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

Abby Brown,[1] Jeff Cappellucci,[1] 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

7CHARGE	7Charge network
AFDC	Alternative Fuels Data Center
AMPED_UP	AmpedUp! Networks
AMPUP	AmpUp network
BN	Blink network
CCS	Combined Charging System; a connector type for DC fast charging
CHAdeMO	connector type for DC fast charging
CHARGELAB	ChargeLab network
CHARGEUP	ChargeUp network
CHARGIE	Chargie 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
ENVIROSPARK	EnviroSpark 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
EVMATCH	EVmatch network
EVN	EVgo network
EVRANGE	EV Range network
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	connector type for Level 1 and Level 2 charging
J3400	connector type for Tesla vehicles, also known as the North American Charging Standard
JULE	Jule network
L1	Level 1
L2	Level 2
LIVINGSTON	Livingston Energy Group network
LOOP	Loop network
NACS	North American Charging Standard
NEVI	National Electric Vehicle Infrastructure
NON	non-networked
NOODOE	Noodoe network
NREL	National Renewable Energy Laboratory

OC	OpConnect network
OCPI	Open Charge Point Interface
POWER_NODE	Electric Era network
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
REVEL	Revel network
RIVIAN_ADVENTURE	Rivian Adventure Network
RIVIAN_WAYPOINTS	Rivian Waypoints network
SHELL_RECHARGE	Shell Recharge network
STAY_N_CHARGE	Stay-N-Charge network
SWTCH	SWTCH Energy network
TESLA	Tesla Supercharger network
TESLAD	Tesla Destination network
UNIVERSAL	Universal EV Chargers network
VLTA	Volta 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 2024b), this report provides a snapshot of the state of EV charging infrastructure in the United States in the fourth calendar quarter of 2023 (Q4 2023) by charging level, network, location, housing density, and disadvantaged community designation. Additionally, this report measures the current state of charging infrastructure compared to the infrastructure requirement scenario outlined in the National Renewable Energy Laboratory's (NREL's) report, *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure* (Wood et al. 2023). 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 sixteenth report in a series. Reports from previous quarters can be found in the Alternative Fuels Data Center (AFDC) and NREL publication databases, as well as the AFDC Charging Infrastructure Trends page (afdc.energy.gov/fuels/electricity_infrastructure_trends.html).

In Q4 2023, the number of EV charging ports in the Station Locator grew by 5.0%, or 9,046 EV charging ports, bringing the total number of ports to 190,072. Public EV charging ports account for most of the ports in the Station Locator, experiencing a growth of 5.2% in Q4 (Figure ES-1). Concurrently, private EV charging ports increased by 3.5%, amounting to the addition of 731 ports. Notably, the Southeast region witnessed the most substantial growth in public charging infrastructure during Q4, with a 7.8% increase in EV charging ports. While California leads the nation in the number of public EV charging ports—home to more than a quarter (27.0%) of all public ports in the Station Locator—it witnessed the slowest growth across regions in Q4 (3.5%).

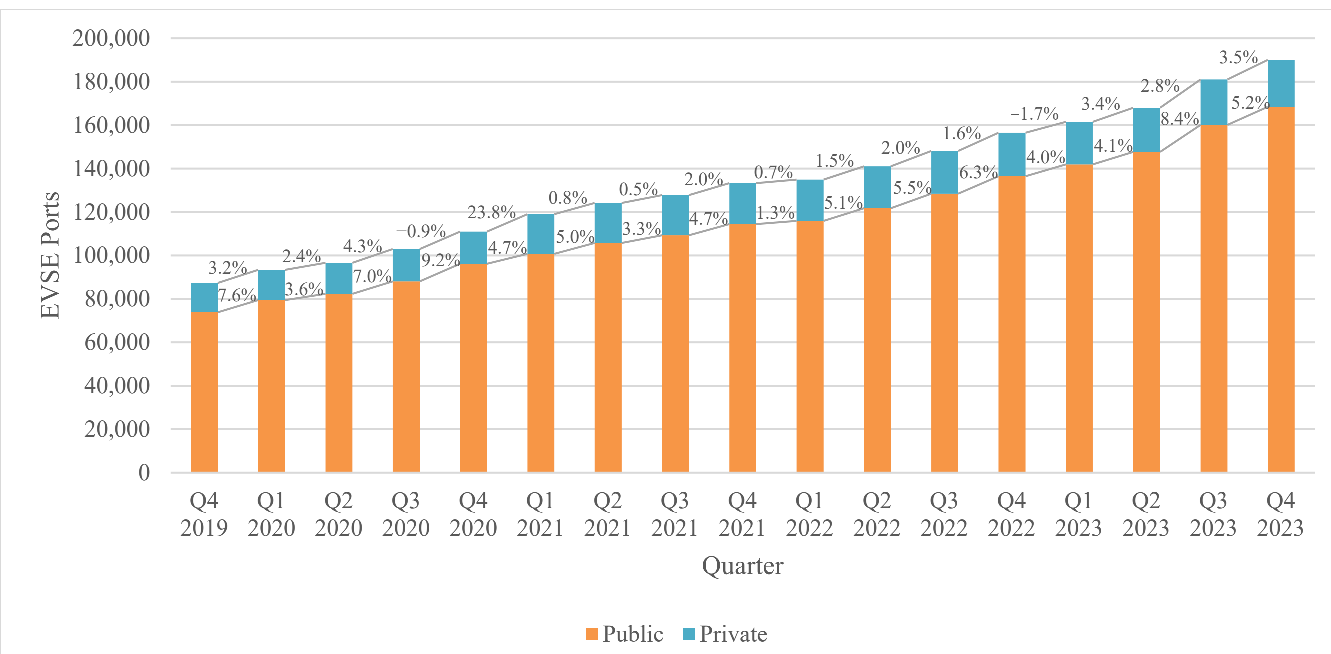

Figure ES-1. Quarterly growth of EV charging ports by access.

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

Among the public EV charging ports, direct-current (DC) fast EV charging ports grew by the largest percentage in Q4 (9.2%), representing the addition of 3,210 EV charging ports. The expansion of DC fast EV charging ports in the Station Locator is primarily driven by new station additions in California, Oklahoma, Texas, and Georgia. Meanwhile, Level 2 (L2) EV charging ports grew by 4.3%, or 5,276 ports, primarily due to installations across California, Massachusetts, Florida, and North Carolina. In contrast, Level 1 (L1) EV charging ports decreased by 171 ports, or 17.4% (Figure ES-2). As discussed in Appendix B.2, stations that the Station Locator team are unable to contact to validate operation are removed from the database as part of the annual unreachable station cleanup process.

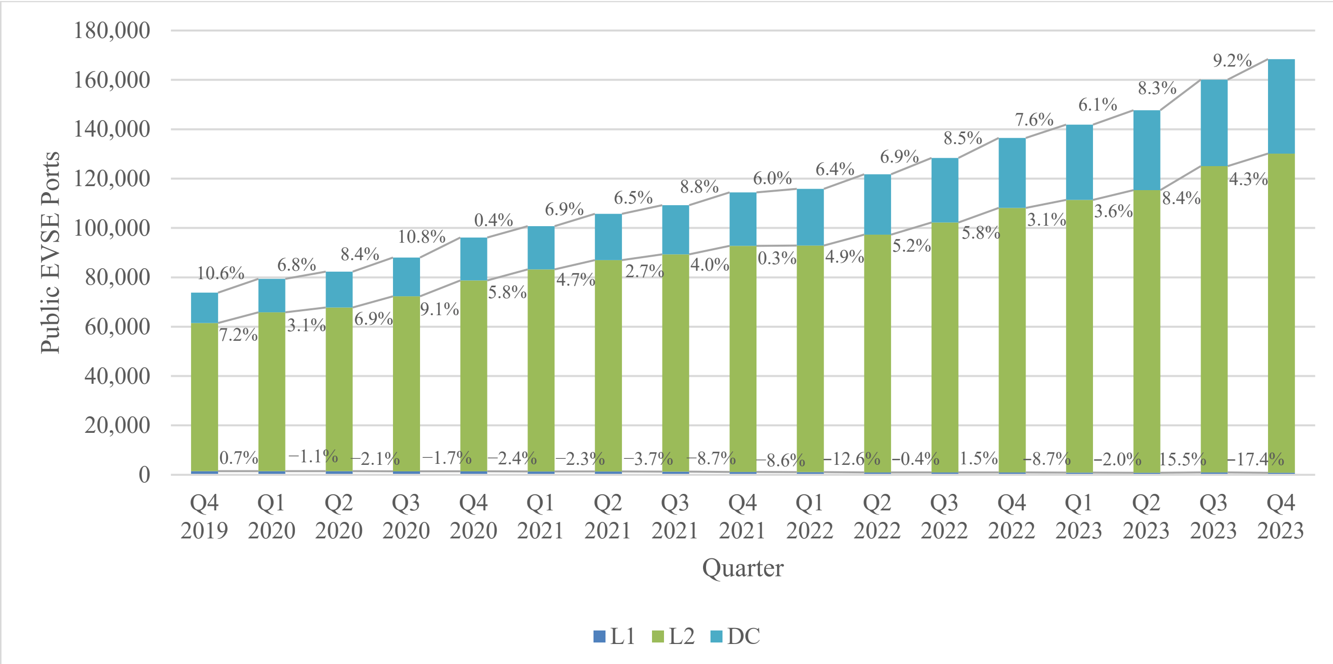

Figure ES-2. Quarterly growth of public EV charging ports by charging level.

Note: Figure excludes legacy EV charging ports that are not classified by charging level and are no longer manufactured. As of Q4, there were 26 public legacy EV charging ports in the Station Locator. Additionally, the percentages in this figure indicate the percent growth between each quarter.

DC fast EV charging ports have the highest power output among the charging levels, allowing them to charge EVs in the least amount of time. As supported by NREL's research, it is essential to deploy a dependable network of public DC fast chargers to increase consumer acceptance of EVs in the United States (Wood et al. 2023). Given the importance of DC fast port availability on consumer adoption, it is important to highlight the trends in the proliferation of these ports in the Station Locator. By way of background, the power output of DC fast EV charging ports spans from 24 to 350 kW. While DC fast EV charging ports with power outputs of 50 kW and 150 kW are the most common, the number of DC fast EV charging ports at higher power levels is steadily increasing (Figure ES-3).

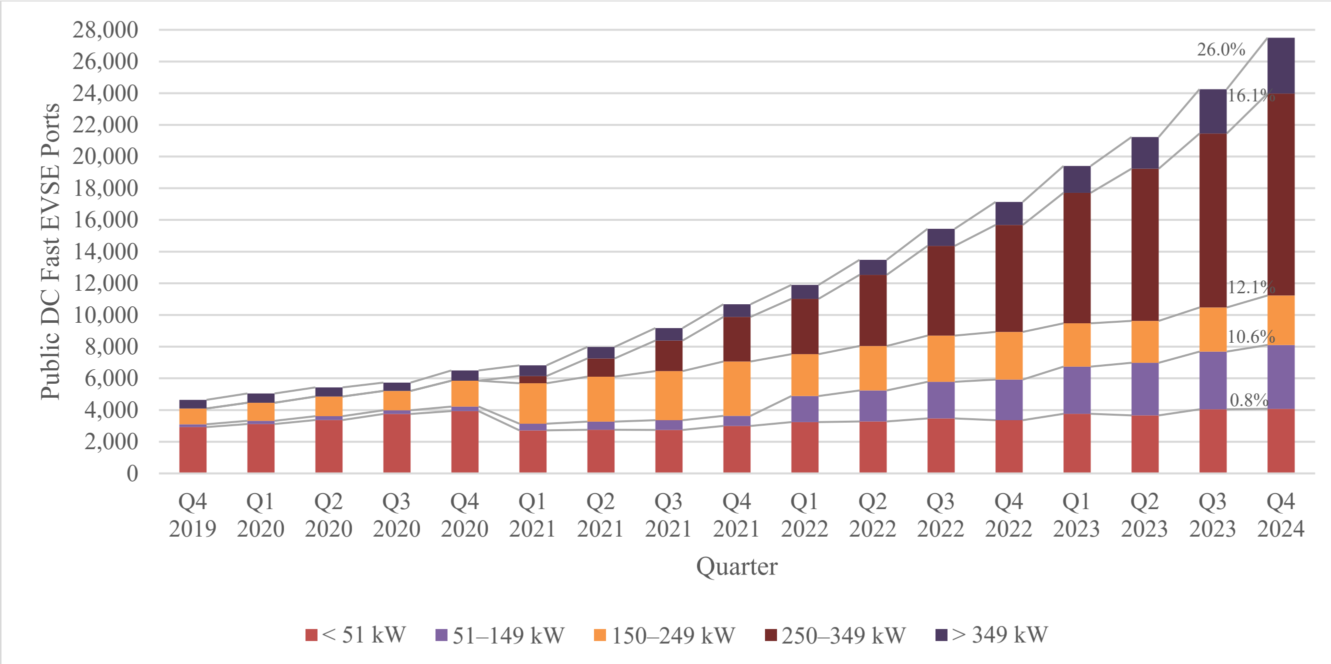

Figure ES-3. Quarterly growth of public DC fast EV charging ports by power output.

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).

Further, *The 2030 National Charging Network* report estimates that the United States would need 182,000 DC fast EV charging ports with a power output at or above 150 kW and 1,067,000 L2 public EV charging ports to support a baseline scenario of 33 million EVs on the road by 2030 (Wood et al. 2023). Based on data from the Station Locator, 10.7% of the estimated DC fast EV charging ports and 12.1% of the estimated Level 2 EV charging ports are currently available to meet such charging needs. However, it is important to note that 61.2% of public DC fast EV charging ports and 7.8% of public Level 2 EV charging ports in the Station Locator are on the Tesla Supercharger and Destination networks, respectively, and are therefore currently only readily accessible (i.e., without an adapter) to Tesla vehicles. When public EV charging ports on these networks are excluded, the number of DC fast and Level 2 EV charging ports currently installed to meet the charging needs of 33 million EVs on the road by 2030 decreases to 6,630 (3.6%) and 119,275 (11.2%), 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) EV charging ports in the Station Locator at the end of each quarter. Notable changes may be attributed to the Station Locator team's manual data collection process, as new manually added EV charging ports are counted in the quarter 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.

Table of Contents

List of Figures

List of Tables

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 2024a). 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 dataset 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, propane stations, and renewable diesel.

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 EV charging ports by 2030 and the newly available funds from the Bipartisan Infrastructure Law and Inflation Reduction Act to support this target. Using Station Locator data, this report explores the growth of both public and private EV charging infrastructure in the United States for the fourth calendar quarter of 2023 (Q4 2023). This is the sixteenth 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 (afdc.energy.gov/fuels/electricity_infrastructure_trends.html).

It is important to state that 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) EV charging 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 EV charging 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, EV charging ports, and connectors (EVRoaming Foundation 2020), as shown in Figure 1 and described below. Therefore, the Station Locator counts the number of EV charging ports at each station location.

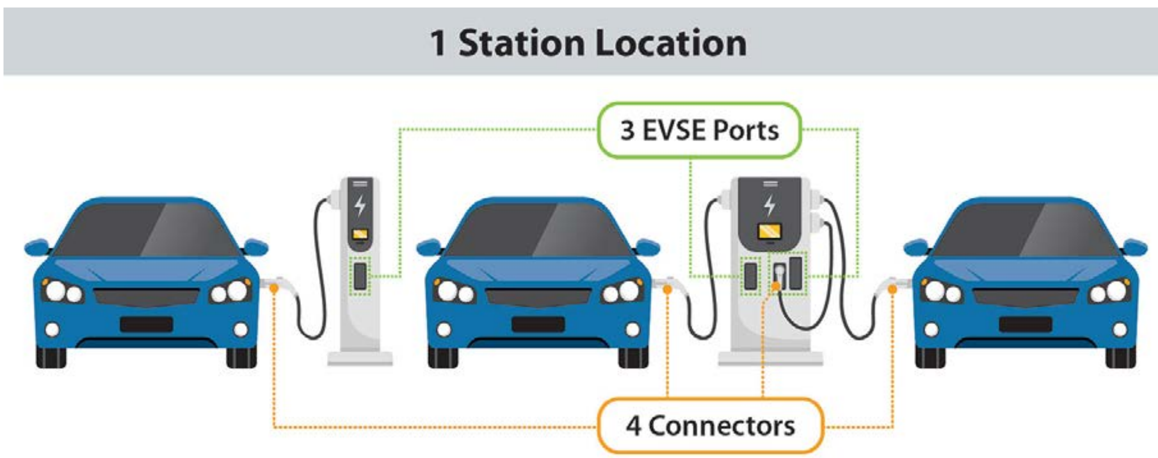

Figure 1. EV charging infrastructure hierarchy.

Source: AFDC (2024d)

The following fuel-specific fields are tracked in the Station Locator for EV charging stations (AFDC 2024c):

- EV charging information:
    - Station location: A site with one or more EV charging ports located at the same address.
    - EV charging port count: The number of outlets or ports available to simultaneously charge vehicles. An EV charging port provides power to charge only one vehicle at a time even though it may have multiple connectors. The unit that houses EV charging ports is sometimes called a charging post, which can have one or more EV charging ports.
    - EV charging port type:

    - Level 1 (L1): 120 V; 1 hour of charging = 5 miles of range.[1] The Station Locator counts standard 120-V alternating-current (AC) outlets as Level 1 EV charging 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 EV charging port, but only one vehicle will charge at a time.
    - J1772: For L1 and L2 charging.[4]
    - Combined Charging System (CCS): For DC fast charging for most vehicle models.[5]
    - CHAdeMO: For DC fast charging for select vehicle models.
    - J3400: For all charging levels for Tesla vehicles, also referred to as the North American Charging Standard (NACS).[6]
  - Network
  - Manufacturer
  - Power output (kW).
- Open date
- Workplace
- Pricing
- Power sharing
- 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

[1] This assumes a power output of 1.9 kW. The actual range per hour of charging depends on the power capacity, which can vary by vehicle and battery state of charge.
[2] This assumes a power output of 6.6 kW. The actual range per hour of charging depends on the power capacity, which can vary by vehicle and battery state of charge. An L2 unit can range from 2.9 to 19.2 kW power output.
[3] The power output of DC fast EV charging ports varies greatly, from 25 to 350 kW. The actual range per hour of charging depends on the power capacity, which can vary by vehicle and battery state of charge.
[4] For L1 charging, most EVs will come with an L1 cordset, so no additional charging equipment is required. On one end of the cord is a standard NEMA connector (e.g., 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 International, similar to the J1772 standard.
[6] The NACS connector was developed by Tesla. In December 2023, SAE International completed its standardization of NACS as SAE J3400. Several automotive manufacturers plan to make their model year 2025 EVs compatible with NACS, as discussed throughout this report (Joint Office of Energy and Transportation 2024).

(Executive Office of the President 2021). The baseline scenario in NREL's report, *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure*, projects there will be 33 million EVs on the road by 2030 (Wood et al. 2023). The NREL report estimates that approximately 28 million EV charging ports—including 1.2 million public EV charging ports and 26.8 million private EV charging ports—will be required by 2030 to support this fleet. NREL arrived at these estimates using the EVI-Pro, EVI-RoadTrip, and EVI-OnDemand modeling tools, as well as assumptions on:

- Vehicle adoption.
- Fleet composition (90% all-electric vehicles and 10% plug-in hybrid electric vehicles by 2030).
- Technology attributes.
- Driving and charging behavior (90% of EVs have reliable access to residential charging by 2030, and therefore most charging occurs at home).

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 EV charging ports modeled by NREL include 182,000 DC fast EV charging ports with a power output of 150 kW or greater, and 1,067,000 Level 2 EV charging ports (Wood et al. 2023). As of Q4, there were 19,388 public DC fast EV charging ports with a power output of 150 kW or greater and 129,342 public Level 2 EV charging ports in the Station Locator.[8] Based on data in the Station Locator in Q4, 10.7% of the estimated DC fast EV charging ports and 12.1% of the estimated Level 2 EV charging ports have been installed to support the infrastructure needs of the 2030 fleet. However, it is important to note that a large share of the public DC fast EV charging ports (61.2%) and a smaller portion of the Level 2 EV charging ports (7.8%) are on the Tesla Supercharger and Destination networks, respectively. As such, these ports are not readily accessible to non-Tesla drivers without the use of an adapter.[9] When public EV charging ports on the Tesla networks are excluded, the number of DC fast and Level 2 EV charging ports currently installed to support the 2030 fleet drops to 6,630 (3.6%) and 119,275 (11.2%), respectively (Figure 2).

[7] Wood et al.'s private infrastructure scenario includes EV charging 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 dataset, 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 71.8% of public DC fast EV charging ports in the Station Locator. Therefore, the number of DC fast EV charging ports with a power output of 150 kW or greater is likely underrepresented.
[9] As of Dec. 31, 2023, 64% of all-electric vehicles on the road were Teslas (Experian Information Solutions 2024). As discussed throughout this report, several auto manufacturers have plans to adopt the Tesla-developed NACS connector, which will make EV charging ports on the Tesla Supercharger and Destination networks accessible to a greater number of vehicles beginning with model year 2025 vehicles.

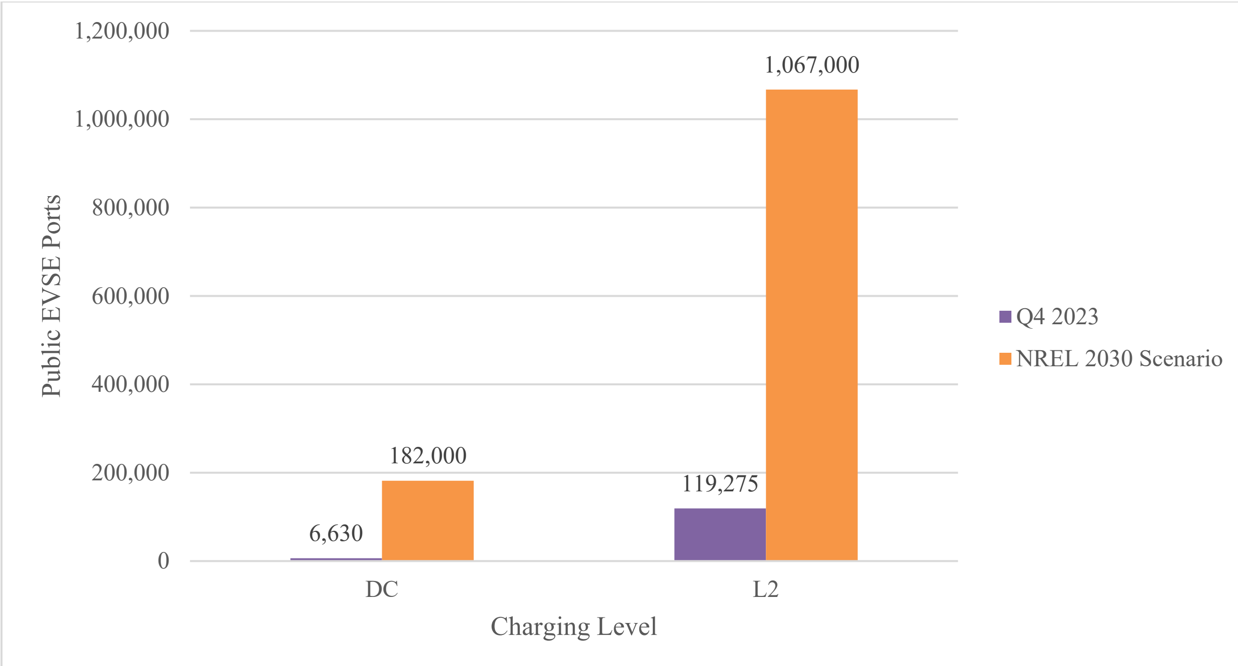

Figure 2. Current availability of public charging (excluding Tesla-only) versus NREL's scenario of 2030 public infrastructure requirements in the United States

By 2030, Wood et al.'s baseline scenario also estimates that there will need to be 0.6 public DC fast EV charging ports and 3.2 public Level 2 EV charging ports per 100 EVs. As of Dec. 31, 2023, there were approximately 4.52 million EVs on the road in the United States (Experian Information Solutions 2024). In Q4, the ratios of public DC fast and Level 2 EV charging ports per 100 EVs were 0.4 and 2.9, respectively. These ratios include EV charging ports on both the Tesla Supercharger and Destination networks (Table 1). Using Wood et al.'s estimated ratios of the number of public DC fast and Level 2 EV charging 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 Q4, the deployment of public DC fast and Level 2 EV charging ports falls short. However, 13.7% of the projected 33 million light-duty EVs in NREL's analysis were on the road as of Q4. As EV registrations continue to grow each quarter, and especially if EV adoption levels increase in line with the study by Wood et al., public EV charging port installations will need to ramp up significantly to keep up with demand.

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

Port Level	EV Charging Ports per 100 EVs in Q4 2023	EV Charging Ports per 100 EVs Needed in 2030 To Support 33 Million EVs
DC fast	0.4	0.6
L2	2.9	3.2

2 EV Charging Infrastructure Trends

The purpose of this report is to identify EV charging infrastructure trends for Q4 of 2023. In Q4, the Station Locator experienced modest growth in EV charging ports with the addition of 9,046 ports, equivalent to a 5% increase. Public EV charging ports, which account for most of the ports in the Station Locator (88.6%), grew by 5.2%, or 8,315 EV charging ports (Figure 3). Concurrently, private EV charging ports saw a 3.5% increase, amounting to the addition of 731 EV charging ports. Further, there was a total of 190,072 EV charging ports in the Station Locator as of Q4, reflecting a nearly 118% increase since the initial report in Q4 2019.

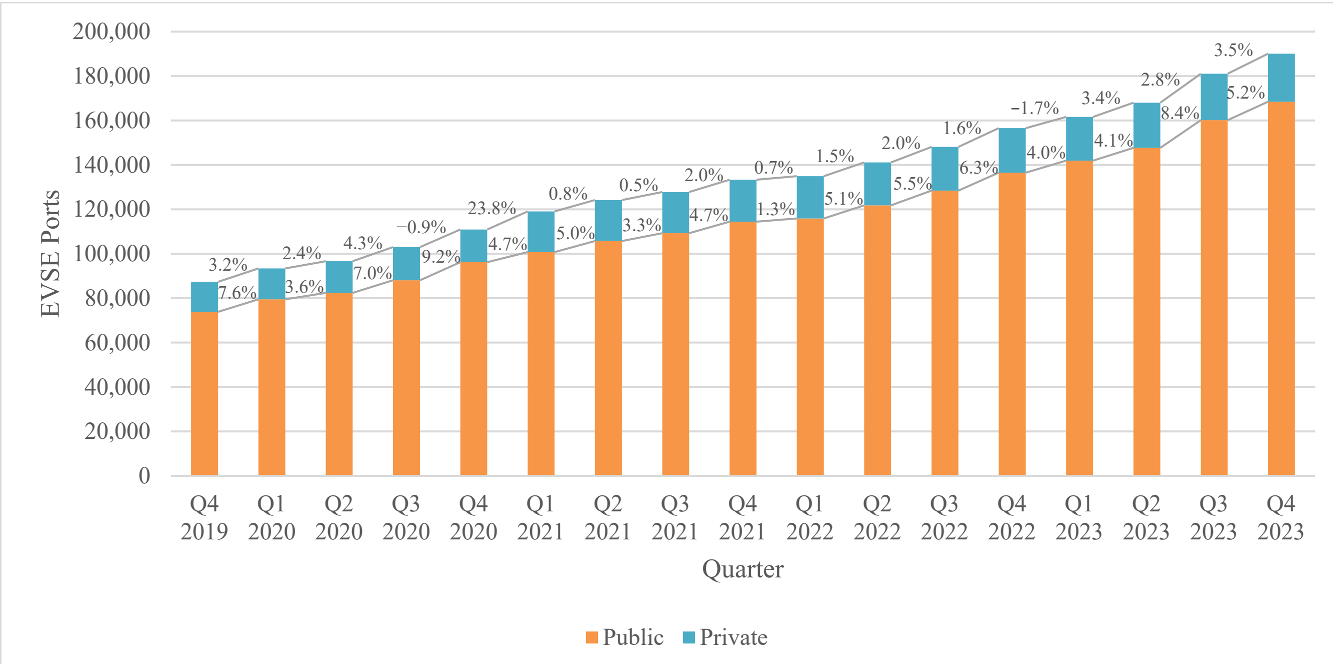

Figure 3. Quarterly growth of EV charging ports by access.

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

The following sections break down the growth of public and private EV charging ports further to highlight what types of EV infrastructure grew in Q4 and where EV infrastructure has grown geographically. Because the number of EV charging ports represents the number of vehicles that can charge simultaneously at an EV charging station, this report will focus on EV charging 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 Q4 2023, there was an increase of 8,315 public EV charging ports, bringing the total count of public EV charging ports in the Station Locator to 168,452. This growth represents a 5.2% increase in public EV charging ports since Q3 2023. The following sections break down the growth of public EV charging ports by charging level, network, region, state, housing density, and disadvantaged community (DAC) designation.

2.1.1 By Charging Level

As shown in Figure 4, the majority of public EV charging ports in the Station Locator are L2, followed by DC fast and L1. However, in almost every quarter since Q4 2019, DC fast ports have increased by the greatest percentage compared to other charging levels (Figure 4). In line with such trends, public DC fast EV charging ports grew by 9.2% in Q4 2023, representing the addition of 3,210 EV charging ports. The rise in DC fast EV charging ports is primarily driven by new station additions in California, Oklahoma, Texas, and Georgia. Concurrently, public Level 2 EV charging ports grew by 4.3%, or 5,276 ports, primarily due to new station additions across California, Massachusetts, Florida, and North Carolina. While public Level 1 EV charging ports decreased by 17.4%, the decrease represents the removal of 171 ports (Figure ES-2). 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.

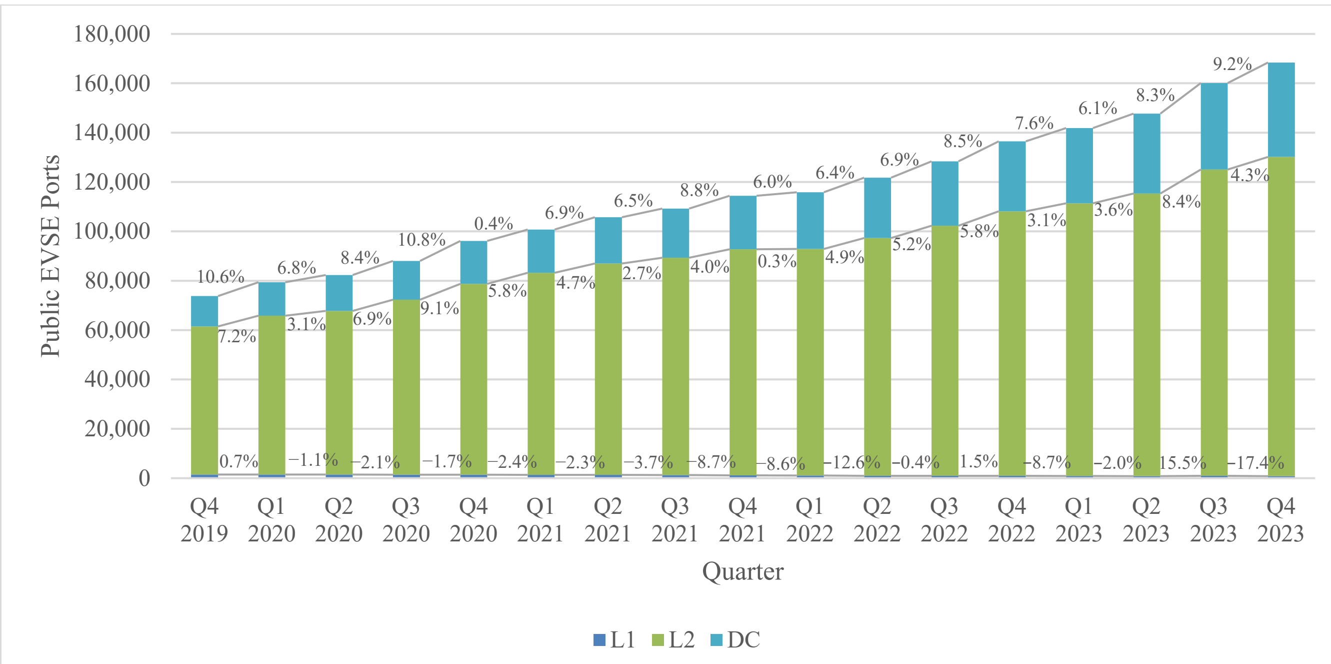

Figure 4. Quarterly growth of public EV charging ports by charging level.

Note: Figure excludes legacy EV charging ports that are not classified by charging level and are no longer manufactured. As of Q4, there were 26 public legacy EV charging ports in the Station Locator. Additionally, the percentages in this figure indicate the percent growth between each quarter.

In comparison to Level 1 and Level 2 EV charging ports, DC fast EV charging ports have the highest power output among the charging levels, allowing them to charge EVs in the least amount of time. One of the conclusions drawn from NREL's report, *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure,* is that deploying a dependable network of public DC fast chargers is essential for driving EV adoption in the United States (Wood et al. 2023). Therefore, it is important to highlight trends in the growth of DC fast EV charging ports in the Station Locator. While Level 1 EV charging ports typically have a power output of around 1–2 kW, and Level 2 EV charging ports can operate at up to 19.2 kW, the power output of DC fast EV charging ports ranges from 24 kW to more than 350 kW. The most common power outputs for DC fast EV charging ports are 50 and 150 kW, though the number of DC fast EV charging ports at higher power levels is steadily increasing, as depicted in Figure 5.

It is worth noting that as of Q4, power output data are available for 71.8% of the 38,271 public DC fast EV charging ports in the Station Locator, up from 37.8% of public DC fast EV charging ports in Q4 2019. Thus, Figure 5 is based on power output data for 27,495 DC fast EV charging ports.[10] Additionally, if a DC fast EV charging port has two connectors with different power outputs, only the maximum power output is counted in Figure 5.

Figure 5 showcases the notable increase (26.0%) in the quantity of EV charging ports with a power output of 350 kW or greater in Q4. Just over half of these new installations were 350-kW EV charging ports on the EVgo network in California and Texas, with fewer installations observed across 20 other states. The remainder of the newly added DC fast charging EV charging ports with power outputs of 350 kW or higher were distributed across the ChargePoint, Electrify America, EV Connect, Rivian Adventure, and Shell Recharge networks.

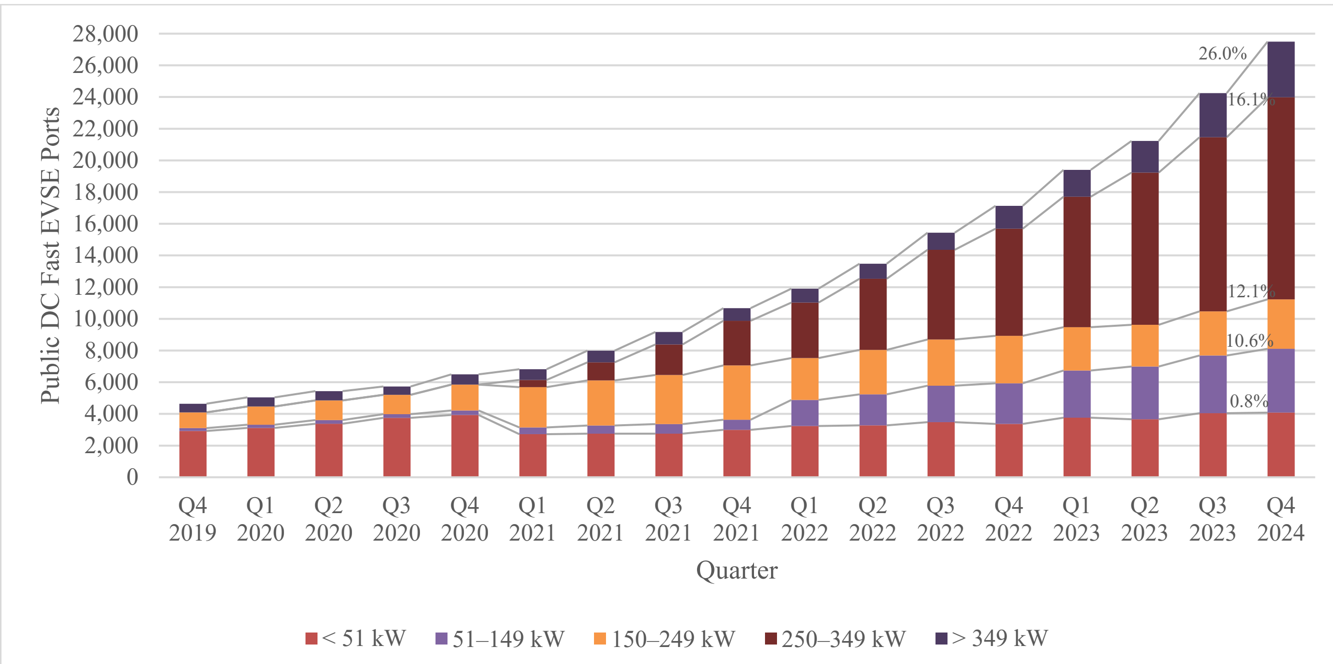

Figure 5. Quarterly growth of public DC fast EV charging ports by power output.

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).

There are currently three types of connectors available for DC fast chargers: CHAdeMO, CCS, and J3400. 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

[10] The remaining 28.2% of public DC fast EV charging ports are primarily on the Tesla Supercharger network or are non-networked. The Station Locator is working to close this gap by requesting these data from Tesla and site hosts of non-networked stations.

vehicles can charge with the J3400 connector. However, 16 auto manufacturers to date have plans to integrate J3400 charge ports into their new EV models beginning with model year 2025 vehicles.[11] Tesla has launched the Magic Dock at several Tesla Supercharger stations, which allows non-Tesla vehicles with the CCS standard to charge at Tesla Superchargers. Additionally, Tesla sells adapters that allow Tesla vehicles to charge at non-Tesla DC fast chargers with a CCS or CHAdeMO connector, and a growing number of auto manufacturers are working with Tesla to provide their customers with adapters so that they can begin charging at Tesla stations with J3400 connectors as early as 2024. For the purposes of this report, however, the following excludes data on adapters and rather focuses on the charge ports that are native to vehicles and charging hardware.

As of Dec. 31, 2023, approximately 64% of registered all-electric vehicles in the United States were Teslas and therefore compatible with the J3400 connector, 31% were compatible with the CCS connector, and 5% were compatible with the CHAdeMO connector (Experian Information Solutions 2024).[12] Of the 45,446 DC fast connectors in the Station Locator as of Q4, CCS connectors grew by the largest percentage (8.3%), followed by J3400 connectors (8.1%) (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 (3.0%) in Q4. One possible reason for this continued growth 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. Additionally, there continue to be older EV models on the road with the CHAdeMO standard. However, CHAdeMO connectors continue to make up a smaller share of public DC fast connectors each quarter. Between Q4 2019 and Q4 2023, the share of DC fast connectors that were CHAdeMO in the Station Locator declined from 22.1% to 17.9%, respectively.

[11] As of November 2023, these manufacturers include Ford Motor Company, General Motors, Rivian, Volvo, Polestar, Mercedes-Benz, Nissan, Honda, Hyundai, Kia, Toyota, BMW, Lucid, Vinfast, Fisker, and Jaguar-Land Rover (Joint Office of Energy and Transportation 2024).
[12] These figures exclude plug-in hybrid electric vehicles because most are not compatible with DC fast EV charging ports.

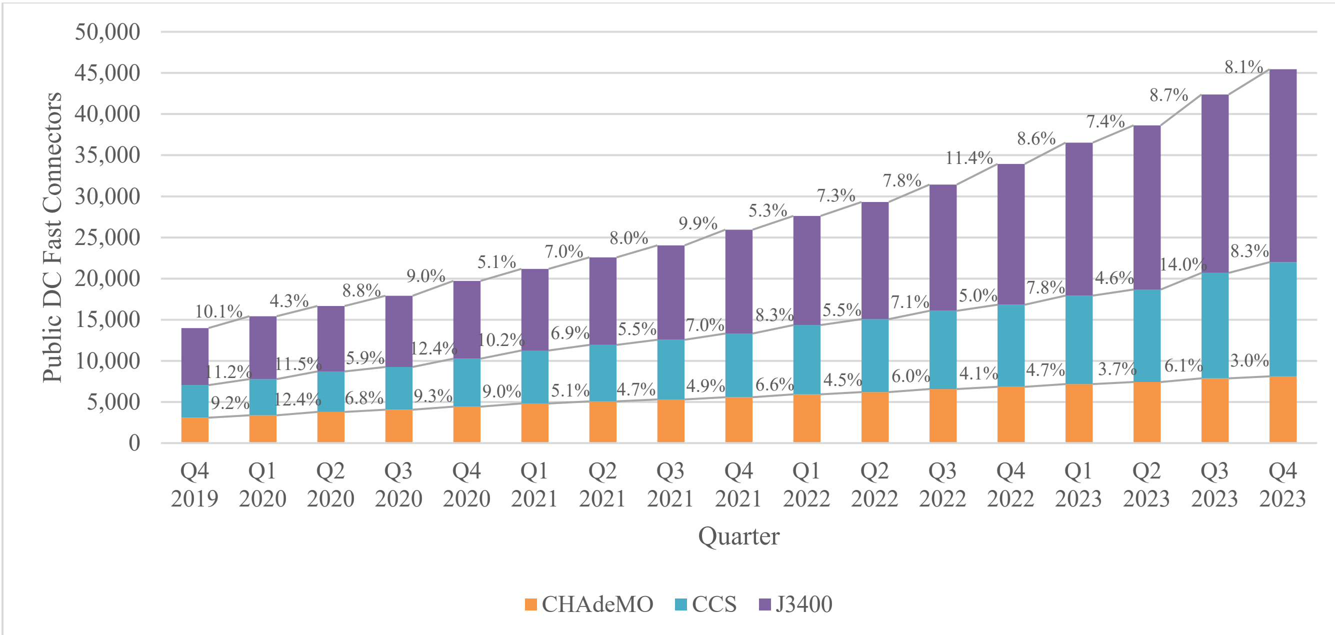

Figure 6. Quarterly growth of public DC fast connectors by type.

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

2.1.2 By Network

The Station Locator team collaborates with most major electric vehicle service providers (EVSPs) to gather EV charging infrastructure data for the Station Locator. As of Q4, the Station Locator incorporates stations from the 41 networks listed below, 15 of which update nightly through an API (marked with asterisks). Four networks—AmpedUp! Networks, Electric Era (i.e., PowerNode), Envirospark, and Stay-N-Charge—were added to the Station Locator in Q4. In addition, the Station Locator contains non-networked (NON) station data, which includes stations that were previously networked.

- 7Charge (7CHARGE)
- AmpedUp! Networks (AMPED_UP)
- AmpUp (AMPUP)
- Blink (BN)*
- ChargeLab (CHARGELAB)
- ChargePoint (CPN)*
- ChargeUp (CHARGEUP)*
- Chargie (CHARGIE)
- Circle K (CIRCLE_K)
- Electric Era (POWER_NODE)
- Electrify America (EA)*
- EnviroSpark (ENVIROSPARK)
- EV Charging Solutions (EVCS)
- EV Connect (EVC)*
- EV Range (EVRANGE)*
- EvGateway (EVGATEWAY)
- EVgo (EVN)*
- EVmatch (EVMATCH)
- FLASH (FLASH)*
- FLO (FLO)*
- FPL EVolution (FPLEV)
- Francis Energy (FCN)*
- Graviti Energy (GRAVITI_ENERGY)
- Jule (JULE)
- Livingston Energy Group (LIVINGSTON)
- Loop (LOOP)
- Noodoe (NOODOE)
- OpConnect (OC)*
- PowerFlex (POWERFLEX)
- Red E Charging (RED_E)

- Revel (REVEL)
- Rivian Adventure Network (RIVIAN_ADVENTURE)*
- Rivian Waypoints (RIVIAN_WAYPOINTS)*
- Shell Recharge (SHELL_RECHARGE)*
- Stay-N-Charge (STAY_N_CHARGE)
- SWTCH Energy (SWTCH)
- Tesla Destination (TESLAD)
- Tesla Supercharger (TESLA)
- Universal EV Chargers (UNIVERSAL)
- Volta (VLTA)*
- ZEF Energy (ZEFNET)

Similar to preceding quarters, the ChargePoint network maintained its position as the network with the most public EV charging ports in the Station Locator in Q4, with 64,919 EV charging ports, or 38.5% of all EV charging ports in the Station Locator. Furthermore, Level 2 EV charging ports continue to comprise most of ChargePoint's network (95.8%). The pattern of Level 2 EV charging ports comprising the majority of the overall share of ports is observed across various networks in the Station Locator, with the exception of the 7Charge, Electrify America, ChargeUp, Circle K, EVgo, Francis Energy, FPL EVolution, Jule, Rivian Adventure Network, Revel, and Tesla Supercharger networks (Figure 7). These networks are predominantly, if not completely, made up of DC fast EV charging ports. In Q4, the Tesla Supercharger network made up the largest share of public DC fast EV charging ports across the networks in the Station Locator (61.2%), followed by Electrify America and EVgo at 10.6% and 7.7%, respectively (Figure 8).

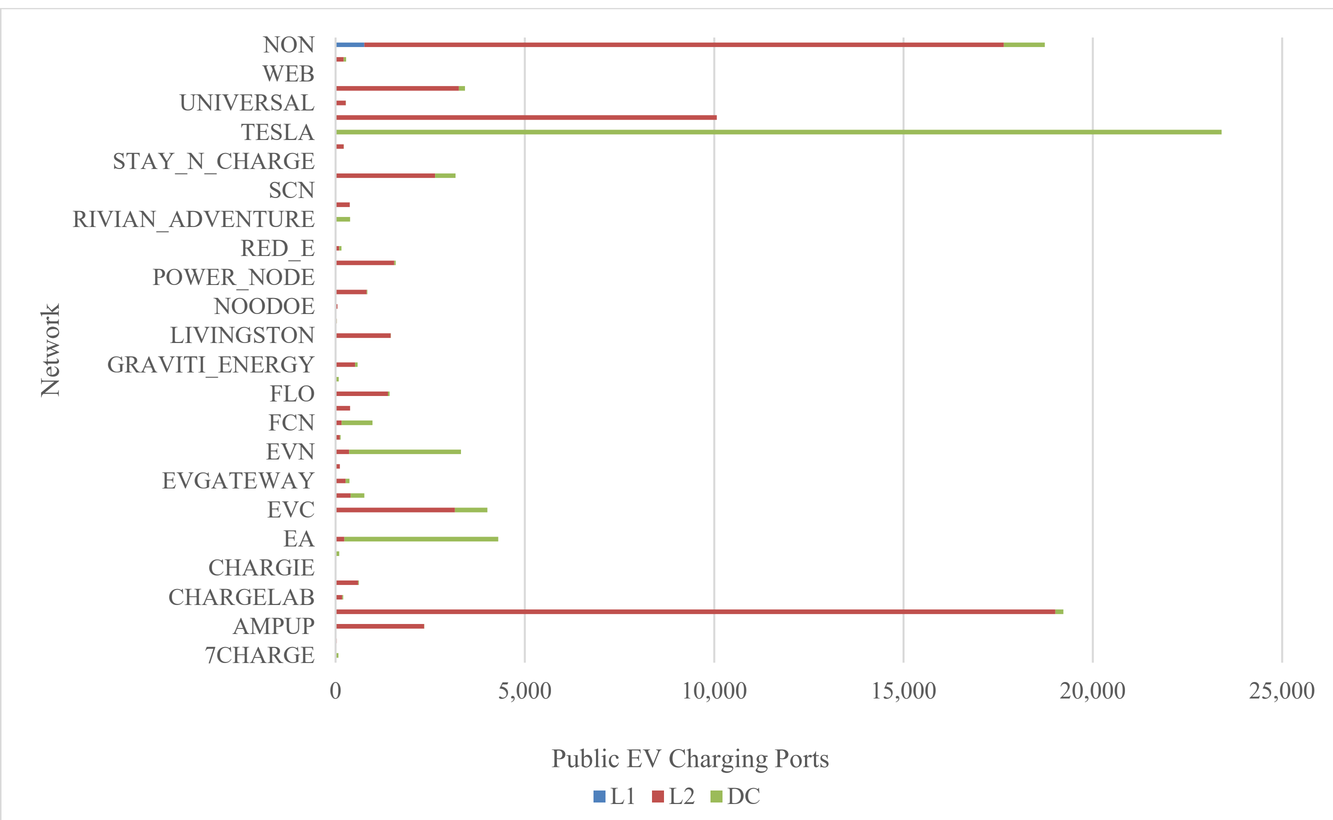

Figure 7. Breakdown of public EV charging ports by network and charging level in Q4 2023.

Note: ChargePoint is excluded from this figure. The size of its network is much larger than others and therefore skews the graph.

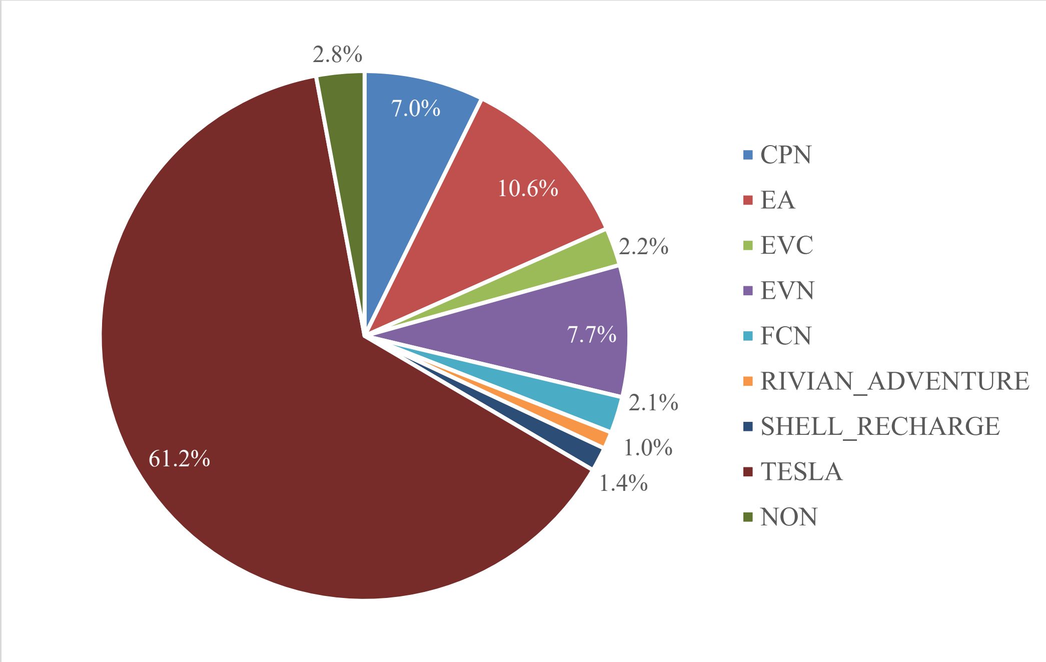

Figure 8. Breakdown of public DC fast EV charging ports by network in Q4 2023.

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

Table 2 presents the percent growth of each network over the last four quarters. The ChargeUp network experienced the largest growth in Q4 (1,825.0%), resulting in the addition of 584 EV charging ports. This increase is attributed to the integration of ChargeUp's API with the Station Locator in October 2023. As discussed in Appendix B, API integrations allow for automated daily imports of station data from networks, meaning that once new stations are commissioned, they are added to the Station Locator database the following day. Francis Energy's API was also integrated into the Station Locator in Q4, contributing to the 81.2% growth in EV charging ports.

The expansion of numerous other networks in Q4 2023 was largely a result of the Station Locator's manual data collection process, as mentioned in Section 1. Notably, this is the reason for the large growth seen on the Loop (200.0%), Noodoe (128.6%), and Red E Charging (61.5%) networks. While these networks saw the highest percentage increase in EV charging ports between Q3 and Q4 2023, this growth only accounts for the addition of approximately 20 to 60 ports each.

In contrast, there was a slight decrease in the number of public EV charging ports in Q4 among the EVmatch (−1.8%), Graviti Energy (−1.4%), and Livingston Energy Group (−0.3%) networks. The decreases noted in the EVmatch and Graviti Energy networks can be attributed to the removal of 22 and 8 public DC fast EV charging ports from the Station Locator, respectively. The decline in EV charging ports on the Livingston Energy Group network is associated with the removal of four Level 2 EV charging ports.

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

Network	Q1 2023 Growth	Q2 2023 Growth	Q3 2023 Growth	Q4 2023 Growth
7CHARGE	N/A	N/A	43.5%	15.2%
AMPUP	7.6%	11.2%	1.1%	N/A
AMPED_UP	N/A	N/A	N/A	24.7%
BN	47.8%	9.8%	238.5%	2.8%
CHARGELAB	15.1%	40.2%	2.3%	14.3%
CHARGEUP	N/A	0.0%	255.6%	1,825.0%
CHARGIE	N/A	N/A	0.0%	0.0%
CIRCLE_K	N/A	333.3%	46.2%	26.3%
CPN	5.1%	3.4%	4.0%	3.7%
EA	1.7%	−3.9%	12.1%	4.3%
ENVIROSPARK	N/A	N/A	N/A	N/A
EVC	7.4%	10.5%	6.1%	5.5%
EVCS	11.8%	23.9%	11.4%	3.3%
EVGATEWAY	7.4%	4.0%	7.8%	1.7%
EV MATCH	N/A	N/A	N/A	−1.8%
EVN	7.7%	3.0%	−0.4%	8.2%
EVRANGE	25.6%	61.2%	62.0%	5.5%
FCN	2.7%	1.8%	−19.2%	81.2%
FLASH	0.0%	331.9%	−51.0%	25.2%
FLO	10.1%	26.3%	7.7%	9.3%
FPLEV	14.9%	5.2%	0.0%	4.9%
GRAVITI_ENERGY	N/A	258.8%	141.4%	−1.4%
JULE	N/A	N/A	N/A	0.0%
LIVINGSTON	6.9%	1.1%	1.4%	−0.3%
LOOP	N/A	N/A	N/A	200.0%
NOODOE	N/A	N/A	2,000.0%	128.6%
OC	5.9%	−2.9%	−9.1%	9.8%
POWER_NODE	N/A	N/A	N/A	N/A
POWERFLEX	0.0%	3.0%	0.9%	13.2%
RED_E	13.8%	10.8%	17.1%	61.5%
REVEL	N/A	N/A	N/A	0.0%
RIVIAN_ADVENTURE	141.2%	82.1%	36.2%	26.2%
RIVIAN_WAYPOINTS	33.3%	14.4%	12.2%	40.4%
SHELL_RECHARGE	5.1%	−5.5%	11.9%	0.4%

Network	Q1 2023 Growth	Q2 2023 Growth	Q3 2023 Growth	Q4 2023 Growth
STAY_N_CHARGE	N/A	N/A	N/A	N/A
SWTCH	239.3%	55.8%	26.4%	17.6%
TESLA	8.6%	7.4%	8.6%	8.1%
TESLAD	−11.5%	0.5%	0.2%	0.7%
UNIVERSAL	29.1%	27.7%	2.5%	9.2%
VLTA	−2.1%	1.0%	2.3%	6.6%
ZEFNET	496.2%	13.5%	46.0%	7.4%
NON	−1.0%	1.4%	0.6%	1.8%
Total	**4.0%**	**4.1%**	**8.4%**	**5.2%**

2.1.3 By Region

The regional growth of public EV charging infrastructure was analyzed by dividing the country into the same seven regions used by Clean Cities and Communities (Figure 9) (Clean Cities and Communities 2024a). See the Q1 2020 report for more information about Clean Cities and Communities (Brown et al. 2020).

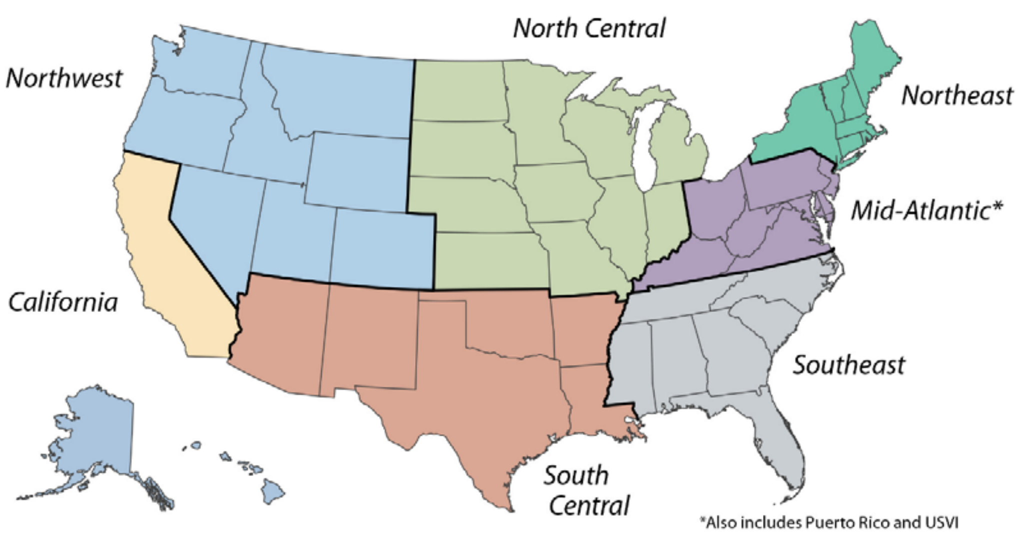

Figure 9. Clean Cities and Communities regions.

Source: Clean Cities and Communities (2024b)

As depicted in Figure 10, California still maintains the largest share of the country's public EV charging ports (27.0%). However, the Southeast region exhibited the most substantial overall growth in terms of both total EV charging port counts and percentage growth during Q4, with an increase of 7.8%, or 1,688 EV charging ports. This growth is mainly attributed to new L2 installations on the ChargeUp, ChargePoint, and Blink networks, along with the addition of DC fast EV charging port installations on the Tesla Supercharger network. In Q4, the expansion of public DC fast EV charging ports outpaced that of Level 2 EV charging ports in all Clean Cities and Communities regions, except for the Northeast (Table 3).

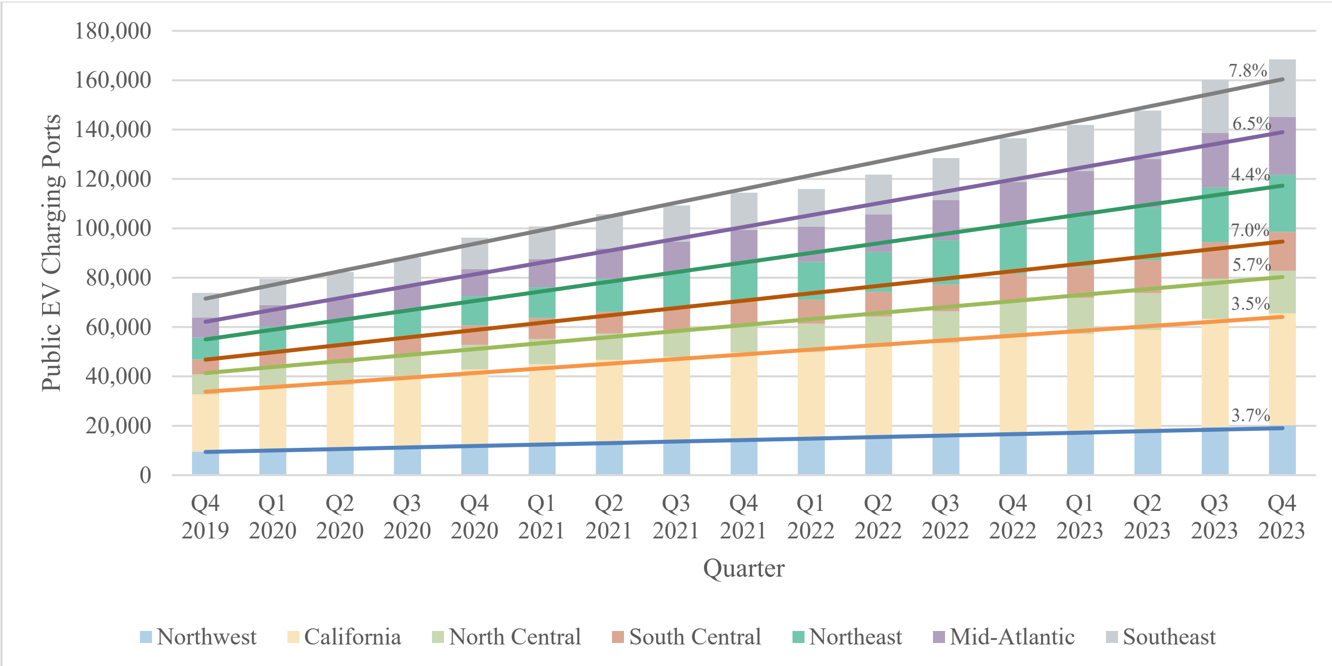

Figure 10. Quarterly growth of public EV charging ports by Clean Cities and Communities region.

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

Table 3. Growth of Public L2 and DC Fast EV Charging Ports by Clean Cities and Communities Region in Q4 2023

Clean Cities and Communities Region	Level 2 EV Charging Port Growth	DC Fast EV Charging Port Growth
California	2.7%	6.5%
Mid-Atlantic	5.9%	8.6%
North Central	3.9%	11.2%
Northeast	4.5%	3.7%
Northwest	3.4%	8.9%
Southeast	3.0%	17.4%
South Central	7.2%	10.2%

2.1.4 By State

To track the growth of EV charging ports by state, the Station Locator team calculated the number of public EV charging 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. The District of Columbia is considered a state for the purpose of this analysis, though U.S. territories, such as Puerto Rico, are excluded. The vehicle registration data are based on Experian's registration information as of Dec. 31, 2022 (Experian Information Solutions 2023).

In Q4, Oklahoma, Delaware, Idaho, Connecticut, and North Carolina were the five states with the most significant percentage growth of EV charging ports per 100 EVs, all surpassing the growth rate of the United States as a whole (Table 4). The growth witnessed in Oklahoma was mainly driven by L2 installations on the Francis Energy and Tesla Destination networks, as well as DC fast charger installations on the Tesla Supercharger network. Additionally, new L2 installations—primarily on the Blink, ChargePoint, and AmpUp networks—contributed to the growth seen in Delaware and Connecticut.

Table 4. Top Five States With the Largest Growth of EV Charging Ports per 100 EVs in Q4 2023[13]

State	EV Charging Ports per 100 EVs in Q3 2023	EV Charging Ports per 100 EVs in Q4 2023	Growth of EV Charging Ports per 100 EVs in Q4 2023
Oklahoma	3.9	5.3	37.6%
Delaware	6.6	7.6	16.1%
Idaho	4.4	4.9	13.4%
Connecticut	6.0	6.8	13.1%
North Carolina	6.3	7.1	12.5%

2.1.5 By Housing Density

To better understand where EV charging infrastructure is being deployed, the Station Locator team analyzed the growth of EV charging ports in urban, suburban, and rural areas across the United States. 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.

As shown in Figure 11, public EV charging ports are predominantly located in suburban census tracts, followed by urban and rural tracts. DC fast EV charging ports showed the largest growth by percentage across all density categories compared with Level 2 EV charging ports, while Level 1 EV charging ports stagnated in suburban and rural areas and decreased sharply in urban areas. DC fast EV charging ports grew by the largest percentage in suburban areas (10.0%), followed by rural and urban areas (9.5% and 7.0%, respectively).

[13] See Appendix A for the growth of EV charging ports per 100 EVs in all states in Q4.

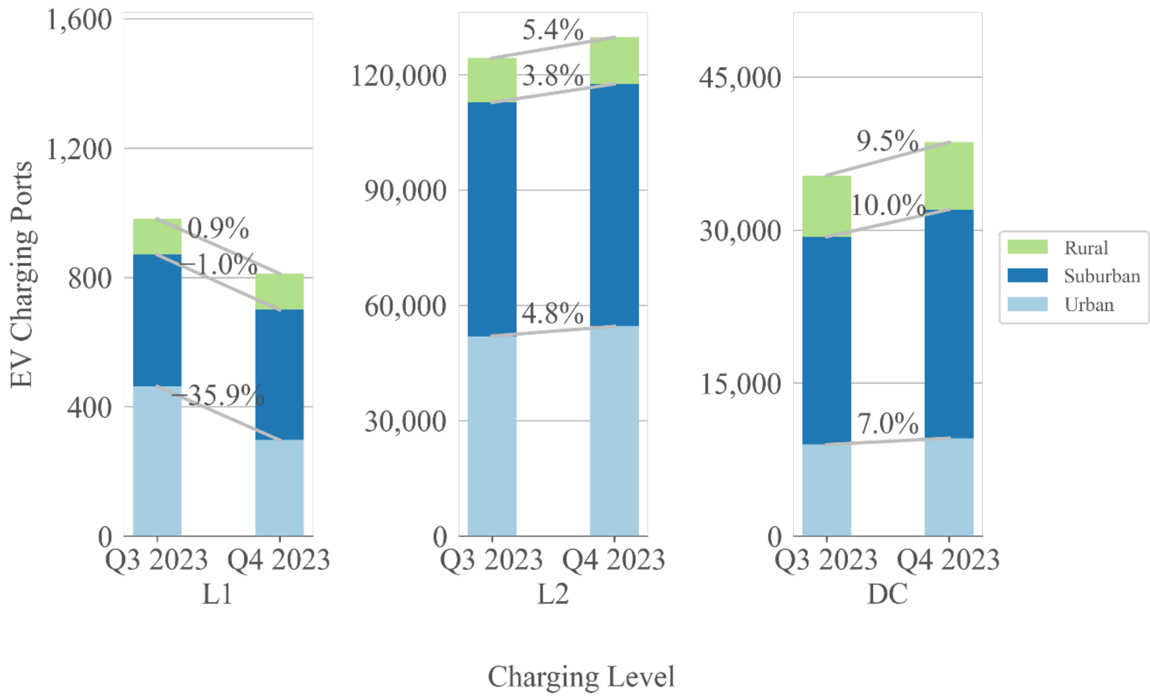

Figure 11. Q4 2023 growth of public EV charging ports by neighborhood type and charging level.

Note: These graphs are not to scale.

2.1.6 By DAC Designation

"Executive Order 14008: Tackling the Climate Crisis at Home and Abroad," issued in 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 2024). 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 DACs. This section focuses on the growth of EV charging ports in both DACs and non-DACs for comparison. The map in Figure 12 shows the census tracts classified as DACs across the United States.

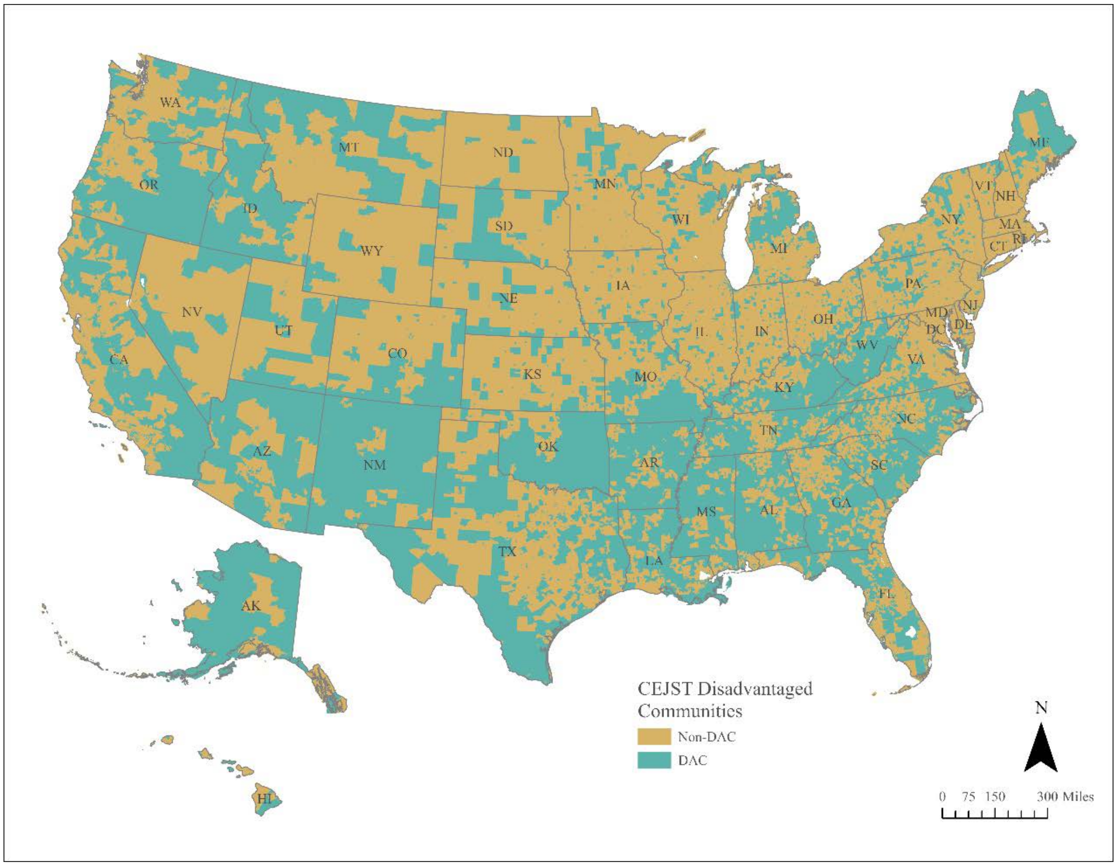

Figure 12. Display of the DACs across the United States.

Note: Alaska and Hawaii are not to scale.

The Station Locator team used the Council on Environmental Quality's Climate and Economic Justice Screening Tool for this section of the analysis. GIS shapefiles with these data are hosted by the Council on Environmental Quality (2024). The DAC shapefile was prepared by aggregating several social, economic, and environmental features into a spatial dataset. The data used by this analysis accounts for census tract-level indicators under several categories of burdens: climate change, energy, health, housing, legacy pollution, transportation, workforce development, and water and wastewater (Council on Environmental Quality 2024).

Overall, 24.2% of public EV charging ports across all charging levels are in DACs, in line with 24.1% from the previous quarter. As shown in Figure 13, the growth of DC fast and Level 2 EV charging ports in non-DACs slightly outpaced growth in DACs. There was a large decrease (−43.9%) of L1 ports in DACs, and a slight decrease in non-DACs (Figure 13).

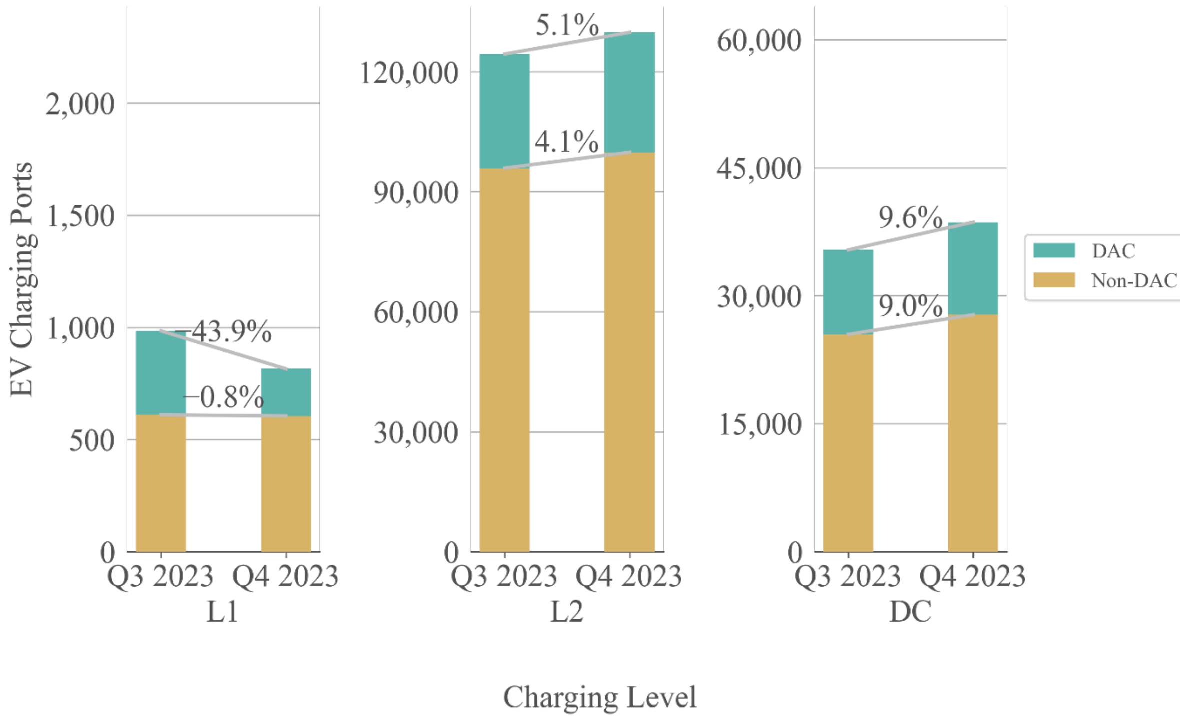

Figure 13. Q4 2023 growth of public EV charging ports by DAC designation and charging level.

Note: These graphs are not to scale.

2.2 Private Charging Trends

In Q4 2023, the number of private EV charging ports in the Station Locator experienced incremental growth, with a 3.5% increase compared to the preceding quarter. Specifically, between Q3 and Q4 2023, the count of private EV charging ports increased from 20,889 to 21,620, driven primarily by the addition of Level 2 EV charging ports. Private Level 2 EV charging ports experienced a growth of 4.0%, while private DC fast EV charging ports saw a marginal increase of 0.8%. More than half of the new private Level EV charging ports were installed on the AmpUp network, while most private DC fast EV charging ports were affiliated with the ChargePoint network or were non-networked. The following sections break down the growth of private EV charging 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 charging stations may not necessarily be shared publicly. The Station Locator team therefore relies on Clean Cities and Communities 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

The vast majority of private EV charging ports in the Station Locator are L2, comprising 87.7% of all private EV charging ports (Figure 14). In Q4, all charging levels grew, with Level 2 EV charging ports growing by the largest percentage (4.0%), representing the addition of 722 ports. Most of the private EV charging ports were added across California and Connecticut on the AmpUp and EVmatch networks. In total, there were 18,963 private Level 2 EV charging ports as of Q4. Private L1 and DC fast EV charging ports exhibited marginal growth—each gaining 6 and 3 ports—leading to a total count of 2,280 and 375 ports, respectively.

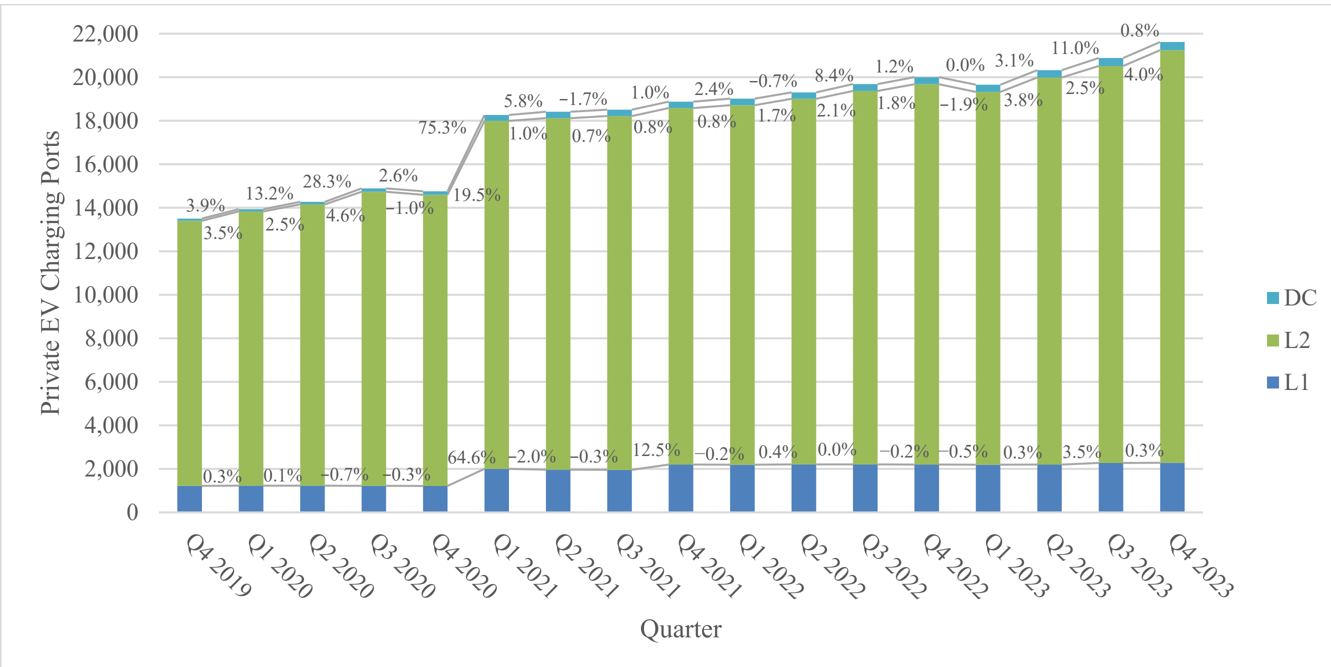

Figure 14. Quarterly growth of private EV charging ports by charging level.

Note: Figure excludes legacy EV charging ports that are not classified by charging level and are no longer manufactured. As of Q4, there were two private legacy EV charging 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 EV charging ports from NREL's Federal Fleets team.

2.2.2 Workplace Charging

Workplace EV charging infrastructure consists of charging stations that are private and designated exclusively for employee use. In the Station Locator, the vast majority (95.1%) of private workplace EV charging ports are L2 (Figure 15). This is expected because employees typically use workplace chargers while their vehicles are parked for an extended period at work, making rapid charging less necessary. As previously noted, data on private workplace charging ports in the Station Locator are likely underrepresented.

In Q4, 153 Level 2 EV charging ports and 6 Level 1 EV charging ports were added to the Station Locator, representing growth rates of 1.5% and 1.4%, respectively. New private workplace Level 2 EV charging ports were added across California, Pennsylvania, Connecticut, and Utah. The majority of the newly added Level 2 EV charging ports were either non-networked or affiliated with the ChargePoint and SWTCH Energy networks. Meanwhile, one private workplace DC fast charging EV charging port was removed from the Station Locator, bringing the total number of DC fast EV charging ports to 78 (Figure 15).

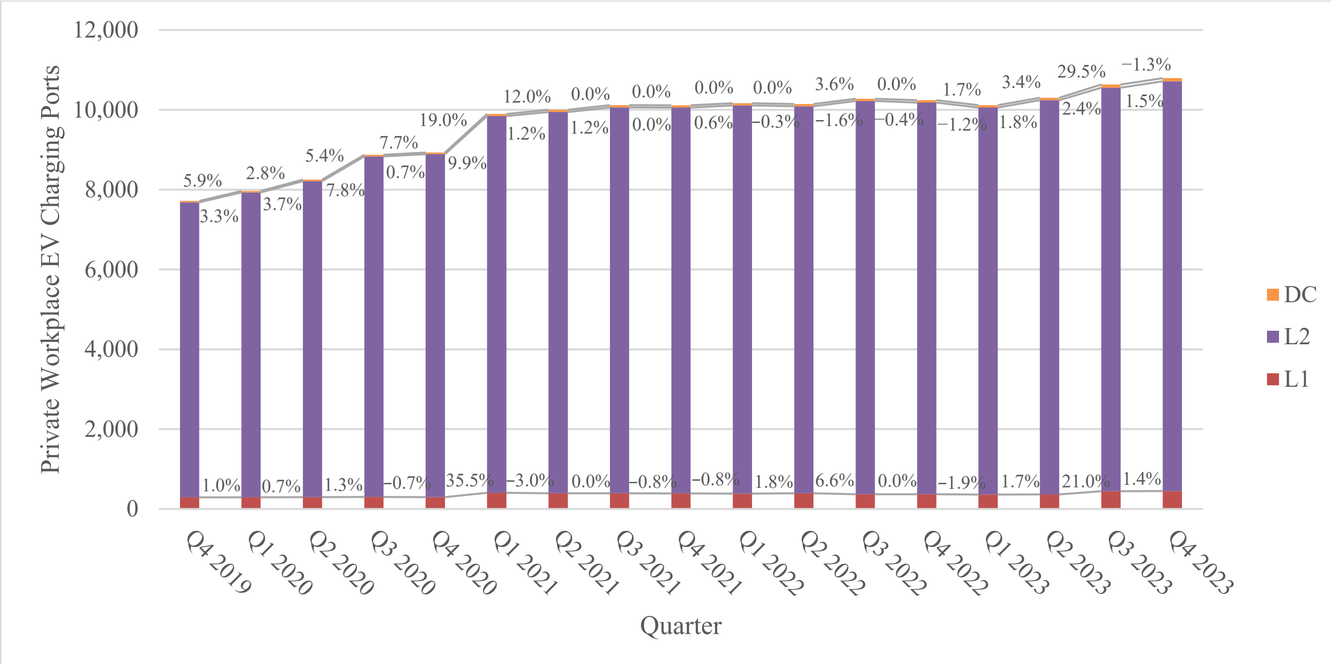

Figure 15. Quarterly growth of private workplace EV charging ports by charging level.

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 prioritize capturing private charging infrastructure installed at multifamily housing that is available for resident use only. Currently, EV charging ports at multifamily housing constitute 9.5% of private EV charging ports in the Station Locator. As shown in Figure 16, multifamily housing EV charging ports in the Station Locator are either L1 or L2, with the overwhelming majority (99.1%) being L2. While the number of L1 multifamily EV charging ports remained unchanged between Q3 and Q4 2023, L2 multifamily EV charging ports increased by 9.7% (Figure 16). This growth was attributed to the addition of 180 new Level 2 EV charging ports, primarily in California, Connecticut, and New York. The total number of multifamily EV charging ports in the Station Locator increased from 1,871 in Q3 2023 to 2,051 in Q4 2023.

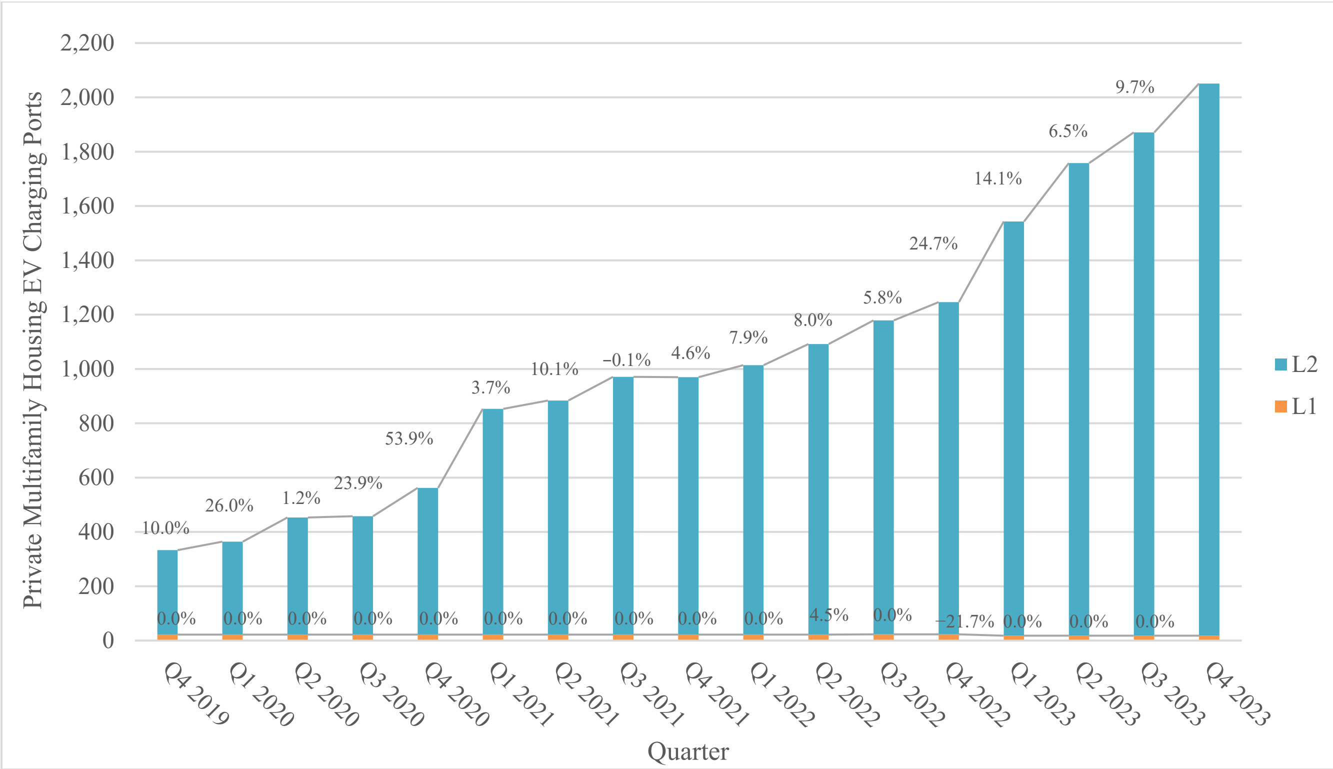

Figure 16. Quarterly growth of private multifamily housing EV charging ports by charging level.

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. If they are, the team categorizes the types of vehicles that charge at the station based on Federal Highway Administration weight classes (i.e., light-duty, medium-duty, or heavy-duty vehicles). As of Q4 2023, the team has collected this information for 85.8% of private EV charging ports in the Station Locator, of which 37.8% are being used for fleet-charging purposes. Note that some fleet EV charging ports are also used by employees and are therefore counted as workplace EV charging ports in Section 2.2.2 as well.

Figure 17 displays the breakdown of these EV charging ports by fleet type and charging level. The fleet type indicates the largest vehicle type that uses the station as of Q4 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 EV charging ports are used to charge light-duty vehicles (Figure 17). Additionally, the majority of fleet-charging EV charging ports are L2 (74.5%).

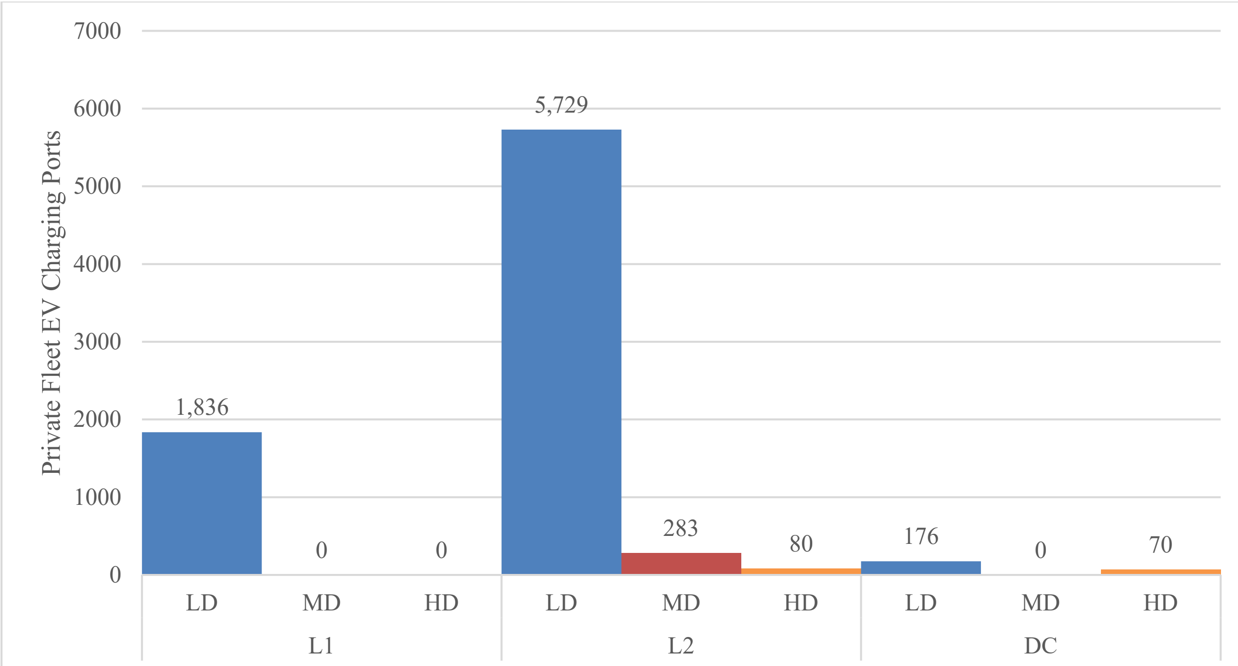

Figure 17. Breakdown of private fleet EV charging ports by charging level and fleet type in Q4 2023.

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

In the closing quarter of 2023, the country witnessed the fruition of the NEVI Formula Program set into motion 2 years ago by the Bipartisan Infrastructure Law. Ohio spearheaded this progress, proudly inaugurating the nation's first EV charging station funded by the NEVI Formula Program (Ohio Department of Transportation 2023). Quickly following suit, New York announced the opening of its first NEVI Formula Program-funded charging station, underscoring the nationwide momentum (New York State 2023). Additionally, several states announced the allocation of NEVI Formula Program funds for the construction of EV charging stations. For example, the Kentucky Transportation Cabinet announced $10.9 million in awards across 16 different sites along Alternative Fuel Corridors (Commonwealth of Kentucky 2023). The announcements reflect the substantial headway made, showcasing state efforts to propel EV charging infrastructure deployment forward.

This quarter also saw significant developments in charging standards. The National Charging Experience (ChargeX) Consortium released a comprehensive report offering recommendations for 26 common EV charging error codes (Idaho National Laboratory 2023). These recommendations aim to streamline error reporting, diagnostics, and resolution, fostering standardization across vehicles and charging manufacturers. The consortium also published an implementation guide to assist the industry in adopting the essential error codes. This initiative, established to enhance public charging reliability and usability, is funded by the Joint Office of Energy and Transportation and involves collaboration with key entities such as Argonne National Laboratory, Idaho National Laboratory, NREL, and key industry stakeholders.

In parallel, SAE International published a technical information report for J3400, marking a crucial step in standardizing the J3400 connector. Standardizing the J3400 connector as J3400 will allow any EV charging hardware manufacturer to produce and deploy the connector on its hardware (SAE International 2023). Additionally, as noted in Section 2.1.1, Ford Motor Company, General Motors, Rivian, Volvo, Polestar, Mercedes-Benz, Nissan, Honda, Hyundai, Kia, Toyota, BMW, Lucid, Vinfast, Fisker, and Jaguar-Land Rover have committed to adopting the J3400 connector as early as 2025 (Joint Office of Energy and Transportation 2024). These auto manufacturers have also pledged to provide J3400 adapters to owners of CCS-compatible vehicles from 2024 onward, promising increased access to charging for EV drivers and an expanded reliable charging network across the country.

To further expedite access to EV charging, the U.S. Department of Transportation adopted DOE's EV charging station categorical exclusion under the National Environmental Policy Act (U.S. Department of Transportation 2023). This strategic move allows for the quicker development and installation of Department of Transportation-funded charging stations falling under categorical exclusions in certain design conditions, contributing to the acceleration of EV charging accessibility.

In tandem with these regulatory strides, charging companies expanded their reach. BMW extended its smart charging service, "Charge Forward," offering incentives to EV customers for aligning their charging with peak renewable energy times. Additionally, Electrify America invested $92 million to expand the charging network in California, and plans to install 520 new charging stations to meet the surging demand for EV charging (Electrify America 2023).

Finally, the Station Locator data collection and management processes will continue to impact future EV charging 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, EV charging ports, and connectors (EVRoaming Foundation 2020). The Station Locator therefore counts the number of EV charging ports at each station location. As of Q4, all manually collected data, as well as EV charging ports on the Blink, ChargePoint, ChargeUp, Electrify America, EV Connect, EVgo, EV Range, FLASH, FLO, Francis Energy, OpConnect, Rivian, Shell Recharge, 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 EV charging 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 explores the expansion of EV infrastructure in the Station Locator in Q4 2023, covering the growth of public EV charging by charging level, network, region, state, housing density, and DAC designation. Additionally, this report analyzes the growth of private EV charging based on charging level and use type (i.e., workplace, multifamily housing, and fleet). Given the swift growth and evolving landscape of EV charging infrastructure, the information presented in this report is intended to help readers understand the dynamics of development, identify potential opportunities, and assess whether the progress aligns with projected charging demand and national targets.

Overall, there was a 5.0% increase in the number of EV charging ports in the Station Locator in Q4. While Level 2 EV charging ports dominate both publicly and privately accessible ports, public DC fast EV charging ports experienced the highest percentage growth in Q4, increasing by 9.2%. Additionally, although California leads the country in the total number of public EV charging ports available (43,586), it experienced the slowest growth rate across Clean Cities and Communities regions at 3.5%. Instead, the Southeast region exhibited the highest percentage growth in public charging infrastructure at 7.8%. Meanwhile private EV charging ports grew incrementally (3.5%), with private Level 2 EV charging ports increasing by the largest percentage across all charging levels (4.0%).

Based on NREL's report, *The 2030 National Charging Network*, which projects the required number of public EV charging ports to support 33 million EVs on the road by 2030, the current availability of DC fast and Level 2 EV charging ports to meet the projected requirements is 10.7% and 12.1%, respectively. It is important to note that 61.2% of public DC fast EV charging ports and 7.8% of public Level 2 EV charging ports in the Station Locator belong to the Tesla Supercharger and Destination networks and are therefore only readily accessible to Tesla vehicles. When public EV charging ports on the Tesla networks are excluded, the number of DC fast and Level 2 EV charging ports currently installed to meet the projected 2030 requirements decreases to 6,630 (3.6%) and 119,275 (11.2%), respectively.

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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Appendix A. EV Charging Ports Growth by State

Table A-1. Q4 2023 Growth of Public EV Charging Ports per 100 EVs by State

State	EV Charging Ports per 100 EVs in Q3 2023	EV Charging Ports per 100 EVs in Q4 2023	Growth of EV Charging Ports per 100 EVs in Q4 2023
AK	4.3	4.7	7.5%
AL	6.9	7.7	11.8%
AR	11.4	11.7	2.5%
AZ	4.1	4.4	6.9%
CA	3.8	3.9	3.5%
CO	6.8	6.9	1.8%
CT	6.0	6.8	13.1%
DC	12.7	13.7	8.3%
DE	6.6	7.6	16.1%
FL	4.6	4.8	5.6%
GA	6.8	7.2	6.8%
HI	3.7	3.7	-0.7%
IA	7.5	8.2	8.1%
ID	4.4	4.9	13.4%
IL	3.9	4.0	2.8%
IN	5.2	5.8	11.5%
KS	10.5	10.8	3.4%
KY	6.9	7.6	9.5%
LA	7.7	8.2	6.3%
MA	9.0	9.6	6.1%
MD	7.5	7.8	4.2%
ME	9.8	10.3	4.3%
MI	5.8	6.2	7.2%
MN	5.6	5.8	3.0%
MO	10.1	10.8	7.1%
MS	10.8	11.1	2.3%
MT	7.0	7.6	7.8%
NC	6.3	7.1	12.5%
ND	17.5	18.7	6.7%
NE	8.0	8.3	3.6%
NH	4.8	5.1	6.0%
NJ	3.3	3.5	6.3%

State	EV Charging Ports per 100 EVs in Q3 2023	EV Charging Ports per 100 EVs in Q4 2023	Growth of EV Charging Ports per 100 EVs in Q4 2023
NM	6.2	6.7	7.2%
NV	4.9	5.3	6.5%
NY	7.9	8.0	2.1%
OH	7.1	7.6	6.0%
OK	3.9	5.3	37.6%
OR	4.5	4.8	6.1%
PA	6.2	6.5	5.1%
RI	10.5	10.6	1.1%
SC	6.7	7.4	10.7%
SD	11.2	11.6	4.0%
TN	6.6	7.2	9.5%
TX	5.0	5.2	3.9%
UT	6.4	6.3	-0.4%
VA	5.6	6.1	8.6%
VT	10.6	10.8	1.4%
WA	4.5	4.7	4.4%
WI	5.5	5.8	6.4%
WV	12.7	13.8	8.8%
WY	17.6	18.5	5.2%

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 EV charging 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 and Communities coalition 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. Networks also 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.

Table B-1 shows a timeline of the integration of the network APIs into the Station Locator data management process, including the integration of OCPI-based APIs. See Section 1.1 for more information on the OCPI protocol.

Table B-1. Timeline of API Integrations in the Station Locator

Date	Network
January 2014	Blink, ChargePoint, SemaConnect
February 2015	Webasto
August 2015	EVgo
June 2018	Shell Recharge
April 2019	Electrify America
October 2019	EVgo (OCPI)
January 2020	FLO
August 2020	OpConnect (OCPI)
January 2021	ChargePoint (OCPI), Shell Recharge (OCPI)
June 2022	Rivian Adventure Network (OCPI), Rivian Waypoints (OCPI)
September 2022	EV Connect (OCPI)
December 2022	Blink (OCPI), SemaConnect (OCPI)
January 2023	Volta (OCPI)
April 2023	FLASH (OCPI)
September 2023	EV Range (OCPI)
October 2023	ChargeUp (OCPI), FLO (OCPI)
November 2023	Francis Energy (OCPI)

As of the end of Q4, there were 68,307 available and temporarily unavailable public and private charging stations in the database that are available on the Station Locator or accessible via API or data download (AFDC 2024b). Of those, approximately 71.5% 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 and Communities coalition 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. In Q4, the Station Locator team received an updated list of stations from the Livingston Energy Group network and

National Grid. 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 and Communities 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.