Electric Vehicle Charging Infrastructure Trends from the Alternative Fueling Station Locator: Second Quarter 2021

Abby Brown,[1] Johanna Levene,[1] Alexis Schayowitz,[2] and Emily Klotz[2]

1 National Renewable Energy Laboratory
2 ICF

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List of Acronyms

AFDC	Alternative Fuels Data Center
AMPUP	AmpUp network
API	application program interface
BN	Blink network
CCS	Combined Charging System
CHARGELAB	ChargeLab network
CPN	ChargePoint network
DC	direct-current
E85	ethanol blend containing 51% to 83% ethanol, depending on geography and season
EA	Electrify America network
EHC	Electric Highway Coalition
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
EVSE	electric vehicle supply equipment
EVSP	electric vehicle service provider
FCN	Francis Energy network
FLO	FLO network
FPLEV	FPL EVolution network
GRN	Greenlots network
HD	heavy-duty
L1	Level 1 charger
L2	Level 2 charger
LD	light-duty
LIVINGSTON	Livingston Energy Group network
MD	medium-duty
NON	non-networked
NREL	National Renewable Energy Laboratory
OC	OpConnect network
OCPI	Open Charge Point Interface
OEM	original equipment manufacturer
PHEV	plug-in hybrid electric vehicle
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
SCN	SemaConnect network
TESLA	Tesla Supercharger network
TESLAD	Tesla Destination network
VLTA	Volta network
WEB	Webasto network

ZEFNET	ZEF network

Executive Summary

The U.S. Department of Energy's Alternative Fueling Station Locator contains information on public and private nonresidential alternative fueling stations in the United States and Canada and currently tracks ethanol (E85), biodiesel, compressed natural gas, electric vehicle (EV) charging, hydrogen, liquefied natural gas, and propane stations. Of these fuels, EV charging continues to experience rapidly changing technology and growing infrastructure. This report provides a snapshot of the state of EV charging infrastructure in the United States in the second calendar quarter of 2021 (Q2). Using data from the Station Locator, this report breaks down the growth of public and private charging infrastructure by charging level, network, and location. Additionally, this report measures the current state of charging infrastructure compared with a 2030 infrastructure projection scenario from NREL's 2017 *National Plug-In Electric Vehicle Infrastructure Analysis* This information is intended to help transportation planners, policymakers, researchers, infrastructure developers, and others understand the rapidly changing landscape for EV charging. This is the sixth 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).

All types of electric vehicle supply equipment (EVSE) ports grew in Q2, except for public and private Level 1 EVSE ports, which decreased by 2.3% and 2.0%, respectively. Overall, there was a 4.3% increase in the number of EVSE ports in the Station Locator, and DC fast EVSE ports grew by the largest percentage (6.8%). The Northeast region had the largest increase in public charging infrastructure in Q2 (7.2%), though California, which has almost a third of the country's public charging infrastructure, continues to lead the country in the number of available public EVSE ports.

NREL's 2017 *National Plug-In Electric Vehicle Infrastructure Analysis* estimated how much public and workplace charging infrastructure would be required in the United States to meet charging needs for a central scenario in which 15 million light-duty EVs are on the road by 2030 (601,000 Level 2 and 27,500 DC fast EVSE ports) (Wood et al. 2017). Based on this analysis, 68.3% and 15.8% of the necessary DC fast and Level 2 EVSE ports, respectively, have been installed as of Q2. It is important to note, however, that the majority (56.8%) of public DC fast EVSE ports in the Station Locator are on the Tesla network and are therefore only readily accessible to Tesla drivers. Additionally, the Joseph R. Biden administration has established a goal of building a national public charging network of 500,000 EVSE ports by 2030. To meet this goal by 2030, approximately 14,706 public EVSE port installations will be required each quarter for the next 9 years, requiring a significant increase from the 5,322 public EVSE ports that have been installed each quarter on average since the start of 2020.

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1 Overview of the Station Locator

The U.S. Department of Energy'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 (Alternative Fuels Data Center 2021a). Originally, it served as a hard copy resource for alternative fuel performance data and eventually 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 Lab (NREL) partnered with National Resources Canada to expand the data set to include the location of those same alternative fuel stations across Canada as the Electric Charging and Alternative Fueling Stations Locator, or *Localisateur de stations de recharge et de stations de ravitaillement en carburants de remplacement* (Levene et al. 2019). The Station Locator database now includes information on public and private nonresidential alternative fueling stations in the United States and Canada and 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 as the federal government recently increased its investment in transportation electrification, original equipment manufacturers (OEMs) double down on their electrification commitments, more utilities begin offering incentives for EVs and infrastructure, and states and municipalities set electrification goals and mandates. Using Station Locator data, this report explores the growth of both public and private EV charging infrastructure in the United States for the second calendar quarter of 2021 (Q2). This is the sixth 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).

1.1 EV Charging Data Sources

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. Electric vehicle service providers (EVSPs), responsible for managing a network of EV charging stations (Figure 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, Clean Cities coordinators, 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 backend 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 EVSE, 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 EVSE to be considered a network, it cannot be considered part of another network and it must have a dedictaed platform that allows users to locate EV charging stations as well as initiate and pay for charging events.

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

1.1.1 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 application program interface (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 2 shows a timeline of the integration of the network APIs into the Station Locator data management process. Open Charge Point Interface (OCPI)-based APIs that have been integrated into the Station Locator are also shown in Figure 2. See Section 1.2 for more information on the OCPI protocol.

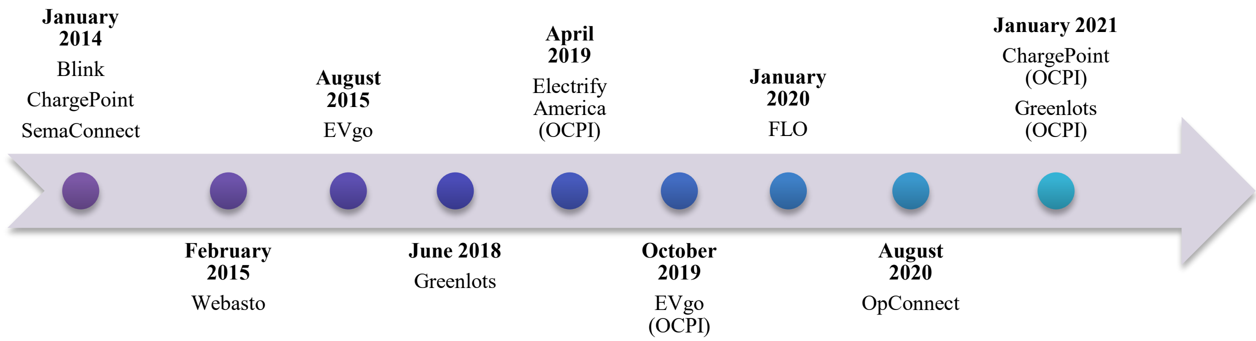

Figure 2. Timeline of API integrations in the Station Locator

As of June 2021, there were 46,533 public and private charging stations in the database, which are available on the Station Locator or accessible via API or data download (Alternative Fuels

Data Center 2021b). Of those, approximately 67% 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.

1.1.2 Manually Collected Data

For non-networked (i.e., not connected to the internet) stations, data sources include trade media, Clean Cities coordinators, a "Submit New Station" form on the Station Locator website, EV charging station manufacturers, electric utilities, OEMs, 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 do not have an API available. These EVSPs include EV Connect, Tesla, and Volta. In Q2, the team received an update from the AmpUp network. 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.

It is important to state these reports reflect a snapshot of the number of available electric vehicle supply equipment (EVSE) ports in the Station Locator at the end of each quarter. Therefore, notable changes may be attributed to the manual data collection process, as new manually added EVSE ports are counted in the quarter in which they are added to the Station Locator as opposed to when the infrastructure was installed. Additionally, stations that are temporarily out of service are not included in these reports.

1.2 EV Charging Data Fields

Current charging infrastructure in the Station Locator generally falls into the following categories:

- **Public:** A broad category that includes EV charging located in publicly accessible areas or along highway corridors.
- **Workplace:** EV charging intended to provide charging to employees during the workday.
- **Commercial/Fleet:** EV charging intended to provide charging for electric fleet vehicles, including municipal/private fleets, car sharing, and transportation network companies.

Note that although fleet data exist in the Station Locator, stations solely for fleet use are not yet designated as such in the Station Locator. The Station Locator team has recently added this level of tracking and will therefore be able to designate stations as such moving forward. See Section 2.2.4 for more details.

Additionally, the Station Locator does not maintain data on single-family residential charging and has minimal, yet expanding, data on charging at multifamily buildings. See Section 2.2.3 for additional details.

In 2019, the Station Locator team began transitioning its counting logic to align with the hierarchy defined in the OCPI protocol: locations, EVSE ports, and connectors (EVRoaming Foundation 2019), as shown in Figure 3 and described in this section. With this transition, the Station Locator is now counting the number of EVSE ports at a station location, rather than the number of connectors as previously counted.

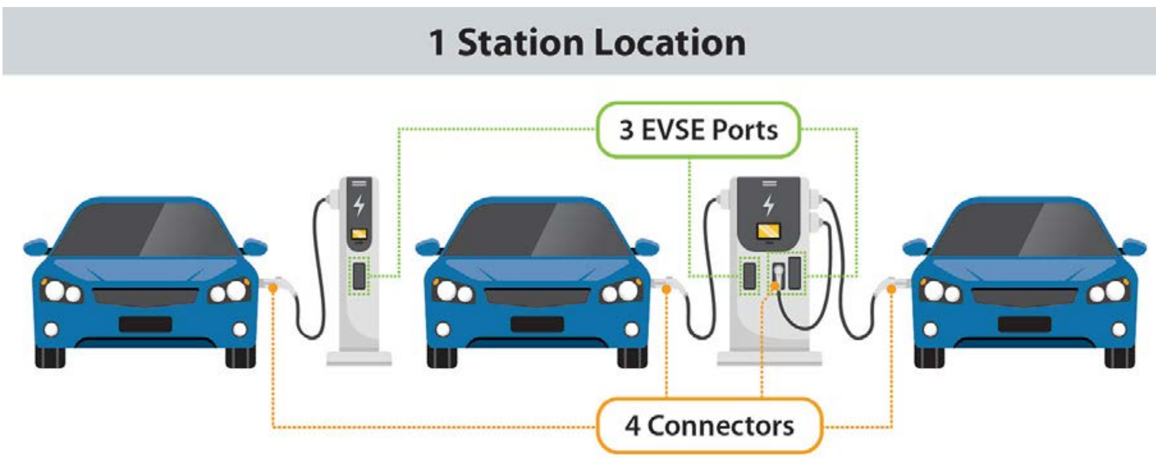

Figure 3. EV charging infrastructure hierarchy

Source: Alternative Fuels Data Center (2021d)

The following fuel-specific fields are tracked in the Station Locator for EV charging stations (Alternative Fuels Data Center 2021c):

- EV charger information:
    - Station location: A site with one or more EVSE ports located at the same address.
    - EVSE port count: The number of outlets or ports available to charge a vehicle (i.e., the number of vehicles that can simultaneously charge at a charging station).
    - EVSE port type
        - Level 1 (L1): 120 V; 1 hour of charging = 2–5 miles of range
        - Level 2 (L2): 240 V; 1 hour of charging = 10–20 miles of range
        - DC fast: 480+ V; 20 minutes of charging = 60–80 miles of range
    - 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 chargers
    - J1772: for Level 1 and Level 2 chargers
    - Combined Charging System (CCS): for DC fast chargers for most vehicle models
    - CHAdeMO: for DC fast chargers for select vehicle models[1]
    - 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.

2 Electric Vehicle Charging Infrastructure Trends

The purpose of this report is to identify EV charging infrastructure trends for Q2 of 2021. However, 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 over the last 10 years (Brown et al. 2020).

In Q2, the number of EVSE ports in the Station Locator grew by 4.3%, or 5,147 EVSE ports. Public EVSE ports grew by 5.0%, and account for the majority of EVSE ports in the Station Locator (Figure 4). Private EVSE ports increased by 0.8%, or 141 EVSE ports (Figure 4).

[1] See the Second Quarter 2020 report for a discussion around which vehicle models use the CHAdeMO standard (Brown et al. 2021a).

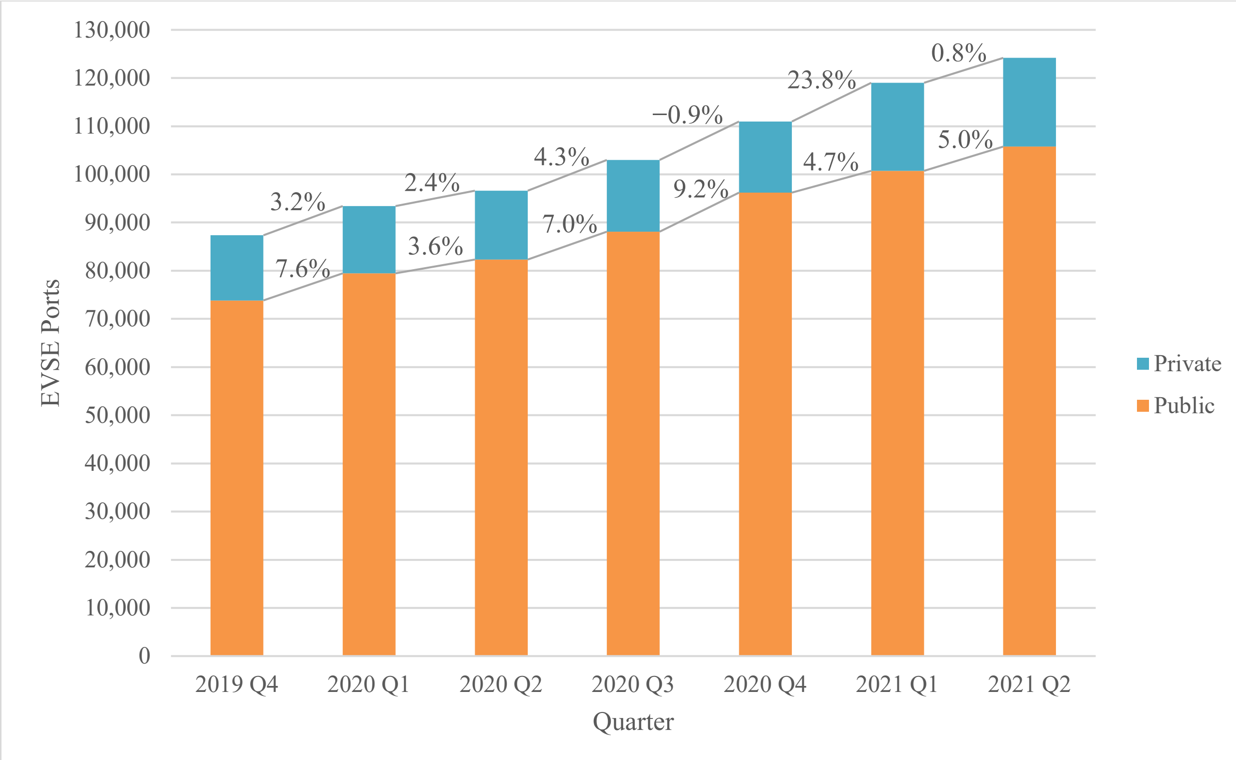

Figure 4. Quarterly growth of EVSE ports by access

The following sections break down the growth of public and private EVSE ports further to highlight what types of EV infrastructure grew in Q2 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 Q2, the number of public EVSE ports in the Station Locator increased by 5,006, bringing the total number of public EVSE ports in the Station Locator to 105,765 and representing a 5.0% increase since Q1. 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 5, 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 increased by the greatest percentage (6.9%) in Q2 (Figure 5). Level 1 EVSE ports decreased by 2.3% (Figure 5). The decrease in public Level 1 EVSE ports can be primarily attributed to closures of ChargePoint stations in California, though the ChargePoint network grew overall in Q2, driven by new Level 2 and DC fast EVSE port installations.

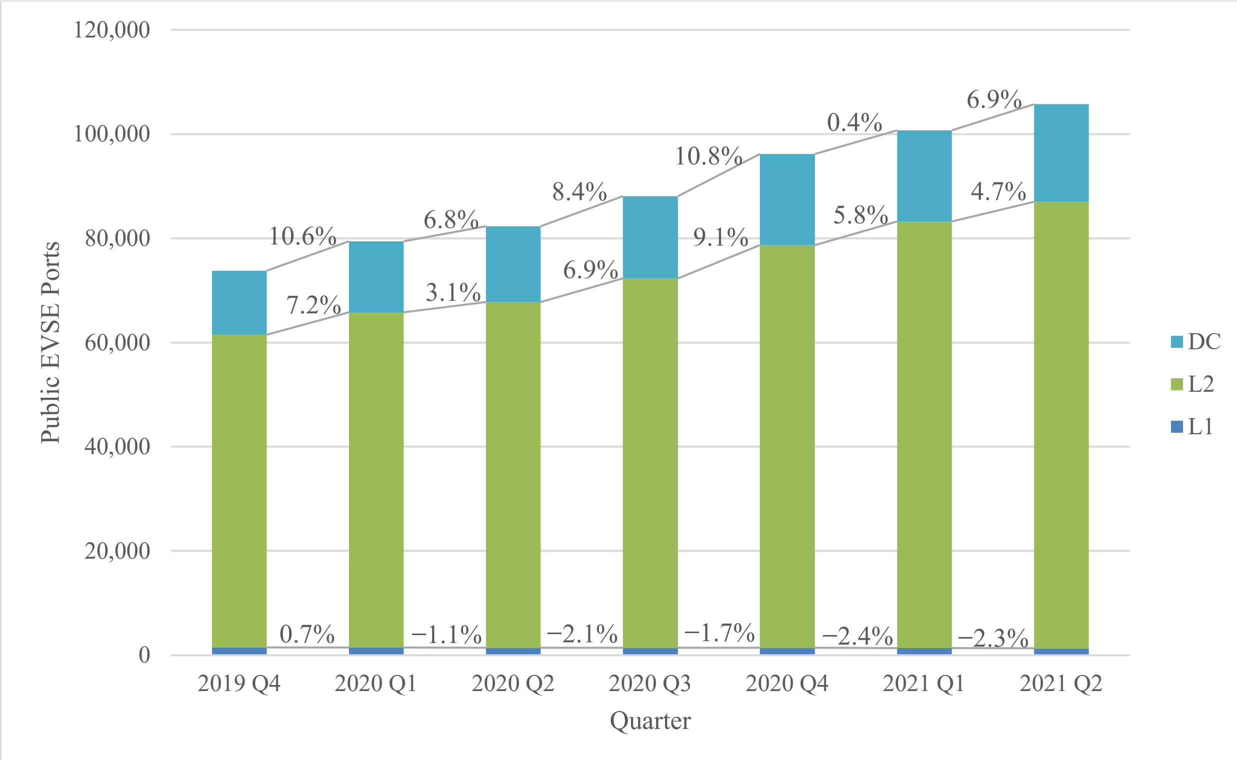

Figure 5. Quarterly growth of public EVSE ports by charging level

Note: Figure excludes legacy EVSE ports.

When compared with Level 1 and Level 2 chargers, DC fast chargers 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 will be 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. DC fast chargers have a typical power output of 50 kW, though DC fast chargers with higher levels of power output are increasingly more available. Extreme fast charging infrastructure, which has a power output of 350 kW or more, was introduced in 2018. As shown in Figure 6, DC fast EVSE ports with these higher power levels remain a minority in the Station Locator.

It is important to point out that of the 18,713 public DC fast EVSE ports in the Station Locator, power output data are currently only available for 42.7%; Figure 6 is therefore based on power output data for 7,986 DC fast EVSE ports. NREL is in the process of integrating updated OCPI-based APIs to streamline the collection of power output data and create a more complete data set. Additionally, if a DC fast EVSE port has two connectors with different power outputs, only the maximum power output is counted in Figure 6.

As shown in Figure 6, the number of EVSE ports with a power output between 51 kW and 299 kW grew by the largest percentage in Q2 (31.3%). This increase is primarily driven by new installations of DC fast EVSE ports on the Electrify America, EVgo, ChargePoint, and Tesla Supercharger networks with a power output ranging from 100 kW to 250 kW.

Additionally, Electrify America temporarily adjusts the power output of its DC fast chargers down to 50 kW while maintenance or upgrades are being performed. This contributed to the decreases seen in 2020 Q3, as well as the increases seen in 2020 Q4, as the chargers that had been adjusted down to 50 kW were adjusted back to their original, higher power output (Figure 6). These reports represent a snapshot of the available electric vehicle supply equipment (EVSE) ports in the Station Locator at the end of each quarter; therefore the Station Locator team expects to continue to see fluctuations in DC fast power output data as a result of these adjustments. For an explanation of the large changes seen in 2021 Q1, see the 2021 Q1 report (Brown et al. 2021b).

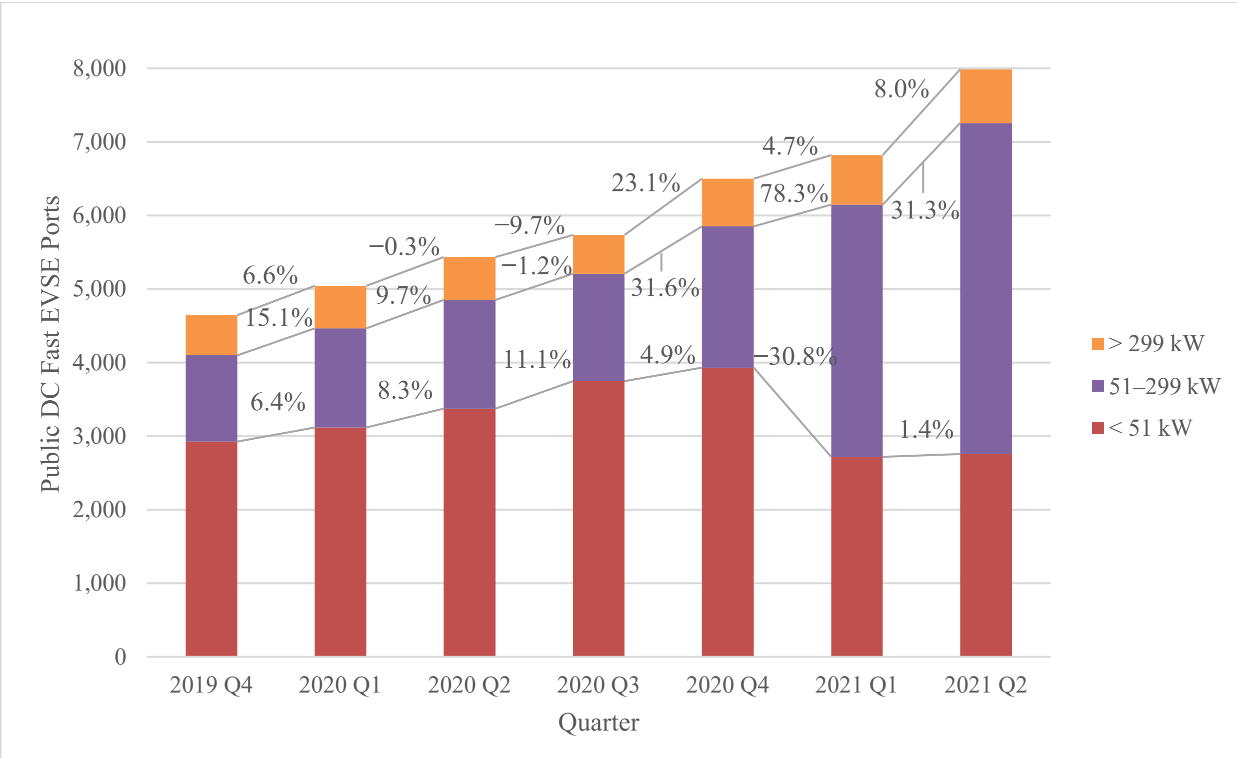

Figure 6. Quarterly growth of public DC fast EVSE ports by power output

Finally, there are currently three types of connectors available for DC fast chargers: CHAdeMO, CCS, and Tesla. As noted in Section 1.2, 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 vehicle (PHEV) are the only models still being produced in the United States with the CHAdeMO connector standard. Only Tesla vehicles can charge with the Tesla connector. At the end of 2020, 50% of registered EVs in the United States were compatible with the CCS connector, 42.5% of registered EVs were Teslas, and 7.5% of registered EVs were compatible with the CHAdeMO connector (Experian 2020).

Of the 22,573 DC fast connectors in the Station Locator as of Q2, Tesla connectors made up 47.1% , a similar market share to the number of Teslas on the road. While the number of CSS connectors grew by almost the same percentage as Tesla connectors in Q2 (6.9% and 7.0%, respectively), CCS connectors made up only 30.5% of DC fast connectors in Q2 compared with the 50% of registered EVs that can charge with a CCS connector. Finally, despite CHAdeMO-compatible vehicles only making up 7.5% of registered EVs, the number of CHAdeMO connectors in the Station Locator continues to grow, and made up 22.5% of DC fast connectors in Q2.

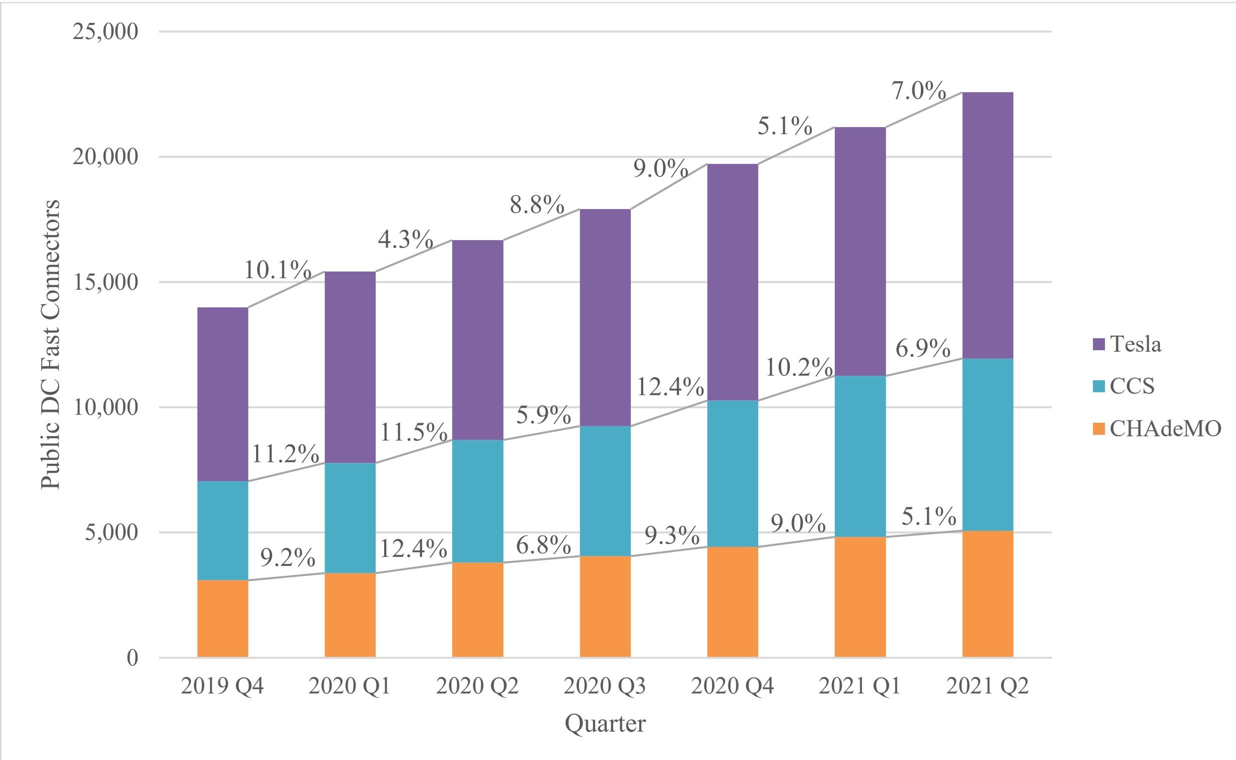

Figure 7. Quarterly growth of public DC fast connectors by type

2.1.2 By Network

As discussed in Section 1.1, the Station Locator team works with most major EVSPs to collect EV charging infrastructure data for the Station Locator. Currently, the Station Locator includes stations on the 22 networks listed below. The Livingston Energy Group network was new to the Station Locator as of Q2. In addition, the Station Locator contains non-networked (NON) station data, which includes stations that were previously networked. Figure 8 shows the growth of networks in the Station Locator since the end of 2019.

- AmpUp (AMPUP)
- Blink (BN)
- ChargeLab (CHARGELAB)
- ChargePoint (CPN)
- Electrify America (EA)
- EV Connect (EVC)
- EV Charging Solutions (EVCS)
- evGateway (EVGATEWAY)
- EVgo (EVN)
- Francis Energy (FCN)
- FLO (FLO)
- FPL EVolution (FPLEV)
- Greenlots (GRN)
- Livingston Energy Group (LIVINGSTON)
- OpConnect (OC)
- Powerflex (POWERFLEX)
- SemaConnect (SCN)

- Tesla Supercharger (TESLA)
- Tesla Destination (TESLAD)
- Volta (VLTA)
- Webasto (WEB)
- ZEF Network (ZEFNET)

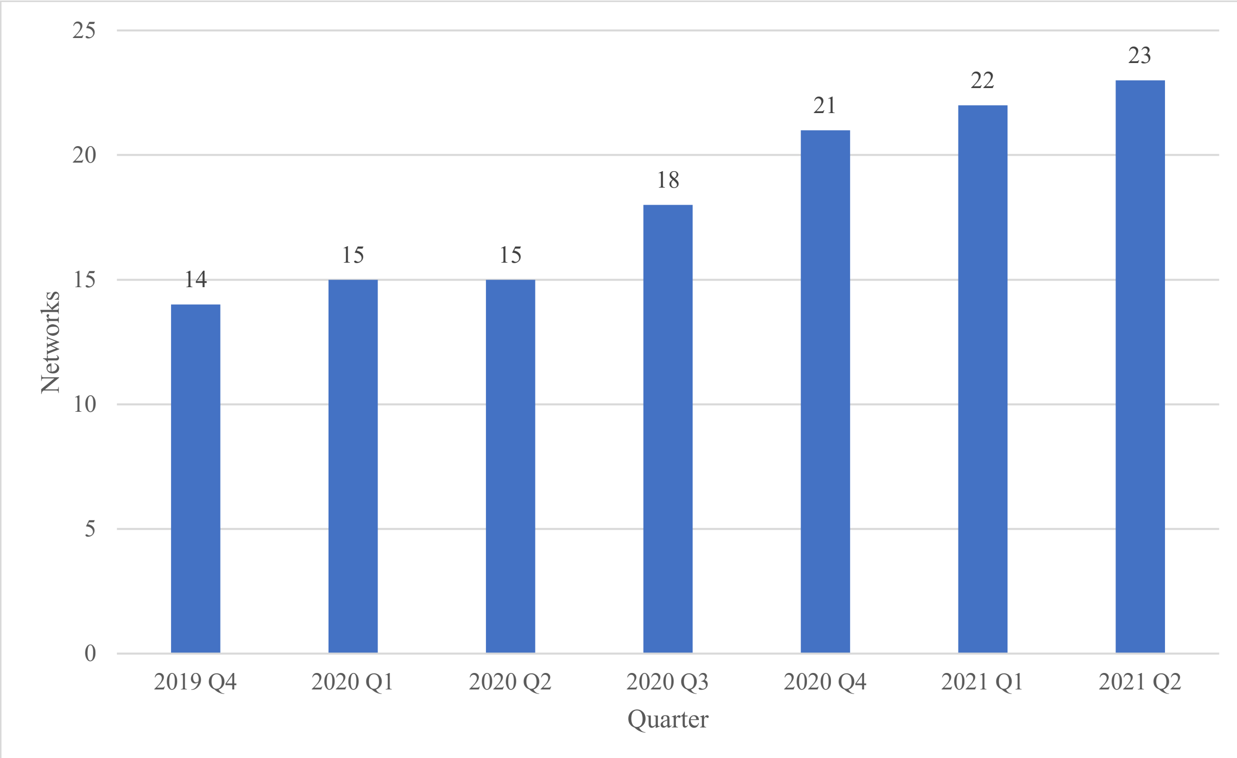

Figure 8. Quarterly growth of networks in the Station Locator

Note: Non-networked stations are counted as one network.

As of the end of Q2, the ChargePoint network accounted for the largest number of public EVSE ports (42.4%) in the Station Locator, and Level 2 chargers constituted the majority of ChargePoint's network (Figure 9). This holds true for many of the networks in the Station Locator, except for the Electrify America, EVgo, Francis Energy, FPL EVolution, and Tesla Supercharger networks. These networks are predominately, if not completely, made up of DC fast chargers. Of the networks with DC fast chargers, Tesla Supercharger has the largest share of public DC fast EVSE ports (56.8%), followed by Electrify America (14.7%) and EVgo (8.1%) (Figure 10).

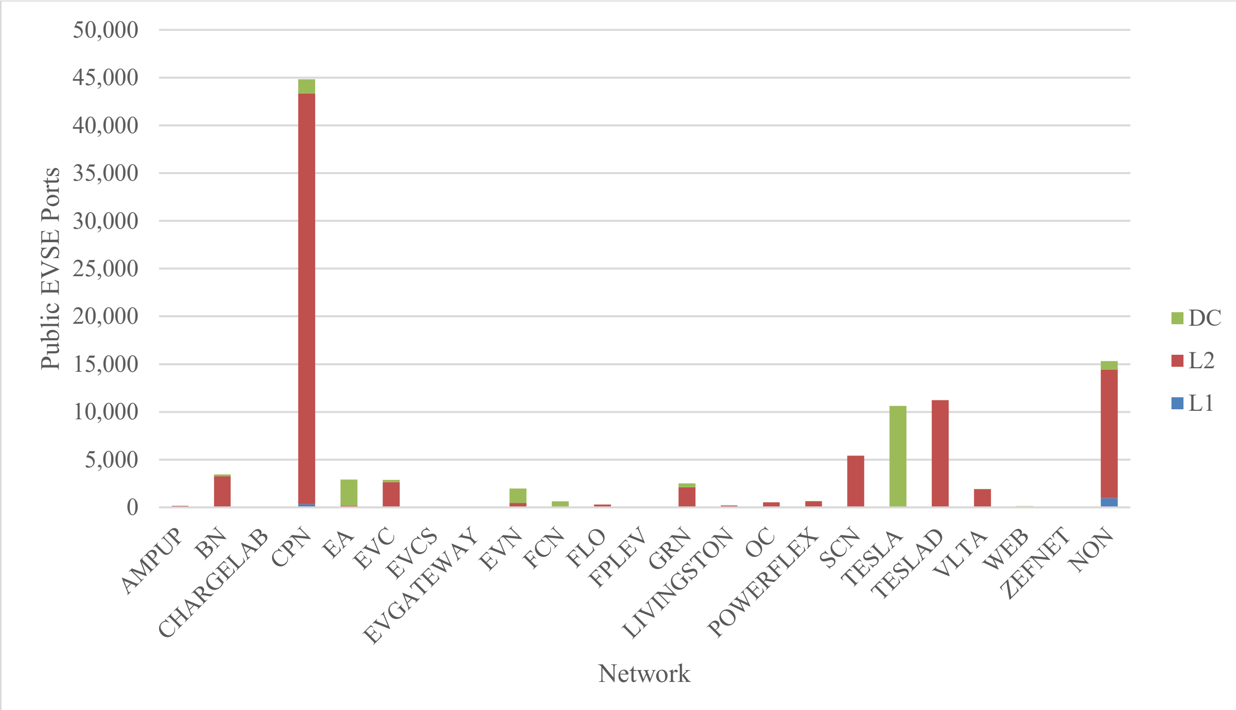

Figure 9. Breakdown of public EVSE ports by network and charging level in Q2

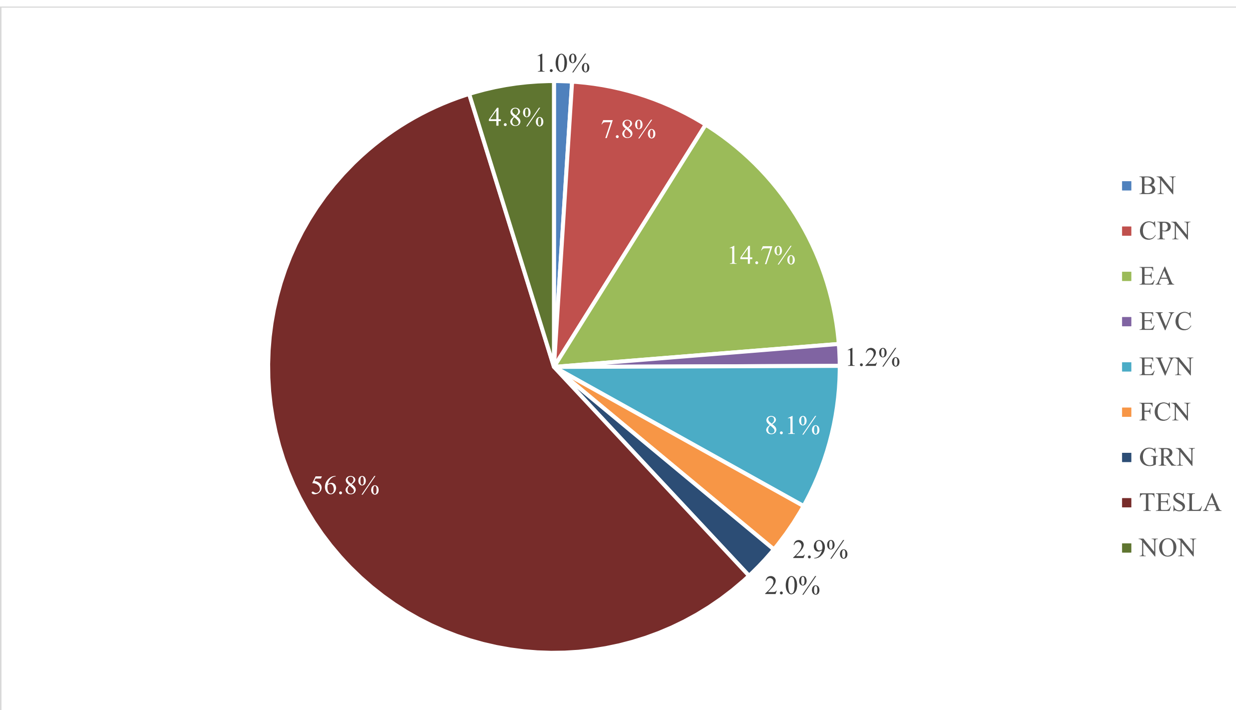

Figure 10. Breakdown of public DC fast EVSE ports by network in Q2

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

Figure 11 shows the growth of each network in Q2, and Table 1 includes the percent growth of each network in Q2. Livingston Energy Group is excluded from Table 1 because it was new to the Station Locator in Q2. The number of public EVSE ports on all networks increased in Q2, with AmpUp, EVgo, Greenlots, and Volta all growing by more than 10% (Table 1). As a result of a large update that AmpUp shared with the Station Locator in Q2, AmpUp grew by the largest percentage (154.5%), which represents an increase of 102 EVSE ports (Table 1). The increase on EVgo's network (12.4%) is primarily due to new DC fast EVSE installations, and is notable given the smaller growth seen in previous quarters. In July 2020, EVgo and General Motors announced plans to add more than 2,700 DC fast chargers throughout the United States through 2025, and in April, the first stations from this collaboration opened in California, Florida, and Washington State (EVgo 2021). The Station Locator team expects to see continued growth on EVgo's network in future quarters.

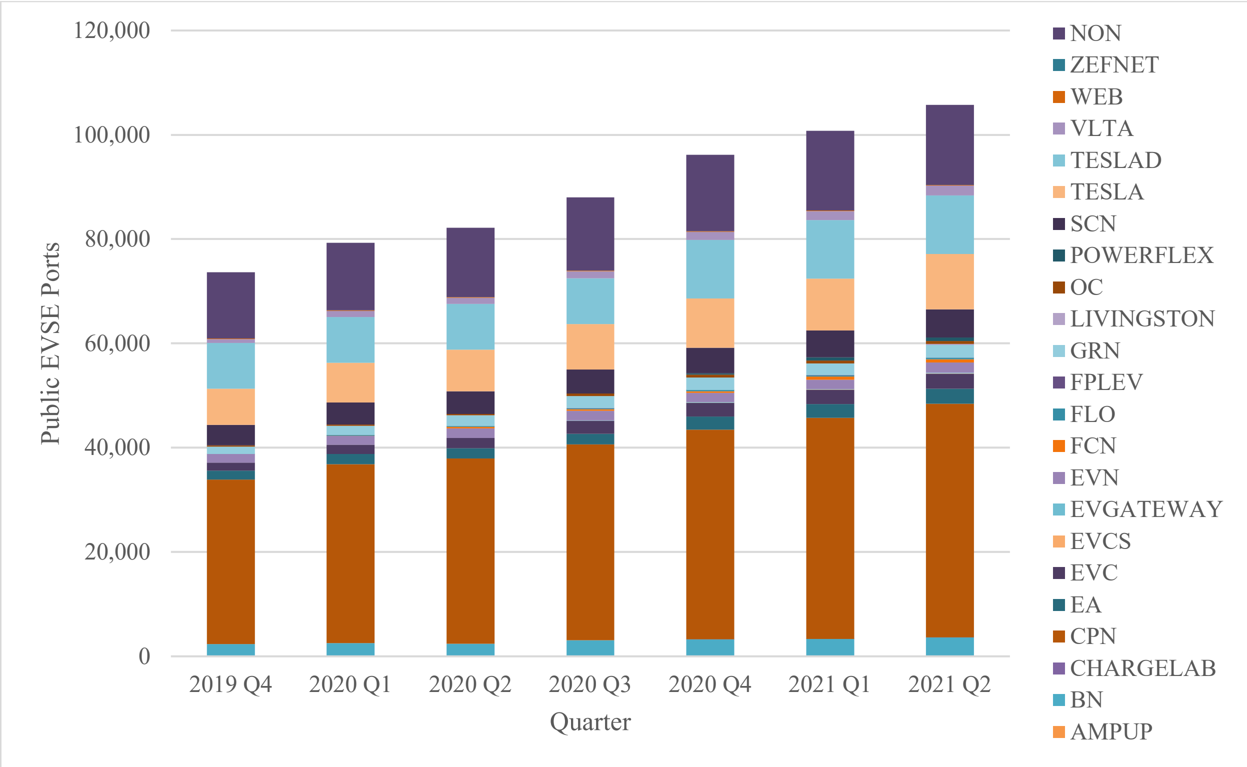

Figure 11. Quarterly growth of public EVSE ports by network

Table 1. Quarterly Growth of Public EVSE Ports by Network

Network	2020 Q1 Growth	2020 Q2 Growth	2020 Q3 Growth	2020 Q4 Growth	2021 Q1 Growth	2021 Q2 Growth
NON	1.8%	3.0%	5.0%	5.0%	3.7%	0.7%
ZEFNET	N/A	N/A	N/A	N/A	N/A	0.0%
WEB	0.9%	−0.9%	0.0%	0.0%	0.0%	0.0%
VLTA	53.5%	0.0%	17.9%	11.8%	10.8%	12.2%
TESLAD	0.2%	0.0%	0.2%	27.5%	0.3%	0.1%
TESLA	10.1%	4.3%	8.8%	9.0%	5.1%	7.0%
SCN	7.6%	2.6%	6.6%	5.6%	5.3%	4.5%
POWERFLEX	N/A	N/A	N/A	13,400.0%	133.7%	0.0%
OC	0.0%	4.9%	87.2%	13.7%	0.0%	0.4%
GRN	24.2%	18.9%	13.0%	5.0%	−6.7%	10.9%
FPLEV	N/A	N/A	N/A	0.0%	0.0%	0.0%
FLO	N/A	25.8%	3.7%	−0.5%	35.9%	5.6%
FCN	0.0%	31,100.0%	0.0%	0.0%	101.0%	0.0%
EVN	3.2%	2.2%	1.2%	−0.3%	−3.3%	12.4%
EVGATEWAY	N/A	N/A	N/A	2.9%	2.8%	0.0%
EVCS	N/A	N/A	N/A	N/A	8.3%	0.0%
EVC	17.7%	11.2%	29.8%	3.2%	4.1%	5.1%
EA	11.9%	2.3%	1.2%	23.9%	6.8%	9.0%
CPN	9.0%	3.4%	5.7%	7.1%	5.4%	5.8%
CHARGELAB	N/A	N/A	N/A	N/A	0.0%	0.0%
BN	5.5%	−3.4%	27.3%	3.5%	2.8%	5.0%
AMPUP	N/A	N/A	N/A	N/A	10.0%	154.5%
Total	7.6%	3.3%	7.0%	9.2%	4.7%	5.0%

2.1.3 By Region

The Clean Cities Coalition Network is broken down into seven regions (Figure 12), which were used to analyze the growth of public EV charging infrastructure across the country (Clean Cities Coalition Network 2021a). See the first report in this series for more information about the Clean Cities Coalition Network (Brown et al. 2020).

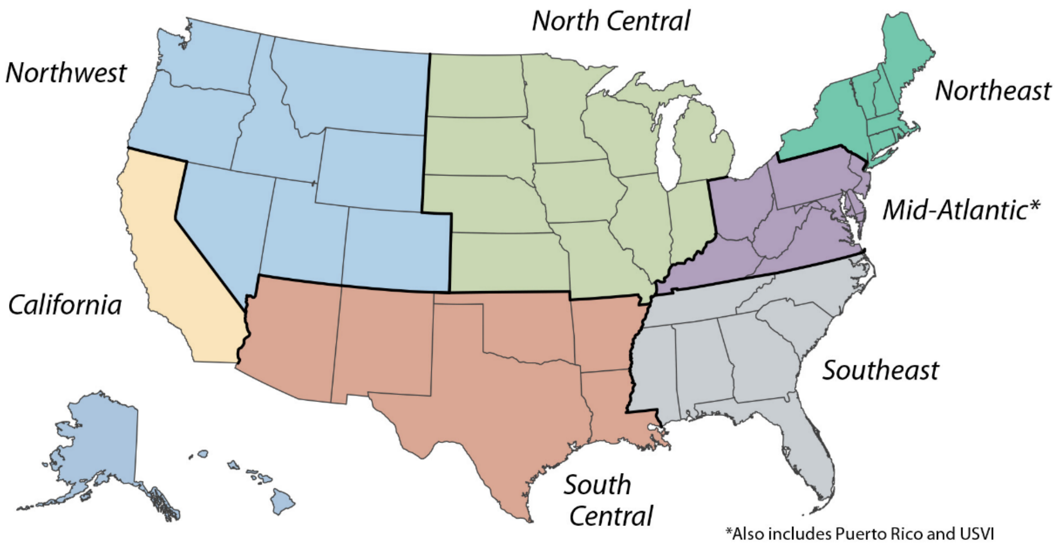

Figure 12. Clean Cities regions

Source: Clean Cities Coalition Network (2021b)

As shown in Figure 13, the California region continues to have the largest share of the country's public EVSE ports (31.6%). However, the Northeast region grew by the largest percentage (7.2%) (Figure 13).

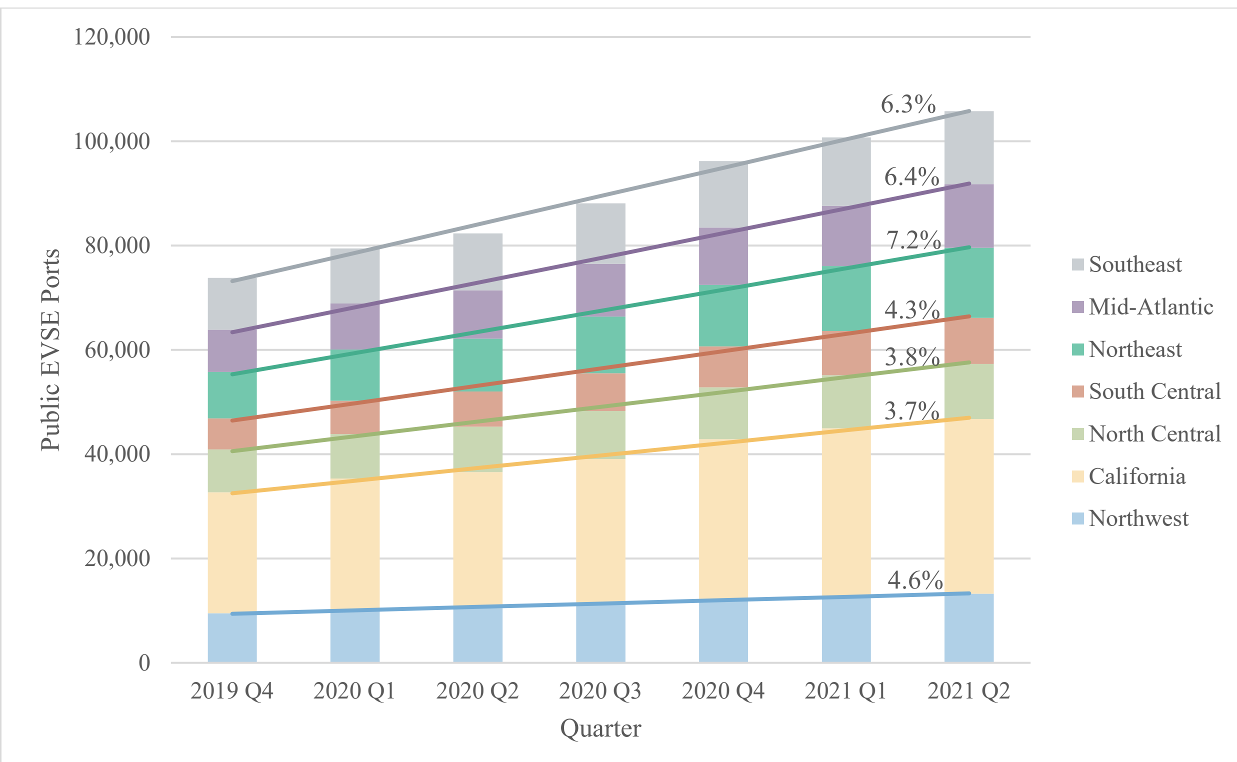

Figure 13. Quarterly growth of public EVSE ports by Clean Cities region

2.1.4 By State

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 proportional impact. Washington, D.C., is considered a state for the purpose of this analysis, and the registration data are from Experian (Experian Information Solutions 2020). Because the registration data account for the number of registered vehicles at the end of each year, this section looks at the growth of public EVSE ports per 100 light-duty EV registrations in 2020 (i.e., from 2019 Q4 to 2020 Q4).

As discussed in the previous section, California has the largest share of the United States' public EVSE ports. Additionally, as of the end of 2020, 42.8% of all light-duty EV registrations were in California (Experian Information Solutions 2020). However, when looking at the number of EVSE ports per 100 EVs, California ranks among the lowest, with 4.4 EVSE ports per 100 EVs (Table 2). This is due to the high rate of EV adoption in California compared with other states. As of the end of 2020, Wyoming had the highest rate of EVSE ports per 100 EVs with 28.8 EVSE ports per 100 EVs (Table 3); however, Wyoming had 0.2% of the United States' share of public EVSE ports and 0.04% of the country's share of EV registrations as of the end of 2020 (Experian Information Solutions 2020).

Table 2. Top Five States With the Lowest Rate of EVSE Ports per 100 EVs as of 2020 Q4

State	EVSE ports per 100 EVs
New Jersey	3.2
Arizona	4.2
California	4.4
Washington State	5.0
Hawaii	5.1

Table 3. Top Five States With the Highest Rate of EVSE Ports per 100 EVs as of 2020 Q4

State	EVSE ports per 100 EVs
Wyoming	28.8
North Dakota	19.8
Mississippi	18.9
West Virginia	17.8
Vermont	17.1

The five states that had the largest growth of EVSE ports per 100 EVs in 2020 were Oklahoma, North Dakota, Alaska, Utah, and Washington, D.C. (Table 4). As discussed in the 2021 Q1 report, there was a large increase of public EVSE ports in Oklahoma due to an update received from the Francis Energy network (Brown et al. 2021b). Overall, in 2020, the number of public EVSE ports in Oklahoma increased by 122.2%, or 352 EVSE ports, and since 2018, Oklahoma has had the largest growth of EVSE ports of all states. Based on conversations that NREL had with stakeholders, the State of Oklahoma has been able to rapidly deploy charging infrastructure in partnership with Francis Energy by developing a statewide plan and leveraging federal resources, such as the Federal Highway Administration's Alternative Fuel Corridor Program and the U.S. Department of Energy's Clean Cities Coalition Network; state incentives, including a tax credit for public charging infrastructure; and funding from ChargeOK, the Oklahoma Department of Environmental Quality's program that funds charging infrastructure with funds from the Volkswagen Environmental Mitigation Trust. Additionally, the Cherokee Nation is a designated beneficiary of the Volkswagen Indian Tribe Trust and has been using its funds to install EVSE ports and purchase electric buses, which has further contributed to this growth.

Table 4. Top Five States With the Largest Growth of EVSE Ports per 100 EVs in 2020

State	Growth of EVSE ports per 100 EVs
Oklahoma	113.6%
North Dakota	79.0%
Alaska	62.8%
Utah	29.3%
Washington, D.C.	18.3%

2.2 Private Charging Trends

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 chargers 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, the number of private, nonresidential charging stations in the Station Locator is likely underrepresented; however, the Station Locator team is continually working to improve the data collection in these areas.

In Q2, the number of private EVSE ports in the Station Locator increased by 141, bringing the total number to 18,416 and representing a 0.8% increase since Q1.The following sections break down the growth of private EVSE ports by level, as well as by three specific types: workplace, multifamily building, and fleet charging.

2.2.1 By Charging Level

As shown in Figure 14, the majority of private EVSE ports in the Station Locator are Level 2. Although DC fast EVSE ports grew by the largest percentage in Q2 (5.8%), Level 2 EVSE ports experienced the largest absolute growth with the addition of 166 EVSE ports (Figure 14). Level 1 EVSE ports decreased in Q2 by 2.0% as a result of a decrease in workplace EVSE (Figure 14).

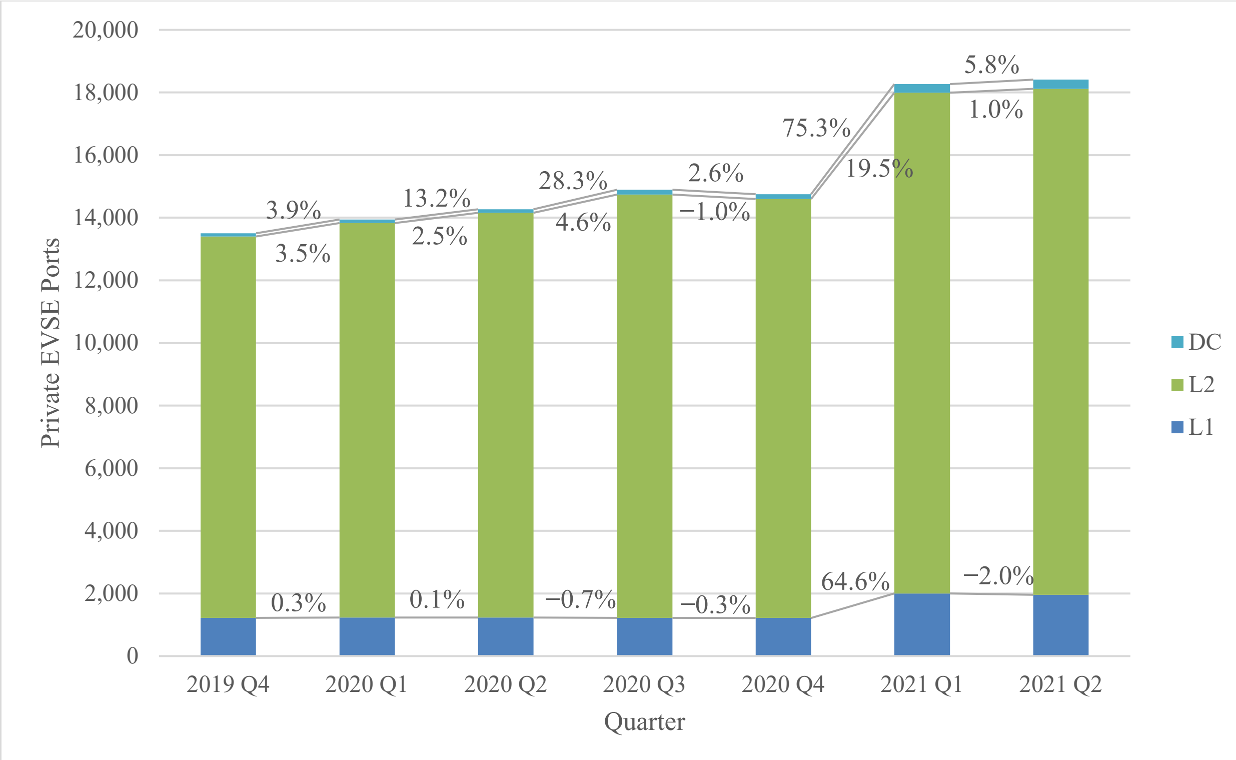

Figure 14. Quarterly growth of private EVSE ports by charging level

Note: Figure excludes legacy EVSE ports.

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 15), 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 of the end of Q2, there were 9,998 workplace EVSE ports in the Station Locator. As shown in Figure 15, the number of DC fast EVSE ports grew by the greatest percentage (12.0%) at workplaces in Q2, though this only represents the addition of six EVSE ports.

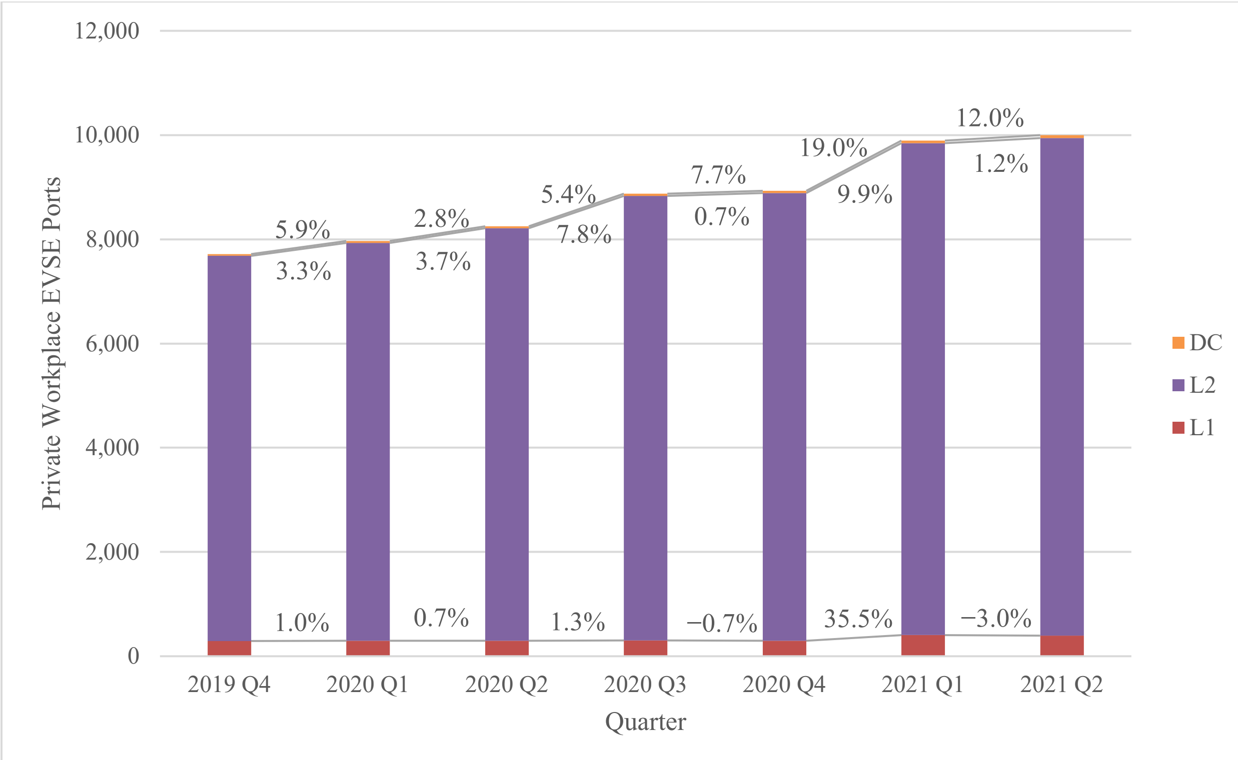

Figure 15. Quarterly growth of private workplace EVSE ports by charging level

2.2.3 Multifamily Building Charging

In 2019, the Station Locator team began a focused effort to capture private charging infrastructure installed at multifamily buildings that is available for resident use only. In Q2, there was a 3.7% increase in EVSE ports at multifamily buildings, bringing the total number of EVSE ports to 884 (Figure 16). Multifamily building EVSE ports in the Station Locator are either Level 1 or Level 2, but as with previous quarters, only Level 2 EVSE ports grew in Q2 (Figure 16).

The Station Locator team continues its concerted efforts to collect data on EVSE ports at multifamily buildings, and the number of these EVSE ports is likely to continue to grow in future quarters.

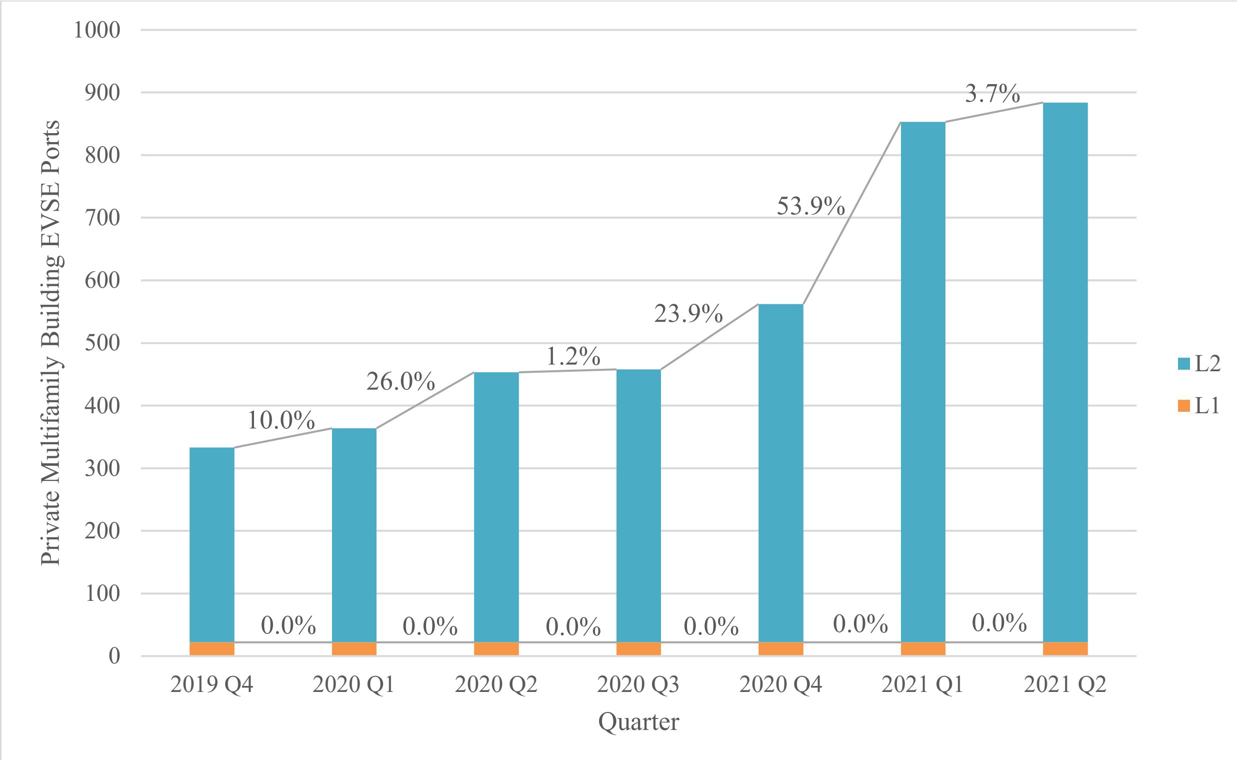

Figure 16. Quarterly growth of private multifamily building EVSE ports by charging level

2.2.4 Fleet Charging

In 2020, the Station Locator team began collecting data on whether stations are dedicated fleet charging stations, and if so, what types of vehicles charge at the station based on the Federal Highway Administration weight class (i.e., light-duty [LD], medium-duty [MD], or heavy-duty [HD] vehicles). As of Q2, the team has collected this information for 85.1% of private EVSE ports, of which 46.2% are being used for fleet charging purposes. Note that some fleet EVSE ports are also used by employees, and are therefore counted in Section 2.2.2 as well.

Figure 17 shows the breakdown of these EVSE ports by fleet type and charging level. The fleet type indicates the largest vehicle type that charged at the station as of Q2, though other vehicle types may charge at the station as well. The majority of EVs on the road are LD vehicles, such as sedans, sports utility vehicles (SUVs), and pickup trucks; unsurprisingly, the majority of fleet charging EVSE ports are used to charge LD vehicles, and the majority of fleet charging EVSE ports are Level 2 (74.5%).

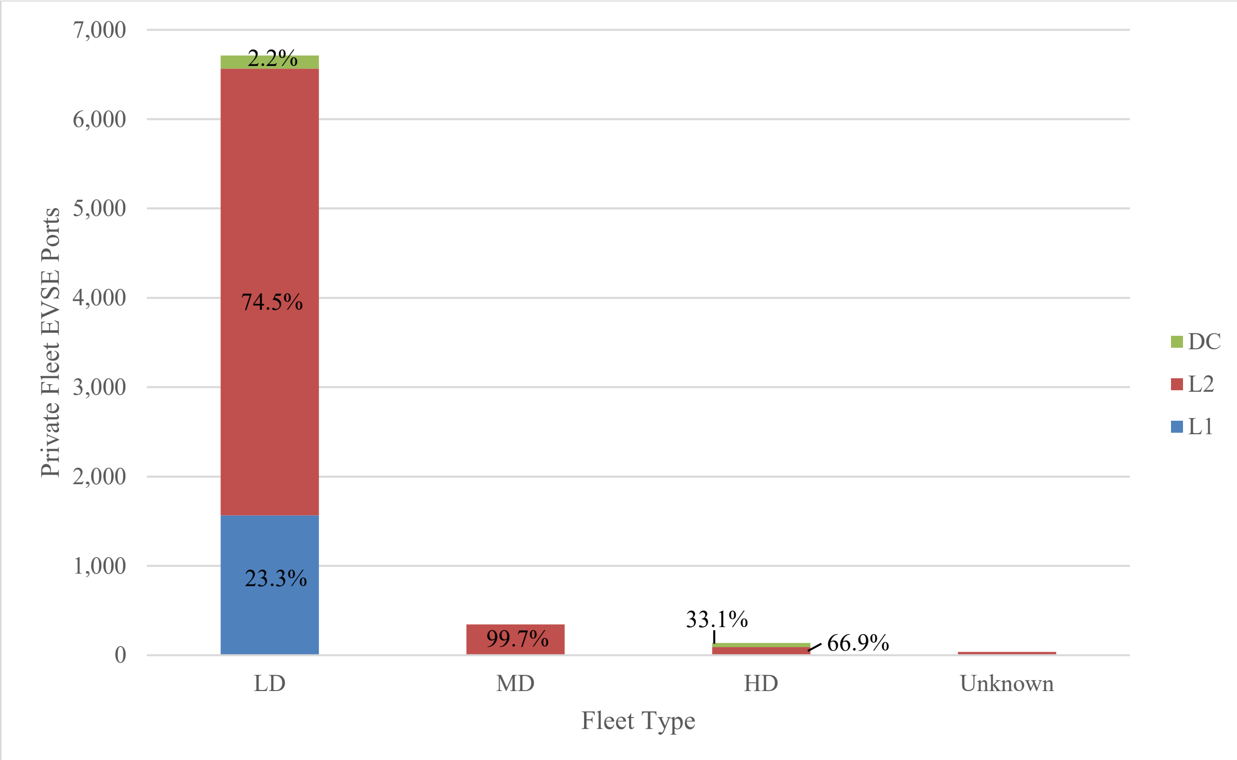

Figure 17. Breakdown of private fleet EVSE ports by fleet type and charging level in Q2

In 2021, the Station Locator team will continue to expand its private fleet data collection efforts, especially for fleets that are installing charging infrastructure for MD and HD vehicles such as school bus fleets and public transit fleets. Additionally, the Station Locator team is tracking the development of MD and HD charging infrastructure and will collect additional data, such as new connector types, as the technology evolves and is deployed.

3 Projecting Future Charging Infrastructure Needs

As discussed in the 2021 Q1 report as well as Section 4, the Joseph R. Biden administration's American Jobs Plan (Plan) establishes grant and incentive programs for the state, local, and private sectors to build a network of 500,000 public EVSE ports in the United States by 2030 (The White House 2021b).[2] As the corresponding legislation and budget had not yet passed as of Q2, installations funded as a result of this Plan have not begun. Additionally, it is unclear whether this goal means that 500,000 additional EVSE ports will be funded by 2030, or enough EVSE ports will be funded so that the total number of EVSE ports in the United States reaches 500,000 by 2030. However, this figure serves as a useful benchmark for where the country's charging infrastructure is headed and what will be required to achieve it. To put this goal into context, the number of public EVSE ports in the Station Locator has grown by an average of 5,322 EVSE ports per quarter since the beginning of 2020. If the Biden administration's goal is

[2] The Plan establishes a goal of installing 500,000 public charging stations by 2030 but does not specifically outline whether a charging station means a location or an EVSE port as defined in Section 1.2. For the purposes of this report, it was assumed that charging station refers to a single-port charger, and therefore 500,000 EVSE ports.

additive, this pace will need to increase to 14,706 public EVSE port installations each quarter for the next 9 years. If the Biden administration's goal is cumulative, then the number of public EVSE port installations is 21.2% of the way towards the administration's goal as of Q2, and approximately 11,595 public EVSE port installations will be required each quarter for the next nine years. Either way, the pace of installations will need to increase significantly.

Details regarding how many Level 2 versus DC fast EVSE ports installations will be required under the Plan have not yet been released; however, NREL's 2017 *National Plug-In Electric Vehicle Infrastructure Analysis* estimated how much public and workplace EV charging infrastructure would be required in the United States to support a growing fleet of light-duty EVs, including both PHEVs and all-electric vehicles (Wood et al. 2017). The analysis' central scenario assumes a linear growth of EV sales to 20% of all light-duty vehicle sales by 2030, which results in 15 million light-duty EVs on the road by 2030. Based on this scenario a total of 27,500 DC fast EVSE ports and 601,000 Level 2 EVSE ports would be required across the United States. This equates to 1.8 DC fast EVSE ports per 1,000 EVs and 40.1 Level 2 EVSE ports per 1,000 EVs..

It is important to point out that this analysis may underrepresent the trajectory of the industry given that it is based on projections from 2017. Since then, some states have established more ambitious electrification plans or have passed regulations to phase out new sales of gasoline-powered light-duty vehicles and increase sales of zero-emission light-duty vehicles. These regulations will therefore increase the number of EVs on the road and the charging infrastructure required to support them. As a result, individual states are likely to set charging infrastructure targets for their states that may not align with the above analysis. Further, OEM electrification investments have increased considerably, with some OEMs committing to only selling EVs in the future, and at the end of Q2 EV sales made up 3.8% of new light-duty vehicle sales, up from 1.1% in 2017 (Zhou 2021). However, for the purposes of this report, this analysis provides an opportunity to benchmark where the country's charging infrastructure currently stands against one possible scenario.

As of Q2, there were 18,769 public and workplace DC fast EVSE ports and 95,208 public and workplace Level 2 EVSE ports available in the United States (Figure 18). Based on NREL's 2017 analysis, the amount of DC fast and Level 2 EVSE ports installed is 68.3% and 15.8%, respectively, of the way toward meeting projected 2030 infrastructure requirements to support 15 millions EVs (Figure 18). As with previous quarters, it is important to note that 56.8% of public DC fast EVSE ports in the Station Locator are on the Tesla Supercharger network, and are therefore only readily accessible to Tesla drivers. Additionally, as of the end of June 2021, over 40% of EVs on the road were Teslas (Experian 2020; Atlas Public Policy 2021b).[3] When public Tesla EVSE ports are excluded, the amount of DC fast and Level 2 EVSE ports currently installed decreases 29.6% and 14.0%, respectively, of the way toward meeting projected 2030 infrastructure requirements.

[3] As of 2021 Q2, the Station Locator team has acquired light-duty EV registration data through 2020. Therefore, this percentage is based on the number of Teslas registered in the United States in 2020, the total number of light-duty EVs registered in the United States in 2020, and 2021 light-duty EV sales data. This figure does not account for Teslas that have been retired in 2021 or total light-duty EVs that have been retired in 2021.

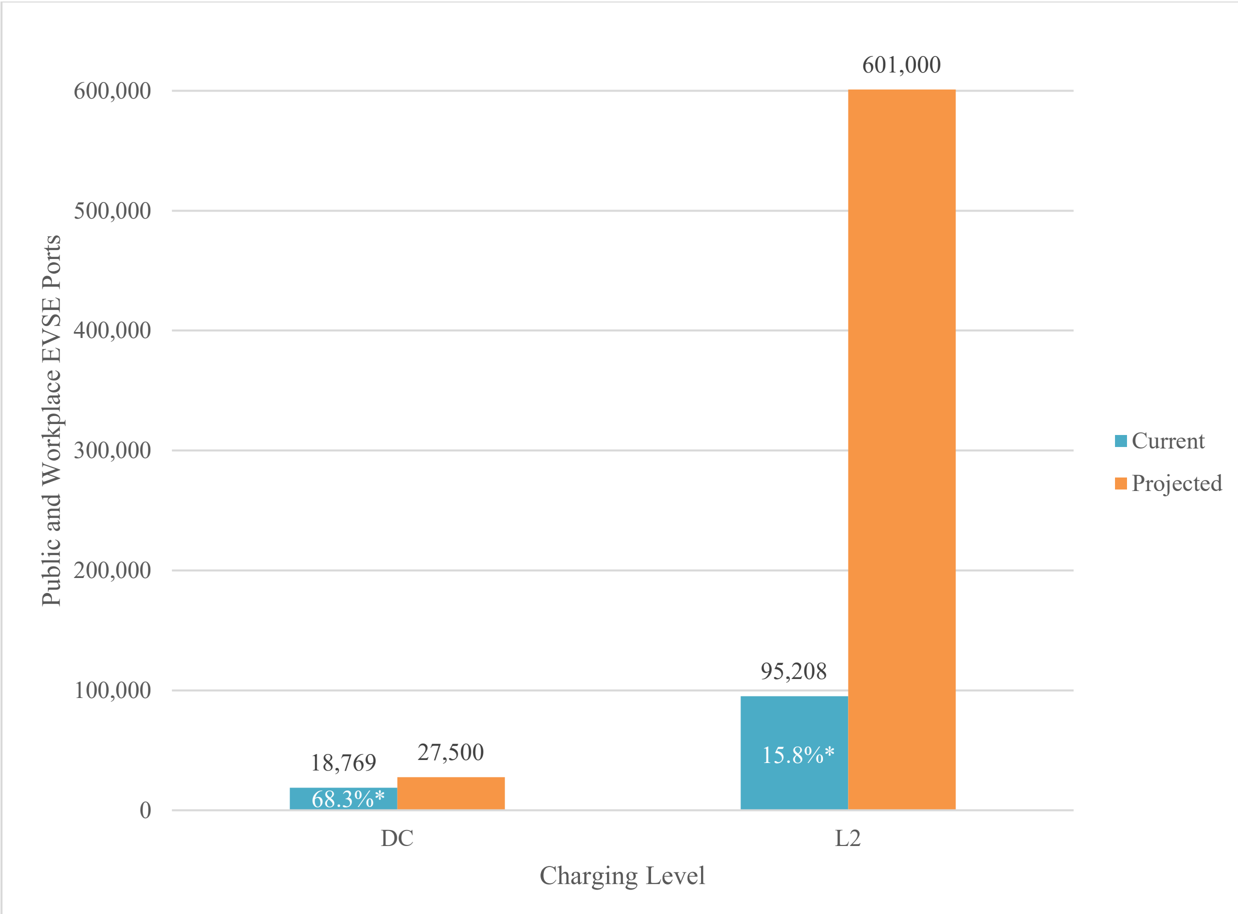

Figure 18. Current availability and projected 2030 need of public and workplace charging in the United States to support 15 million EVs

*Indicates the percent of projected EVSE ports that have been installed as of Q2.

As of Q2, there were approximately 1.8 million EVs in the United States' light-duty fleet (Experian 2020; Zhou 2021).[4] The ratios of DC fast and Level 2 public and workplace EVSE ports per 1,000 EVs in Q2 were 10.0 and 51.0, respectively (Figure 19). These ratios decrease to 4.4 and 45.0 when Tesla EVSE ports are excluded. Using NREL's 2017 analysis' estimated ratios of 1.8 DC fast and 40.1 Level 2 EVSE ports per 1,000 EVs as a proxy for how much infrastructure is sufficient to meet charging needs, Figure 19 indicates that as of Q2, public and workplace DC fast and Level 2 EVSE ports are keeping up with current charging needs in this scenario. However, this comparison does not speak to whether the geographic distribution of EVSE ports matches where there is charging demand. Future reports will include more granular data on the geographic distribution of EVSE ports across the United States. Additionally, it is

[4] As of 2021 Q2, the Station Locator team has acquired light-duty EV registration data through 2020. The number of EVs as of June 2021 is therefore based on 2020 EV registration data and 2021 light-duty EV sales data. The 1.8 million figure does not account for vehicles that have been retired in 2021 and may slightly overestimate the number of EVs on the road.

notable that only 12.5% of the 15 million light-duty EVs projected for 2030 were on the road as of Q2, despite the rapid growth of the EV market in 2021 so far.

Figure 19. Quarterly availability and projected 2030 need of public and workplace EVSE ports per 1,000 EVs in the United States to support 15 million EVs[5]

4 Developments That Could Impact Future Quarters

After much negotiation in Congress over the Investing in a New Vision for the Environment and Surface Transportation (INVEST) in America Act (H.R. 3684), also referred to as the infrastructure bill, President Biden and Vice President Harris announced their support for a bipartisan infrastructure deal at the end of June (The White House 2021b). The Bipartisan Infrastructure Framework includes $1.2 trillion, including $579 billion in new spending, to support the initiatives Biden proposed in the Plan, but allocates significantly less funding for EVs and EV charging infrastructure than originally proposed (The White House 2021b). The Plan included $174 billion in transportation electrification investments, $15 billion of which would fund EV charging infrastructure development (The White House 2021a, 2021c). This figure has been cut in half to $7.5 billion in the Bipartisan Infrastructure Framework (The White House 2021b). However, the Biden administration has not adjusted its target of building 500,000 public EV chargers in the United States by 2030 (The White House 2021b). The Bipartisan

[5] In previous reports, Figure 19 was based on 2018 light-duty EV registration data and 2019 and 2020 light-duty EV sales data. Figure 19 is now based on 2019 and 2020 light-duty EV registration data as well as light-duty EV sales data for 2020 and 2021 to more accurately represent the number of light-duty EVs on the road. This resulted in a decrease of 22,573 light-duty EVs in each quarter in 2020 and a decrease of 23,828 light-duty EVs in 2021 Q1.

Infrastructure Framework also allocates $7.5 billion for electrifying school and transit buses, bringing the total amount earmarked for EVs and EV charging infrastructure to $15 billion (The White House 2021b). Despite the reduced funding, if the infrastructure bill passes it will be the largest federal investment in EVs and EV charging infrastructure to date (Atlas Public Policy 2021a).

At the state level, Q2 saw more action to increase zero-emission vehicle sales within state borders. In April, both New Jersey and New York proposed rules to adopt California's Advanced Clean Truck Program, which requires that OEMs incrementally increase medium- and heavy-duty zero-emission vehicles sales in New Jersey beginning in 2024 through 2035 (N.J.A.C. 7:27-31 and 33; NY S.B. S4097 (2021)). Also in April, 12 states—California, Connecticut, Hawaii, Maine, Massachusetts, New Mexico, New Jersey, New York, North Carolina, Oregon, Rhode Island, and Washington State—signed a letter to President Biden urging him to pass legislation that would phase out the sale of light-duty gasoline-powered vehicles in the United States by 2035 (Neuman 2021). This letter follows California's announcement in 2020 that it would enact this phaseout, as well as announcements from a handful of other states that are considering doing the same, including Massachusetts and New Jersey. Washington State was also considering similar legislation, but in May, Governor Jay Inslee vetoed H.B. 1204, which would have banned the sale or registration of new gasoline-powered passenger vehicles in Washington State due to concerns with a provision that would implement a road usage fee in the state (Dow 2021). While it is not likely that the Biden administration will pass such legislation at the federal level, it is likely that more states will move toward this phaseout.

EV sales in the United States remained strong in Q2, and Q2 broke the record for the highest sales in a single quarter to date with almost 150,000 EVs sold (Zhou 2021). Q2 also saw increased EV investment from OEMs, with Ford increasing its commitment from $22 billion to $30 billion by 2025 and GM increasing its commitment from $27 billion to $35 billion through 2025 (Ford 2021; GM 2021). Audi also became the latest OEM to announce plans to only manufacture all-electric vehicles by 2026, and plans to sell its last internal combustion engine vehicle in 2033 (Lambert 2021).

Q2 also saw an increase in commitments to growing the United States' network of DC fast EVSE ports. As discussed in the 2021 Q1 report, in March 2021, six utilities in the Southeast and Midwest formed the Electric Highway Coalition (EHC), which is focused on building a network of DC fast chargers along major highways (Lewis 2021). Since then, another eight utilities have joined EHC, including AVANGRID, Consolidated Edison, DTE Energy, Eversource Energy, Exelon, FirstEnergy Corporation, ITC Holdings Corporation, and National Grid (Tennessee Valley Authority 2021). The EHC now comprises 14 members that represent 29 states and the District of Columbia across the Southeast, Midwest, and Northeast. Additionally, 7-Eleven announced plans to install 500 DC fast EVSE ports at 250 of its stores in the United States and Canada by the end of 2022 (7-Eleven Corporate 2021). The Station Locator team will work with these utilities and 7-Eleven to ensure that the stations installed through these efforts are included in the Station Locator.

Finally, the Station Locator data collection and management processes will continue to impact future EVSE port counts as well. As noted in Section 1.1.1, since 2019, the Station Locator team has been transitioning its counting logic to align with the hierarchy defined in the OCPI protocol:

station locations, EVSE ports, and connectors (EVRoaming Foundation 2019). With this transition, the Station Locator is now counting the number of EVSE ports at a station location rather than the number of connectors, as previously counted. For example, a charging location with one EVSE port and two connectors was previously counted twice, but is now only counted once using the OCPI protocol's counting logic. As of Q2, all manually collected data, as well as EVSE ports on the ChargePoint, Electrify America, EVgo, and Greenlots networks, are counted according to the OCPI logic. Additionally, as discussed in Section 1.1.1, as additional OCPI APIs are integrated into the Station Locator, the Station Locator team may continue to see increases in station counts due to cases where one station is split out into several new stations to represent different physical locations of EVSE ports at one address. Finally, NREL is continuously working with EVSPs to add new APIs to the Station Locator, and as these new APIs come online, there will likely be an increase in the number of EVSE ports in the Station Locator.

5 Conclusion

This report examines the growth of EV infrastructure in the Station Locator, including the growth of public EV charging by charging level, network, region, and state, and the growth of private EV charging by charging level and use type (i.e., workplace, multifamily building, and fleet), in Q2 of 2021. With such rapid growth and change in EV charging infrastructure, the information presented in this report aims to help readers understand how and where the infrastructure is developing, where there may be areas of opportunity, and whether development is keeping pace with projected charging demand and national targets.

As of the end of Q2, Level 2 chargers accounted for the majority of both public and private EVSE ports in the Station Locator (81.0% and 87.8%, respectively). Overall, there was a 4.3% increase in the number of EVSE ports in the Station Locator. Although Level 2 EVSE ports contributed to the majority of that growth in absolute terms, both public and private DC fast EVSE grew by the largest percentage when compared with Level 1 and Level 2 EVSE port growth. California continues to lead the country in terms of the total number of public EVSE ports available (33,470), though public charging infrastructure grew by the largest percentage in the Northeast region in Q2 (7.2%).

Based on NREL's 2017 projection of the number of public and workplace Level 2 chargers required to support a scenario in which there are 15 million EVs on the road by 2030, the number of DC fast and Level 2 EVSE ports is 68.3% and 15.8%, respectively, of the way toward meeting projected 2030 needs (Wood et al. 2017). However, the majority (56.8%) of public DC fast EVSE ports in the Station Locator are on the Tesla network and are therefore only readily accessible to Tesla drivers. When Tesla EVSE ports are removed, this decreases to 29.6% and 14.0%, respectively. The number of DC fast EVSE ports and Level 2 EVSE ports per 1,000 EVs was 10.0 and 51.0, compared with NREL's projected need of 1.8 and 40.1, respectively. Excluding Tesla EVSE ports, the current ratios decrease to 4.4 DC fast EVSE ports per 1,000 EVs and 45.0 Level 2 EVSE ports per 1,000 EVs. Using NREL's ratios as a proxy for current charging needs, this indicates that infrastructure development is keeping up with current charging needs in terms of the total amount available across the United States.

However, when comparing the current rate of deployment of public charging infrastructure with the Biden administration's goal of installing 500,000 EVSE ports in the United States by 2030, it is clear that the pace of installations will need to significantly increase. Since the start of 2020, an average of 5,322 public EVSE ports have been installed each quarter. To meet the Biden Administration's goal by 2030, approximately 14,706 public EVSE port installations will be required each quarter for the next 9 years.Finally, as the Station Locator team adds new charging networks to the Station Locator and continues its concerted effort to collect multifamily building and fleet charging data, there will continue to be large increases in the number of EVSE ports available.

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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