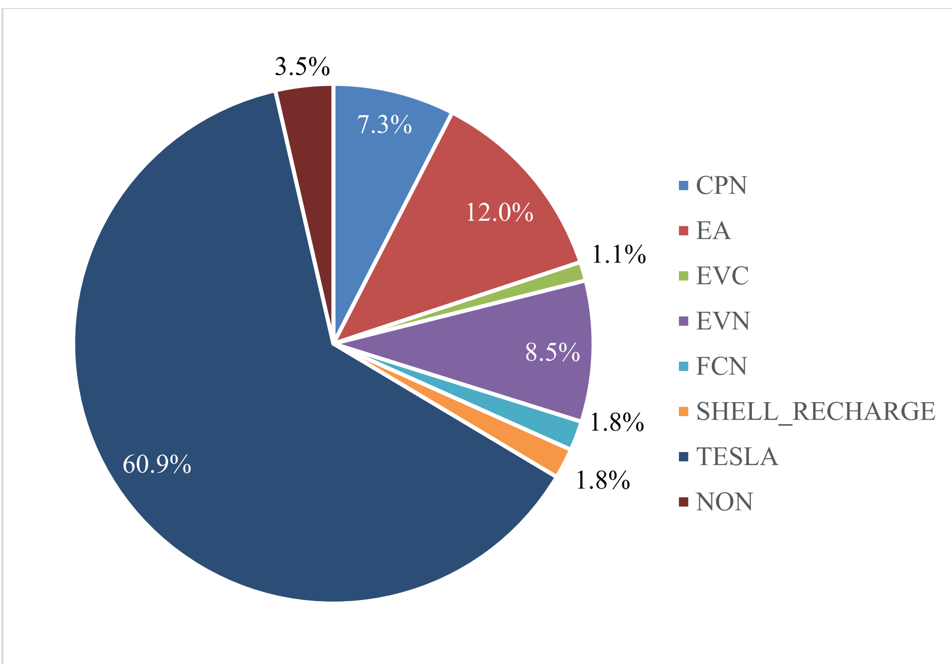

Figure 8. Breakdown of public DC fast EVSE ports by network in Q1 2023.

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 Q1, and Table 2 includes the percent growth of each network over the last four quarters. Similar to Q4 2022, the growth of many networks in Q1

2023 was largely a result of the Station Locator's manual data collection process, as noted in Section 1. For example, this is the reason for the large growth seen on the ZEF Energy network (496.2%). The large growth on the SWTCH Energy network, the network with the second largest growth in Q1 (239.3%), is due to new installations in New York state. Over the past year, SWTCH Energy has partnered with PlugIn Stations Online, an installer and distributor of charging hardware, to install public EVSE ports throughout New York state in areas with limited access. The public charging partnership recently reached a milestone of installing 100 public EVSE ports (SWTCH 2023).

As with Q4, the significant increase of EVSE ports on the Rivian Adventure Network and Rivian Waypoints network, on the other hand, was not a result of the manual data collection process, as Rivian's station data are imported and updated on a nightly basis via an application programming interface (API) (see the end of this section for networks updated via an API). This increase on both networks primarily reflects new installations along the West Coast.

Finally, the number of EVSE ports on the Tesla Destination and Volta networks, as well as the number of non-networked EVSE ports, decreased in Q1. The Tesla Destination decrease was due to the manual update process and the resulting removal of decommissioned stations based on updated data provided by Tesla. This was also the driver in the decrease of public non-networked EVSE ports because many Tesla Destination stations are co-located with non-networked Level 2 stations. Similarly, Volta's API was integrated with the Station Locator in February 2023, resulting in the removal of stations that had been decommissioned since the last manual update that the Station Locator received from Volta.

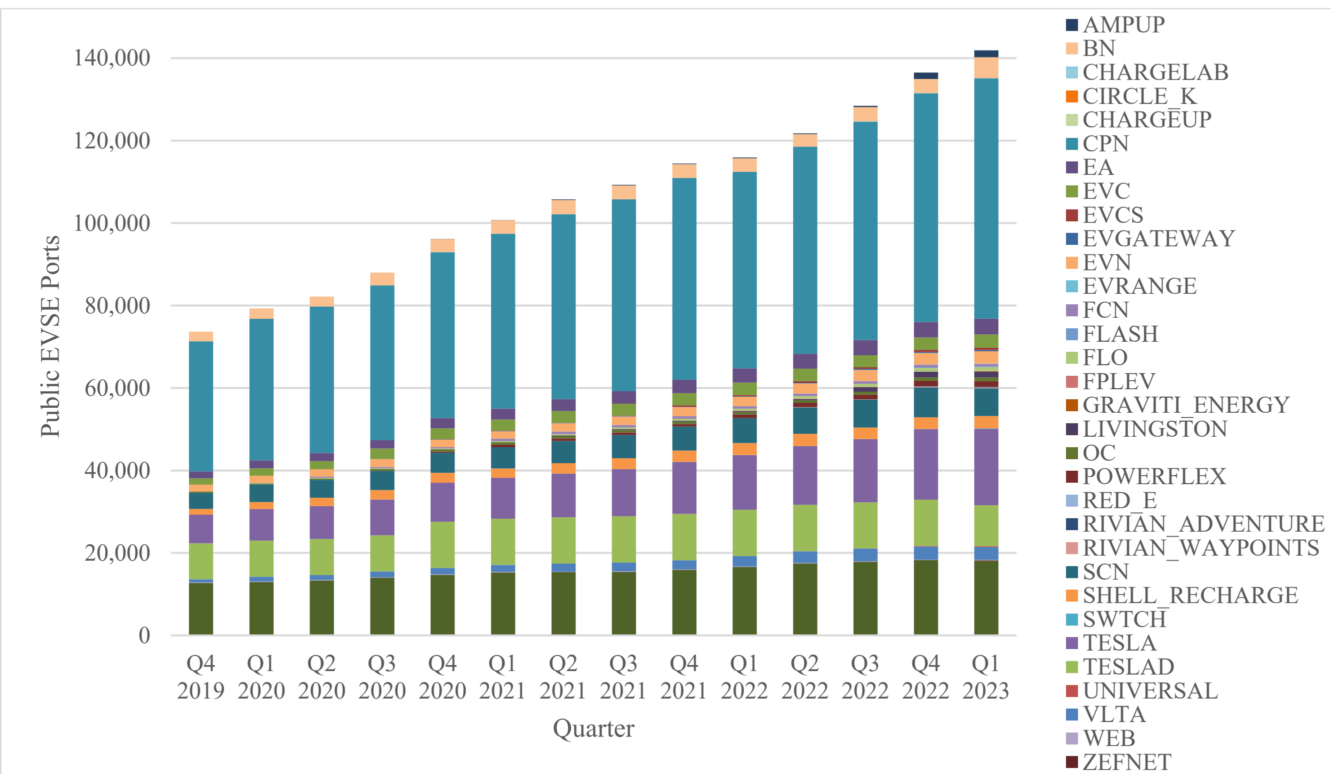

Figure 9. Quarterly growth of public EVSE ports by network

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

Network	Q2 2022 Growth	Q3 2022 Growth	Q4 2022 Growth	Q1 2023 Growth
AMPUP	10.7%	61.9%	387.8%	7.6%
BN	−8.1%	13.2%	−0.8%	47.8%
CHARGELAB	0.0%	1,180.0%	65.6%	15.1%
CHARGEUP	N/A	N/A	N/A	N/A
CIRCLE_K	N/A	N/A	N/A	N/A
CPN	5.4%	5.4%	4.6%	5.1%
EA	4.0%	2.6%	1.7%	1.7%
EVC	0.3%	−2.4%	2.8%	7.4%
EVCS	23.3%	−3.5%	22.7%	11.8%
EVGATEWAY	25.2%	80.5%	11.2%	7.4%
EVN	8.5%	9.1%	4.3%	7.7%
EVRANGE	N/A	N/A	62.5%	25.6%
FCN	0.0%	−1.4%	2.6%	2.7%
FLASH	N/A	N/A	N/A	0.0%
FLO	30.2%	21.2%	8.3%	10.1%
FPLEV	−22.1%	0.0%	0.0%	14.9%
GRAVITI_ENERGY	N/A	N/A	N/A	N/A
LIVINGSTON	47.9%	287.4%	24.0%	6.9%
OC	6.4%	11.5%	18.8%	5.9%
POWERFLEX	17.8%	7.8%	17.9%	0.0%
RED_E	N/A	N/A	N/A	13.8%
RIVIAN_ADVENTURE	N/A	161.5%	50.0%	141.2%
RIVIAN_WAYPOINTS	64.3%	30.4%	160.0%	33.3%
SCN	6.7%	5.7%	7.3%	−7.7%
SHELL_RECHARGE	1.2%	−6.4%	2.1%	5.1%
SWTCH	−13.3%	46.2%	47.4%	239.3%
TESLA	7.4%	7.8%	11.5%	8.6%
TESLAD	0.5%	−1.3%	0.6%	−11.5%
UNIVERSAL	N/A	N/A	208.3%	29.1%
VLTA	11.9%	9.5%	2.7%	−2.1%
WEB	0.0%	0.0%	0.0%	0.0%
ZEFNET	0.0%	85.7%	0.0%	496.2%
NON	5.2%	2.3%	2.3%	−1.0%
Total	**5.1%**	**5.5%**	**6.3%**	**4.0%**

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 32 networks listed below, 14 of which update on a nightly basis via an API (marked with asterisks). ChargeUp, Circle K, and Graviti Energy are new to the Station Locator as of Q1. 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)*
- ChargeUp (CHARGEUP)
- Circle K (CIRCLE_K)
- Electrify America (EA)*
- EV Connect (EVC)*
- EV Charging Solutions (EVCS)
- EvGateway (EVGATEWAY)
- EVgo (EVN)*
- EV Range (EVRANGE)
- FLASH (FLASH)*
- FLO (FLO)*
- FPL EVolution (FPLEV)
- Francis Energy (FCN)
- Graviti Energy (GRAVITI_ENERGY)
- Livingston Energy Group (LIVINGSTON)
- OpConnect (OC)*
- PowerFlex (POWERFLEX)
- Red E Charging (RED_E)
- Rivian Adventure Network (RIVIAN_ADVENTURE)*
- Rivian Waypoints (RIVIAN_WAYPOINTS)*
- SemaConnect (SCN)*
- Shell Recharge (SHELL_RECHARGE)*
- SWTCH Energy (SWTCH)
- Tesla Destination (TESLAD)
- Tesla Supercharger (TESLA)
- 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 (28.6%). However, the South Central region grew by the largest percentage in Q1 (7.9%), primarily as a result of new Level 2 installations on the Blink and ChargePoint networks in Arkansas, Arizona, and Texas, as well as new Level 2 non-networked EVSE ports in Arkansas, Arizona, and New Mexico. New Tesla Supercharger installations in Arizona and Texas also contributed to this growth. DC fast EVSE ports grew at a faster rate than Level 2 EVSE ports in each region in Q1, with the South Central region seeing the largest percentage growth (Table 3).

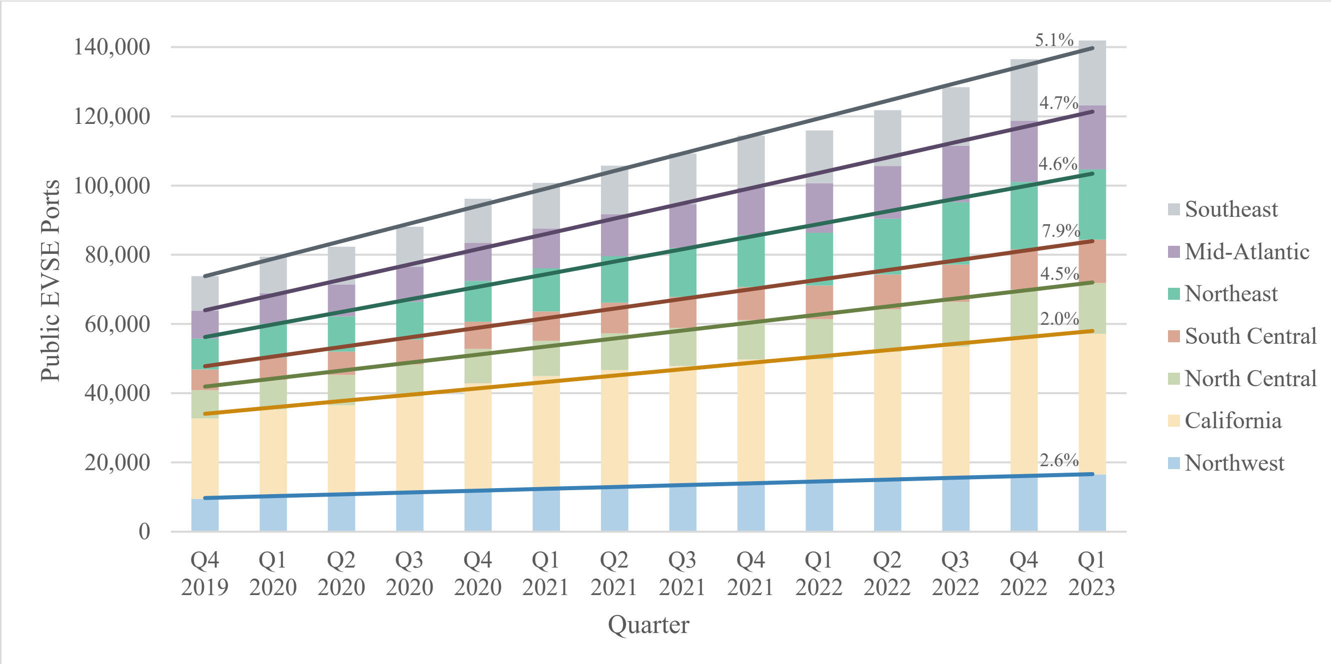

Figure 10. Quarterly growth of public EVSE ports by Clean Cities region.

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 Q1 2023

Clean Cities Region	Level 2 EVSE Port Growth	DC Fast EVSE Port Growth
California	1.3%	4.9%
Mid-Atlantic	4.1%	7.9%
North Central	3.7%	7.2%
Northeast	4.5%	5.9%
Northwest	1.2%	8.7%
Southeast	4.1%	8.9%
South Central	6.0%	14.0%

The regional growth of public EV charging infrastructure was analyzed by dividing the country into the same seven regions used by the Clean Cities Coalition Network (Figure 11) (Clean Cities Coalition Network 2023a). See the Q1 2020 report for more information about the Clean Cities Coalition Network (Brown et al. 2020).

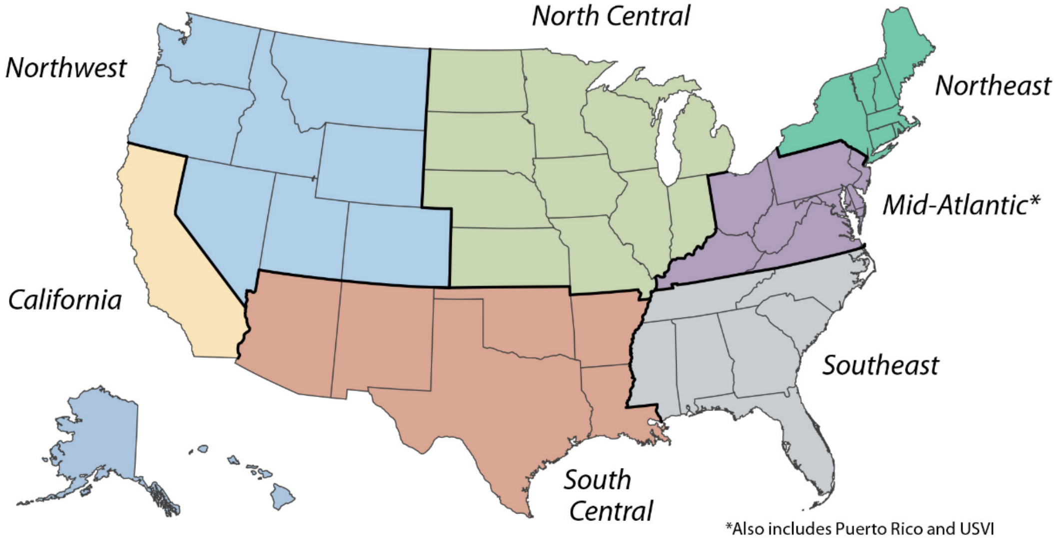

Figure 11. Clean Cities regions.

Source: Clean Cities Coalition Network (2023b)

2.1.4 By State

In Q1, the five states that had the largest percent growth of EVSE ports per 100 EVs were Mississippi, Arkansas, South Dakota, New Mexico, and Louisiana, all of which outpaced the growth in the United States as a whole (Table 4). The growth in both Mississippi and Arkansas is largely due to new Level 2 installations. In both states, these new EVSE ports are primarily non-networked, although roughly one-third are on the Blink and Tesla Destination networks in Arkansas.

Table 4. Top Five States With the Largest Growth of EVSE Ports per 100 EVs in Q1 2023[11]

State	EVSE Ports per 100 EVs in Q4 2022	EVSE Ports per 100 EVs in Q1 2023	Growth of EVSE Ports per 100 EVs in Q1 2023
Mississippi	8.1	9.9	21.5%
Arkansas	8.3	10.1	21.3%
South Dakota	8.7	10.1	16.1%
New Mexico	4.9	5.7	15.4%
Louisiana	5.6	6.4	13.1%

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 this analysis, and the vehicle registration data are based on Experian's registration information as of Dec. 31, 2022 (Experian Information Solutions 2023a).

[11] See Appendix A for the growth of EVSE ports per 100 EVs in all states in Q1.

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 tracts, then rural tracts with the fewest. DC fast EVSE ports showed the largest growth across all density categories compared with Level 2, while Level 1 showed a significant decrease across all density categories. As shown in Figure 12, DC fast EVSE ports grew by the largest percentage in suburban areas (8.3%), followed by urban and rural areas (6.6% each).

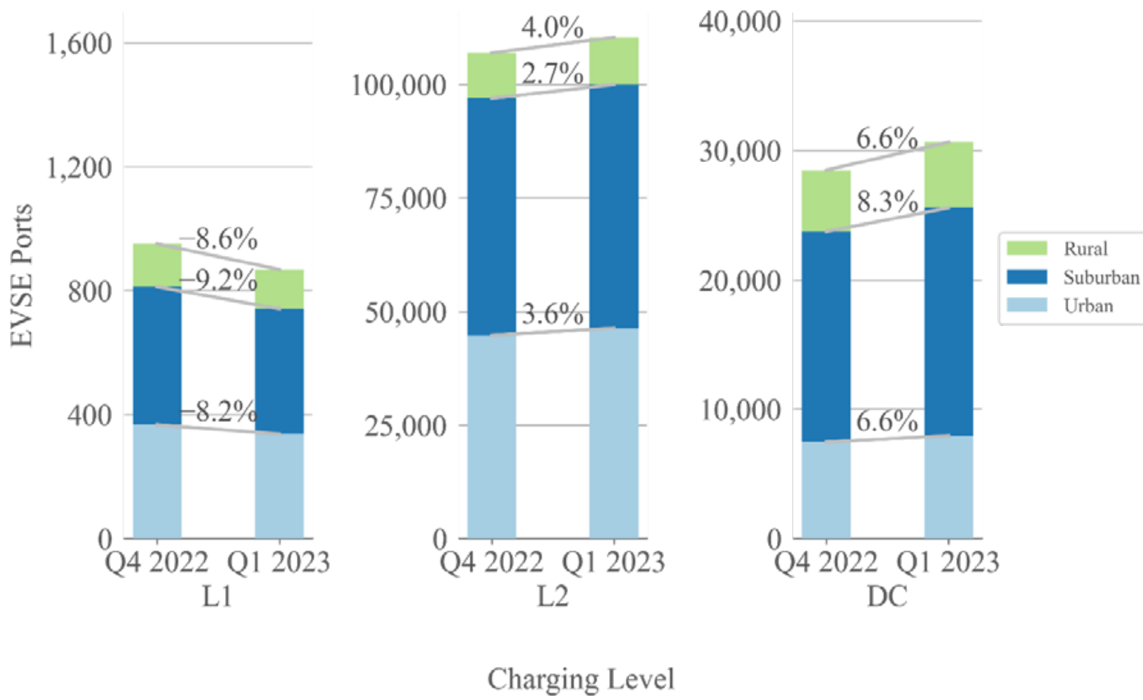

Figure 12. Q1 2023 growth of public EVSE ports by neighborhood type and charging level.

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

Executive Order 14008, issued in early 2021, ensures that the benefits of federal climate investments flow to communities that have been historically underserved and disproportionately burdened by climate change, pollution, and environmental hazards (Argonne National Laboratory 2023). The Justice40 Initiative, which came out of Executive Order 14008, directs

40% of the overall benefits of certain federal investments, including the National Electric Vehicle Infrastructure (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.

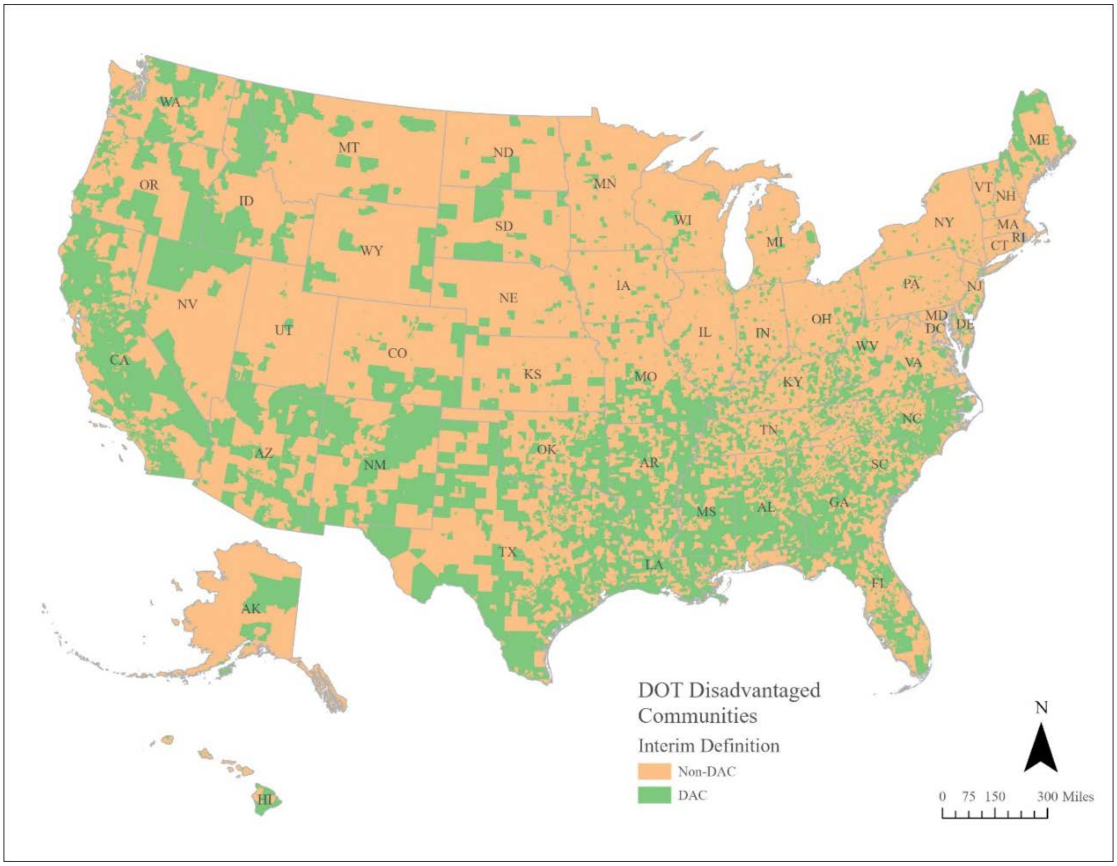

Figure 13. Display of the disadvantaged communities across the United States.

Note: Alaska and Hawaii are not to scale.

Overall, 36.2% of public EVSE ports across all charging levels are in DACs, up from 33.7% from the previous quarter. As shown in Figure 14, The growth of Level 2 and DC fast EVSE in DACs slightly outpaced growth in non-DACs. Although Level 1 EVSE ports decreased overall, there was a much smaller decrease in DACs than non-DACs (Figure 14).

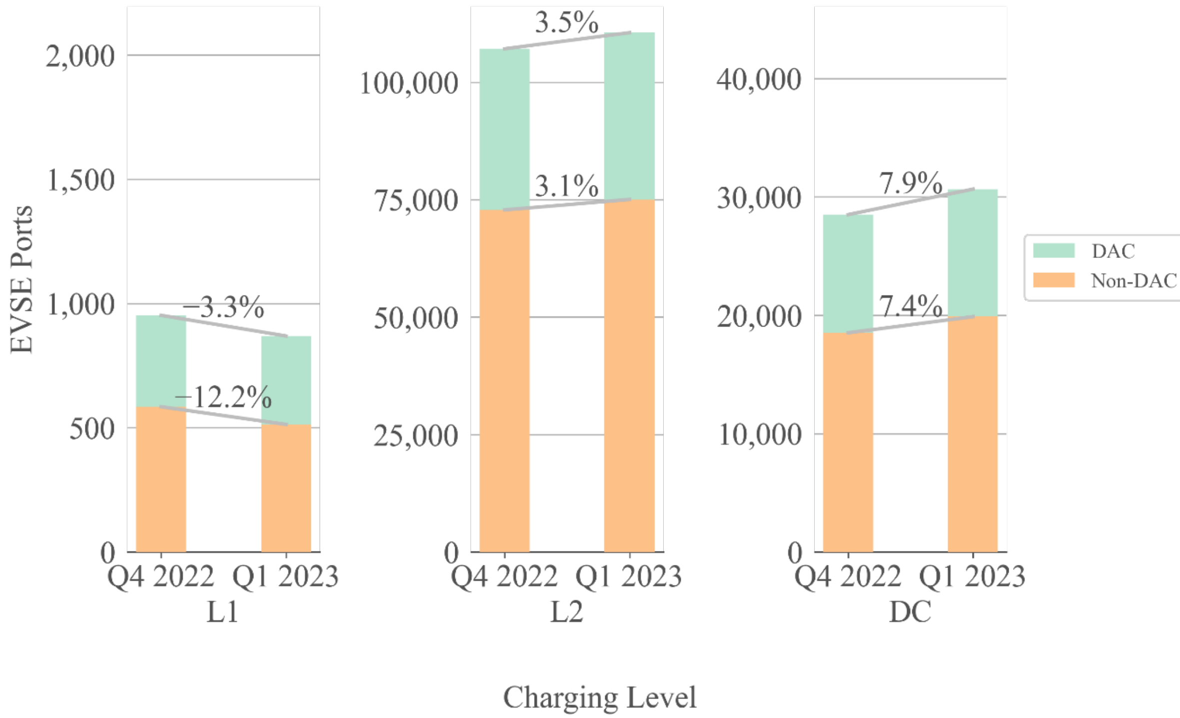

Figure 14. Q1 2023 growth of public EVSE ports by DAC designation and charging level.

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 for the NEVI Formula Grant Program for this section of the analysis. GIS shapefiles with these data are hosted by Argonne National Laboratory (2023). 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 the U.S. Department of Transportation. 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 2023).

2.2 Private Charging Trends

The number of private EVSE ports in the Station Locator declined from 20,002 in Q4 2022 to 19,653 in Q1 2023, representing a decrease of 1.7%. The decline is primarily attributed to the removal of non-networked Level 2 EVSE across Illinois, Massachusetts, and Michigan from the Station Locator. As discussed in Appendix B.2, stations that the Station Locator team are unable to contact are removed from the database as part of the annual unreachable station cleanup process. The decrease in private EVSE in Q1 is attributable to the completion of this process in early January 2023.

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 vast majority of private EVSE ports in the Station Locator are Level 2, representing 87.2% of all private EVSE ports. In Q1, private Level 2 EVSE ports declined by the largest percentage (−1.9%), followed by private Level 1 EVSE ports (−0.5%). Specifically, private Level 2 and Level 1 EVSE ports declined by 336 and 10 ports, respectively. Meanwhile, the percentage of private DC fast EVSE ports remained steady at 325 ports. The overall decline in ports is attributed to completion of the annual unreachable station cleanup process in early January 2023 (Appendix B.2).

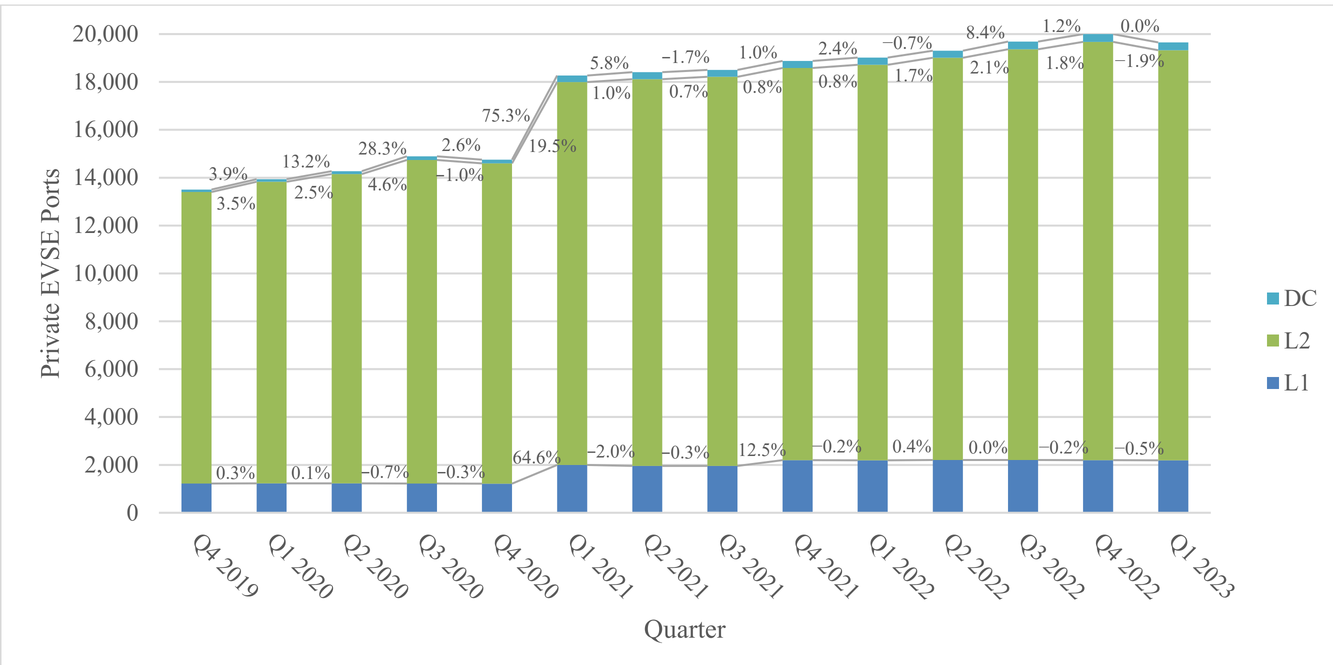

Figure 15. Quarterly growth of private EVSE ports by charging level.

Note: Figure excludes legacy EVSE ports that are not classified by charging level and are no longer manufactured. As of Q1, there were two 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 Q1 2021 is primarily attributed to the addition of federally owned EVSE ports 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. As previously noted, private workplace charging data are likely underrepresented in the Station Locator.

In line with the overall private EVSE port count trends in Q1, there was a decrease of 1.2% in private EVSE ports at workplaces. Overall, the total number of private workplace EVSE ports in the Station Locator at the end of Q1 was 10,116, which is 124 ports fewer than in Q4 (Figure 16). As previously discussed, the decline is associated with the removal of stations due to the annual unreachable station cleanup process. Specifically, the decline is associated with the removal of non-networked and ChargeLab EVSE ports in Illinois, Massachusetts, Michigan, and Washington.

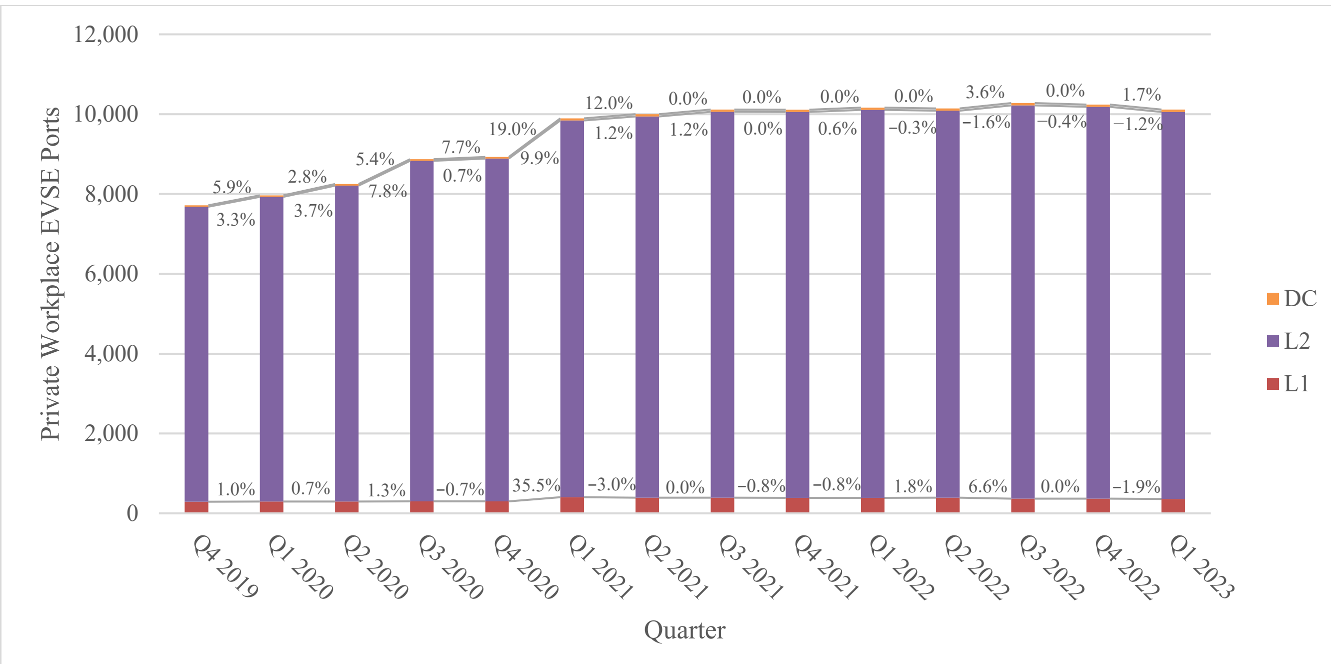

Figure 16. Quarterly growth of private workplace EVSE ports by charging level.

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 Q1, the number of Level 1 multifamily EVSE ports decreased by 21.7% (Figure 17). However, this only represents a decrease of 5 EVSE ports. Overall, the number of multifamily EVSE ports grew by 3.0%, driven by 297 new Level 2 installations, primarily in California, and bringing the total number of multifamily EVSE ports in the Station Locator to 1,543. Overall, EVSE ports at multifamily housing represent 7.8% of private EVSE ports in the Station Locator.

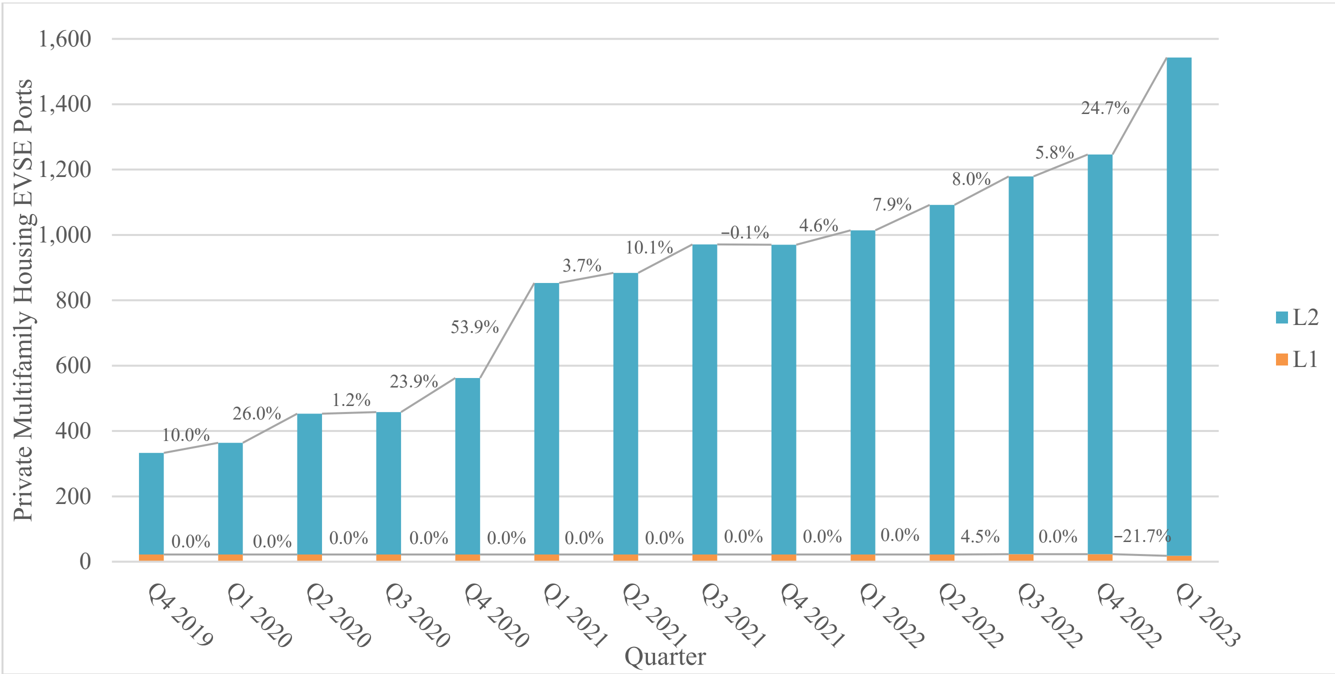

Figure 17. Quarterly growth of private multifamily housing EVSE ports by charging level.

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 Federal Highway Administration weight classes (i.e., light-duty, medium-duty, or heavy-duty vehicles). As of Q1, the team has collected this information for 89.0% of private EVSE ports in the Station Locator, of which 39.6% 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 Q1 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 light-duty vehicles, such as sedans, SUVs, and pickup trucks; unsurprisingly, the majority of fleet-charging EVSE ports are used to charge light-duty vehicles (Figure 18). Additionally, the majority of fleet-charging EVSE ports are Level 2 (Figure 18).

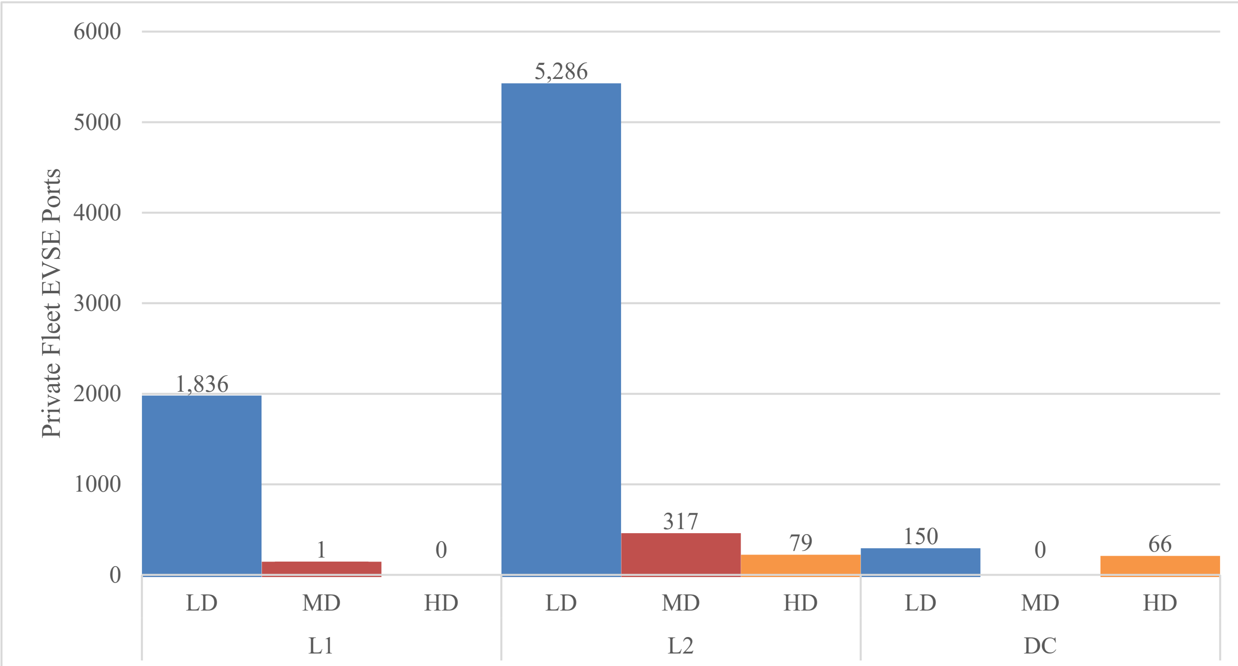

Figure 18. Breakdown of private fleet EVSE ports by charging level and fleet type in Q1 2023.

Note: LD = light-duty, MD = medium-duty, and HD = heavy-duty

The Station Locator team continues to expand its private fleet data collection efforts, especially for fleets that are installing charging infrastructure for medium- and heavy-duty vehicles such as school bus fleets and public transit fleets. Additionally, the Station Locator team is tracking the development of medium- and heavy-duty 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

A new year calls for new major developments that will impact charging infrastructure for years to come. First, the U.S. Department of Transportation launched the Charging and Fueling Infrastructure (CFI) Discretionary Grant Program, which will make $2.5 billion available over 5 years to a variety of applicants, including local and tribal governments (Federal Highway Administration 2023a). The funding will be used to install EV charging and alternative vehicle fueling infrastructure in communities via Community Charging and Fueling Grants and along designated Alternative Fuel Corridors via Alternative Fuel Corridor Grants. The CFI Discretionary Grant Program builds upon the NEVI Formula Grant Program, both of which were established by the Bipartisan Infrastructure Law, to expand public charging infrastructure across the country.

Second, the final rule outlining the minimum standards and requirements for federally funded EV charging infrastructure projects, including projects funded by the CFI Discretionary Grant Program and the NEVI Formula Grant Program, was published in Q1. The final rule establishes standards in six areas, including installation, operation, and maintenance; interoperability; traffic control devices and on-premise signs; data reporting requirements; network connectivity; and data sharing (Federal Highway Administration 2023b). These standards seek to improve access to and reliability of federally funded charging infrastructure while also facilitating data sharing. The Station Locator will include these stations once deployment begins, and future reports will track the growth of stations funded by both programs.

At the state level, new legislation was introduced by several states to support the electrification of medium- and heavy-duty vehicles. For example, Maryland introduced House Bill 230, which would require the Maryland Department of the Environment to adopt rules that would establish requirements for the sale of new zero-emission medium- and heavy-duty vehicles by Dec. 1, 2023. Maryland governor Wes Moore also approved an incentive program aimed at transitioning business' medium- and heavy-duty fleets to electric by offering grants that cover 100% of the cost differential between gas-powered and electric vehicles. Additionally, Washington introduced House Bill 1368, which requires school districts to purchase zero-emission school buses beginning in 2035 and establishes a zero-emission school bus grant program (Khatib 2023).

The U.S. Postal Service (USPS) continued to make progress toward electrifying its delivery fleet in Q1. They awarded a contract for 9,250 Ford E-Transit vans, which are expected to be delivered by the end of 2023 (USPS 2023). USPS also awarded a contract to Blink Charging to provide up to 41,500 EV charging units to support its fleet (Blink Charging 2023). Blink will provide its dual-port charger that can deliver a 19.2-kW charge to two vehicles simultaneously.

On the private sector side, companies are continuing to invest in clean transportation and make electrification commitments. First, numerous electric fleet expansion efforts are underway. Uber is committing to reach 400 million EV miles driven on its platform in the United States by the end of 2023 (The White House 2023b). Uber will be helping drivers transition to EVs by distributing resources and establishing partnerships with automakers, rental companies, and charging companies. Highland Electric Fleets is committing to help 1,000 school districts across North America, including those in historically underserved communities, improve student and community health by electrifying their school bus fleet by 2030. In the community charging realm, itselectric has committed to install 100 curbside Level 2 chargers across the United States by the end of 2023, and Smart Charge America committed to installing more than 140,000 Level 2 chargers by 2030. Lastly, Qmerit has committed to help 100 companies electrify their fleets through home and workplace charging installations and to help 500 companies deploy EV charging for employees and customers by the end of 2023. Through private sector investments, the Station Locator team expects to see an increased mix of public and private Level 2 and DC fast charging stations in the next year.

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's counting logic aligns 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 Q1, all manually collected data, as well as EVSE ports on the Blink, ChargePoint, Electrify America, EV Connect, EVgo, SemaConnect, Shell Recharge, OpConnect, Rivian, and Volta networks, are counted according to the OCPI logic. Additionally, NREL is continuously working with EVSPs to add new APIs to the Station Locator to help keep the Station Locator as up to date as possible. 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 Bipartisan Infrastructure Law 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, as well as the growth of private EV charging by charging level and use type (i.e., workplace, multifamily housing, and fleet) in Q1 2023. 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.

Overall, there was a 3.2% increase in the number of EVSE ports in the Station Locator in Q1. Although public Level 2 EVSE ports grew by the largest number (3,322) in Q1 and continue to make up the largest share (77.9%) of EVSE ports in the Station Locator, public DC fast EVSE ports grew at the fastest rate (7.6%). California continues to lead the country in terms of the total number of public EVSE ports available (40,610), though public charging infrastructure grew by the largest percentage in the South Central region in Q1 (7.9%).

Based on NREL's report *The 2030 National Charging Network*, which estimates the number of public EVSE ports required to support a scenario in which there are 33 million EVs on the road by 2030, the number of DC fast and Level 2 EVSE ports is 7.0% and 10.4%, respectively, of the way toward meeting projected 2030 requirements. However, it is important to note that 60.9% of public DC fast EVSE ports and 9.0% of public Level 2 EVSE ports in the Station Locator are on the Tesla Supercharger and Destination networks, respectively, and are therefore only readily accessible to Tesla vehicles. When public Tesla-only EVSE ports are excluded, the number of DC fast and Level 2 EVSE ports currently installed decreases to 4,421 (2.4%) and 100,580 (9.4%), respectively (Figure 2).

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). 2023a. "About the Alternative Fuels Data Center." Accessed April 25, 2023. https://afdc.energy.gov/about.html.

———. 2023b. "Alternative Fueling Station Locator." Accessed April 25, 2023. https://afdc.energy.gov/stations/#/find/nearest.

———. 2023c. "Data Included in the Alternative Fueling Station Data." Accessed April 25, 2023. https://afdc.energy.gov/data_download/alt_fuel_stations_format.

———. 2023d. "Developing Infrastructure to Charge Plug-In Electric Vehicles." Accessed April 25, 2023. https://afdc.energy.gov/fuels/electricity_infrastructure.html.

Argonne National Laboratory. 2023. "Electric Vehicle Charging Equity Considerations." Accessed April 25, 2023. https://www.anl.gov/esia/electric-vehicle-charging-equity-considerations.

Blink Charging. 2023. "Blink Charging Announces Contract with United States Postal Service to Provide EV Charging Stations and Network Services for Growing EV Fleet." Press release, March 16, 2023. https://blinkcharging.com/news/blink-charging-announces-contract-with-united-states-postal-service-to-provide-ev-charging-stations-and-network-services-for-growing-ev-fleet/.

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.

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. 2023a. "About Clean Cities." Accessed April 25, 2023. https://cleancities.energy.gov/about/.

———. 2023b. "Technology Integration Program Contacts." Accessed April 25, 2023. 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.

Executive Office of the President. 2021. "Executive Order 14037: Strengthening American Leadership in Clean Cars and Trucks." *Federal Register* 86 FR 43583, Aug. 5, 2021. https://www.federalregister.gov/documents/2021/08/10/2021-17121/strengthening-american-leadership-in-clean-cars-and-trucks.

Experian Information Solutions. 2023a. *Derived 2022 annual registration counts by the National Renewable Energy Laboratory.* Golden, Colorado: National Renewable Energy Laboratory.

Experian Information Solutions. 2023b. *Derived Q1 2023 registration counts by the National Renewable Energy Laboratory.* Golden, Colorado: National Renewable Energy Laboratory.

Federal Highway Administration. 2023a. "Biden-Harris Administration Opens Applications for First Round of $2.5 Billion Program to Build EV Charging in Communities & Neighborhoods Nationwide." Press release, March 14, 2023. https://highways.dot.gov/newsroom/biden-harris-administration-opens-applications-first-round-25-billion-program-build-ev.

Federal Highway Administration. 2023b. "National Electric Vehicle Infrastructure Standards and Requirements." *Federal Register* 88 FR 12724, March 30, 2023. https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements.

Khatib, Moe. 2023. "New Year, New EV Legislation." *EV Hub Weekly Digest*, Feb. 6, 2023. https://www.atlasevhub.com/weekly-digest/new-year-new-ev-legislation/.

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*.

SWTCH. 2023. "SWTCH Energy and PlugIn Stations Online Announce Installation of 100 EV charging Ports Throughout New York State." Media release, April 6, 2023. https://swtchenergy.com/swtch-energy-and-plugin-stations-online-announce-installation-of-100-ev-charging-ports-throughout-new-york-state/.

The White House. 2023a. "FACT SHEET: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicle Chargers." https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/.

The White House. 2023b. "FACT SHEET: Biden-Haris Administration Announces New Private and Public Sector Investments for Affordable Electric Vehicles." https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/17/fact-sheet-biden-harris-administration-announces-new-private-and-public-sector-investments-for-affordable-electric-vehicles/.

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. 2023. "Justice40 Initiative." Accessed April 25, 2023. https://www.transportation.gov/equity-Justice40.

U.S. Postal Service. 2023. "USPS Moves Forward with Awards to Modernize and Electrify the Nation's Largest Federal Fleet." USPS News, Feb. 28, 2023. https://about.usps.com/newsroom/national-releases/2023/0228-usps-moves-forward-with-awards-to-modernize-and-electrify-nations-largest-federal-fleet.htm.

Wood, Eric, Brennan Borlaug, Matt Moniot, Dong-Yeon (D-Y) Lee, Yanbo Ge, Fan Yang, and Zhaocai Liu. 2023. *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure.* Golden, CO: National Renewable Energy Laboratory. NREL/ TP-5400-85654. https://www.nrel.gov/docs/fy23osti/85654.pdf.

Appendix A. EVSE Ports Growth by State

Table A-1. Q1 2023 Growth of Public EVSE Ports per 100 EVs by State

State	EVSE Ports per 100 EVs in Q4 2022	EVSE Ports per 100 EVs in Q1 2023	Growth of EVSE Ports per 100 EVs in Q1 2023
AK	4.5	4.5	0.0%
AL	5.8	6.0	5.2%
AR	8.3	10.1	21.3%
AZ	3.3	3.7	10.3%
CA	3.4	3.5	2.0%
CO	5.6	5.7	1.7%
CT	4.6	4.8	4.7%
DC	10.5	10.7	2.2%
DE	5.0	5.1	0.6%
FL	3.8	3.9	4.5%
GA	6.0	6.2	2.5%
HI	3.7	3.7	−1.5%
IA	6.6	6.8	4.2%
ID	3.3	3.6	6.9%
IL	3.8	3.8	−0.8%
IN	4.1	4.4	6.5%
KS	9.3	9.7	4.3%
KY	5.4	5.7	6.3%
LA	5.6	6.4	13.1%
MA	7.9	8.1	3.5%
MD	5.9	6.2	4.2%
ME	8.3	8.6	3.3%
MI	4.9	5.1	4.7%
MN	4.5	4.9	8.4%
MO	8.8	9.5	8.1%
MS	8.1	9.9	21.5%
MT	5.5	5.7	4.4%
NC	5.0	5.3	5.3%
ND	15.4	16.7	8.2%
NE	6.6	6.9	4.0%
NH	4.0	4.1	2.1%
NJ	2.5	2.8	10.0%

State	EVSE Ports per 100 EVs in Q4 2022	EVSE Ports per 100 EVs in Q1 2023	Growth of EVSE Ports per 100 EVs in Q1 2023
NM	4.9	5.7	15.4%
NV	4.5	4.3	−4.9%
NY	7.0	7.4	5.9%
OH	5.8	6.1	5.0%
OK	4.1	4.2	2.7%
OR	3.6	4.0	10.9%
PA	4.9	5.2	4.8%
RI	10.1	10.4	3.4%
SC	5.3	5.8	10.8%
SD	8.7	10.1	16.1%
TN	5.3	5.7	8.3%
TX	3.8	4.0	5.7%
UT	5.4	5.4	0.0%
VA	4.7	4.7	2.0%
VT	10.3	10.3	0.4%
WA	3.5	3.6	3.2%
WI	4.5	4.7	2.4%
WV	11.6	11.9	2.6%
WY	15.2	16.4	7.4%

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 dedicated 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, including the integration of OCPI-based APIs. In Q1, Volta's OCPI-based API was integrated into the Station Locator. See Section 1.1 for more information on the OCPI protocol.

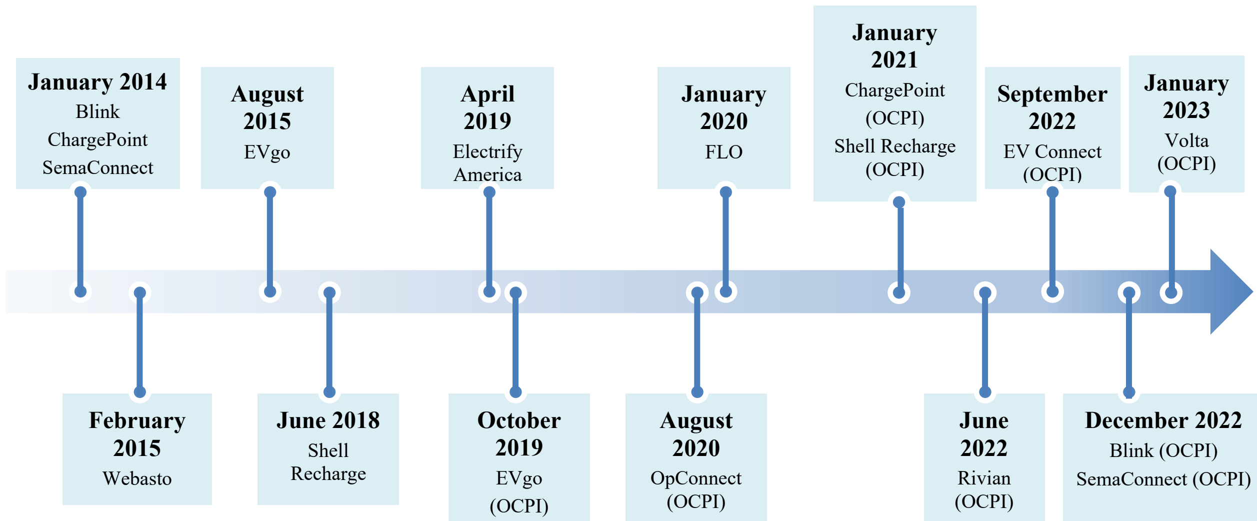

Figure B-2. Timeline of API integrations in the Station Locator

As of the end of Q1, there were 58,925 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 (AFDC 2023b). Of those, approximately 73% 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. In Q1, the Station Locator team received an updated list of stations from Tesla. 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.