

Appendix F

Electric Vehicle Charging Infrastructure

Table F1. Electric Vehicle Charging Infrastructure
(Number)

	Locations ^a							Ports						
	With Public Ports Only	With Private Ports Only	With Public and Private Ports	With Net-worked Ports Only ^b	With Non-Net-worked Ports Only ^c	With Net-worked and Non-Net-worked Ports	Total	DC ^d Fast-Charging Ports	Level 2 Charging Ports	Level 1 Charging Ports	Legacy Charging Ports	Total	DC ^d Fast-Charging Ports per Location ^e	Level 2 Charging Ports per Location ^f
2007 Year	NA	NA	NA	NA	NA	NA	432	NA	NA	NA	NA	NA	NA	NA
2008 Year	NA	NA	NA	NA	NA	NA	440	NA	NA	NA	NA	NA	NA	NA
2009 Year	NA	NA	NA	NA	NA	NA	484	NA	NA	NA	NA	NA	NA	NA
2010 Year	NA	NA	NA	NA	NA	NA	626	NA	NA	NA	NA	NA	NA	NA
2011 Year	NA	NA	NA	NA	NA	NA	2,100	NA	NA	NA	NA	5,070	NA	NA
2012 Year	NA	NA	NA	NA	NA	NA	6,200	NA	NA	NA	NA	15,192	NA	NA
2013 Year	NA	NA	NA	NA	NA	NA	8,100	NA	NA	NA	NA	19,472	NA	NA
2014 Year	NA	NA	NA	NA	NA	NA	10,957	1,494	20,636	3,781	NA	25,913	NA	NA
2015 Year	12,213	1,218	1,454	9,546	4,480	859	14,885	6,892	45,154	4,178	597	56,821	3.21	3.33
2016 Year	16,020	1,716	1,508	12,716	4,983	1,545	19,244	10,702	60,237	4,054	362	75,355	3.56	3.49
2017 Year	19,661	1,782	1,428	15,609	5,179	2,083	22,871	12,372	74,714	3,733	453	91,272	3.76	3.61
2018 Year	21,849	1,848	1,415	17,100	5,348	2,664	25,112	11,540	82,975	2,873	108	97,496	3.92	3.58
2019 Year	24,289	2,147	1,291	19,151	5,923	2,653	27,727	14,681	92,128	3,022	92	109,923	3.96	3.66
2020 Year	28,127	1,849	1,458	22,542	6,202	2,690	31,434	19,059	106,542	2,750	61	128,412	4.19	3.77
2021 Year	45,291	2,363	1,491	39,267	7,166	2,712	49,145	24,224	125,026	3,583	56	152,889	3.98	2.84
2022 Year	52,256	2,563	1,566	48,030	8,019	336	56,385	29,573	143,145	3,212	45	175,975	4.07	2.85
2023 January	52,915	2,779	1,311	48,751	7,942	312	57,005	30,041	142,401	3,180	39	175,661	4.05	2.80
February	53,889	2,737	1,071	49,494	7,897	306	57,697	30,634	142,839	3,128	36	176,637	4.05	2.79
March	54,851	2,758	1,071	50,390	7,986	304	58,680	31,682	144,778	3,125	35	179,620	4.09	2.78
April	55,603	2,803	1,061	51,144	8,004	319	59,467	32,288	146,539	3,118	34	181,979	4.08	2.78
May	56,438	2,814	1,064	51,977	8,019	320	60,316	32,994	148,814	3,125	33	184,966	4.07	2.79
June	57,874	2,846	1,055	53,408	8,045	322	61,775	34,590	150,563	3,107	30	188,290	4.10	2.76
July	58,713	2,863	1,053	54,265	8,043	321	62,629	35,424	152,187	3,225	29	190,865	4.09	2.76
August	59,629	2,880	1,044	55,273	8,003	277	63,553	36,093	154,442	3,220	29	193,784	4.08	2.76
September	60,293	2,912	1,045	55,953	8,020	277	64,250	36,948	149,693	3,220	29	189,890	4.06	2.66
October	61,251	2,930	1,045	56,917	8,026	283	65,226	37,762	152,114	3,218	29	193,123	4.07	2.66
November	61,953	2,949	1,039	57,613	8,047	281	65,941	39,339	153,460	3,220	29	196,048	4.13	2.66
December	62,458	2,981	1,021	58,136	8,059	265	66,460	40,176	154,386	3,053	29	197,644	4.13	2.66
2024 January	63,070	3,002	986	58,798	8,037	223	67,058	41,117	155,361	2,993	29	199,500	4.13	2.66
February	63,568	3,034	978	59,392	7,981	207	67,580	41,932	156,092	2,981	29	201,034	4.13	2.66
March	64,136	3,058	980	59,993	7,979	202	68,174	42,884	157,386	2,981	29	203,280	4.13	2.67
April	65,013	3,066	978	60,863	7,994	200	69,057	44,060	159,730	2,982	29	206,801	4.13	2.68
May	65,363	3,073	966	61,172	8,020	210	69,402	44,745	160,539	2,983	29	208,296	4.12	2.68
June	65,857	3,078	963	61,672	8,027	199	69,898	45,391	161,627	2,981	29	210,028	4.11	2.69
July	66,414	3,371	946	62,501	8,035	195	70,731	46,238	164,282	2,976	29	213,525	4.10	2.70
August	66,325	3,378	933	62,432	8,010	194	70,636	47,377	164,659	2,965	29	215,030	4.16	2.72
September	66,380	3,362	924	62,517	7,965	184	70,666	47,958	161,542	2,962	29	212,491	4.17	2.67
October	66,947	3,419	882	62,956	8,178	114	71,248	49,180	163,211	2,935	29	215,355	4.18	2.68
November	67,008	3,425	869	63,072	8,123	107	71,302	49,754	163,137	2,926	28	215,845	4.21	2.68
December	67,535	3,548	867	63,772	8,071	107	71,950	50,582	165,720	2,925	28	219,255	4.22	2.70
2025 January	68,431	3,470	863	64,440	8,217	107	72,764	51,930	167,402	2,742	28	222,102	4.22	2.71
February	^R 69,345	3,470	863	^R 65,354	8,217	107	^R 73,678	^R 52,274	^R 168,830	2,742	28	^R 223,874	^R 4.20	2.70
March	68,984	3,470	863	64,993	8,217	107	73,317	53,017	170,024	2,742	28	225,811	4.24	2.73

^a Includes all of the electric vehicle (EV) charging ports located at a single location regardless of who is able to access the ports, what charging network they belong to, or the level of charging. Ports are determined to be at the same location based on latitude, longitude, and AFDC equipment ID number. Does not include data on charging infrastructure at single-family residential locations.

^b Networked ports are connected to the internet, can communicate with their EV service provider, have a dedicated platform that allows users to find the chargers, and pay to charge. The service provider can manage who can access the port and the cost of charging. The charging infrastructure may also be able to communicate directly with drivers, other charging infrastructure, and utilities.

^c Non-networked ports are not connected to the internet and provide only basic charging capabilities.

^d Direct current.

^e Calculated as the total number of DC fast charging ports divided by the total

number of locations with DC fast charging ports (available in the microdata file). Includes only locations with DC fast charging ports.

^f Calculated as the total number of Level 2 charging ports divided by the total number of locations with Level 2 charging ports (available in the microdata file). Includes only locations with Level 2 charging ports.

R=Revised. NA=Not available.

Notes: • See "Appendix F Methodology and Sources" and end of section. • See "Electric Vehicle" in Glossary. • Data are at end of period. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#appendices> (Excel and CSV files) for all available national and state annual and monthly data beginning in June 2015 and monthly microdata file.

Sources: See end of section.

Data Source

The U.S. Energy Information Administration (EIA) receives administrative electric vehicle (EV) charging infrastructure data from the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy Alternative Fuels Data Center (AFDC).¹ AFDC collects and publishes location-level charging infrastructure data that allows alternative fuel vehicle owners to find fueling and charging stations near them or along a route. AFDC receives daily updates from many of the networked providers.² Networked providers that do not provide daily updates provide regular updates. AFDC contacts non-networked³ providers every two years to determine if the stations are still in service.⁴ AFDC does not collect data on charging infrastructure at single-family residential locations.

Historical annual data (2007-2014)

Historical annual data come from the AFDC Alternative Fueling Station Counts by State ([https://afdc.energy.gov/stations/states?count=total&include temporarily unavailable=false&date=](https://afdc.energy.gov/stations/states?count=total&include_temporarily_unavailable=false&date=)) and are included in the 2023 historical data file (<https://afdc.energy.gov/files/docs/historical-station-counts.xlsx?year=2023>). Estimated location counts for 2011-2013 are from AFDC analysis (<https://afdc.energy.gov/data/10964>).

Historical monthly data (June 2015 – December 2021)

The National Renewable Energy Laboratory (NREL), which manages the AFDC, provided the historical data to EIA. The data began in June 2015 and went through December 2021, however not all months were available. The table below shows the months of data EIA received. For the months that are blacked out, EIA did not receive any data.

2015	2016	2017	2018	2019	2020	2021
			January	January	January	January
	February	February	February	February	February	February
	March	March	March	March	March	March
	April	April	April	April	April	April
		May		May	May	
June	June	June	June	June	June	June
	July		July	July	July	July
August		August	August	August	August	August
September	September	September	September	September	September	September
		October	October	October	October	October
November	November	November	November	November		November
		December	December	December	December	December

Monthly updates (January 2022 – present)

Beginning in January 2022, EIA began pulling the data through the AFDC API⁵ on the last business day of every month.

Data

EIA uses multiple variables from the AFDC database to develop the MER PDF, excel, CSV, microdata and monthly state data output files. AFDC variables of interest include:

- Location information – station name, ID, fuel type code, open date, access code, status code, facility type, EV renewable source, EV pricing
- Physical location information – latitude, longitude, street address, city, state, zip, intersection/directions

- Charging port information – EV network, EV connector types, EV DC fast num, EV level 1 EVSE num, EV level 2 EVSE num, EV other EVSE

Historical data series included variables with different names but with the same data. The charging port information was structured differently in historical datasets. Work was completed to convert the data in the historical datasets into the same format as the current datasets.

Data quality

The EV charging infrastructure data are administrative data and do not have the same level of statistical accuracy as data published from many of EIA's surveys.

Coverage

The data do not represent the entire population or a statistically representative subset of the population of EV charging infrastructure. Instead, the data represent the known to NREL EV charging infrastructure at the time of the data pull. NREL works with EV charging network providers to receive daily updates.⁶ The accuracy and timeliness of the networked providers charging infrastructure will continue to improve as additional networked providers convert to providing daily updates to NREL. There are also non-networked public and private EV chargers, and it is harder to track when these ports become available for use or are decommissioned. These challenges result in less EV charging infrastructure reported than exists, but it is unknown how many additional EV charger locations and ports exist. It is likely that the networked EV charging infrastructure are more accurately represented than the non-networked charging infrastructure. It is also likely that the public charging infrastructure is more accurately represented than the private charging infrastructure due to a lack of incentive for the owners of private charging infrastructure to make the existence of their ports known to the public.

Data Cleaning

EIA has not verified the accuracy of the administrative data and only conducted minimal cleaning of the data. The cleaning EIA did complete included:

- Fixing latitudes and longitudes if they equaled 0, 0 or 1, -1, to facility creation of location ID
- Normalizing the naming convention of several variables including the electric network providers and the facility type
- Removing charging infrastructure outside of the United States, that had not opened yet, and non-EV locations

Breaks in series

There was a break in series in the number of charging locations between December 2020 and January 2021 because of a definitional change to align with the international standard – Open Charge Point Interface (OCPI).⁷

Duplicate observations

It is likely that duplicate observations exist. Duplicate observations may be introduced multiple ways:

- Multiple people adding the same charging port
- Updates to the networked providers database creating the appearance of a new charging port
- Changes in the underlying data structure of the historical data series creating the appearance of new ports
- EIA's imputation of number of charging ports to the date the charging port opened, not the date it first appeared

Because EIA cannot verify if these are duplicates, the details of the possibly duplicated charging infrastructure remain in the database.

Creation of the location and port id

In most historical datasets, the AFDC data included an equipment ID variable that is helpful to identify EV charging locations. However, this variable was inadequate to track EV charging location overtime for a couple reasons:

1. Between February 2017 and January 2018, 10 monthly datasets are missing equipment IDs
2. Ports located at the same location could have different equipment IDs for various reasons:
 - a. Co-located public and private ports have different equipment IDs
 - b. Co-located networked and non-networked ports have different equipment IDs
 - c. Ports that either came online or were added to the AFDC database at different times have different equipment IDs
 - d. Changes in underlying systems could cause an already established port to receive a new equipment ID

For these reasons, EIA created a new ID variable called the “Location ID” using latitude and longitude pairings and equipment ID. It is common for a location ID to be associated with multiple latitudes and longitudes parings as well as multiple equipment IDs due to responses to these variables changing in the historical datasets.

To allow for variation across ports at a location, EIA created a “Port ID” variable using access group (public versus private access), network provider, port level (DC fast charger, Level 2, Level 1, or Legacy), and equipment ID. Every unique combination of the previously mentioned variables received a different Port ID.

Imputation

EIA imputes all missing and incomplete data. Historical datasets had missing subsets of data, so EIA had to fill in the missing data. The missing subsets varied from large (all private charging ports) to small (ports missing for one month and then reappearing during the next month). EIA filled in the missing month with the port count data from the following month.

EIA also imputed data in months that we did not receive any data from NREL. EIA imputed the data using data from the first month following the missing month if the location open date was during the missing month or prior. We did not extend the life of any ports if the last month they appeared in was the month prior to the missing month. We assumed the last month in service was the last month the port appeared, not during the missing month.

In addition, we imputed to remove errors that only appear in one month. For each historical month, EIA compared the previous and following months. If those months were equal but the middle month was different, then EIA updated the middle month to match the other months. New EV ports require a long time lag to install, so it is unlikely that the number of ports would change for a single month then return to their original number.

It is common for EV infrastructure to be added to the AFDC website months or years after the location came online. Because of this, EIA also backfilled EV charging port data to cover all months since the port was available, not only when it appeared in the AFDC database. The MER conducts this backfill imputation twice per year, in the May and November MERs, to correspond with the release of data in the State Energy Data System (SEDS).⁸

Data quality analysis

In December 2023 and January 2024, we conducted a data quality evaluation study to assess the accuracy of the number of electric vehicle (EV) charging ports and charging locations. The study relied on a virtual ground truthing process that compared the number of charging ports listed for 120 randomly sampled charging locations from the August 2023 MER File compared to what EIA observed in online resources available, particularly online street-level imagery. A paired t-test found no significant mean difference between the MER File charging port counts versus observed charging port counts at a 99% confidence level. The MER File reflected the observed number of charging ports approximately 94% of the time, and the MER File reflected the observed number of charging ports within an absolute value difference of two charging ports approximately 99% of the time. The study also identified potential sources of error that contributed to charging port count differences but based on the quantitative findings of the study, these possible sources of error

seemed to have limited effect on the MER File's accuracy. Overall, the study findings show that the MER File's data quality accuracy was generally high at reflecting observable charging port counts.

Available data

In addition to the monthly and annual national data, monthly state level data and a microdata file are also available at <http://www.eia.gov/totalenergy/data/monthly/#appendices>.

-
1. Alternative Fuels Data Center: <https://afdc.energy.gov/stations/#/find/nearest>
 2. Networked ports are connected to the internet, can communicate with their EV service provider, have a dedicated platform that allows users to find the chargers and pay to charge. The service provider can manage who can access the station and the cost of charging. The charging infrastructure may also be able to communicate directly with drivers, other charging infrastructure, and utilities.
 3. Non-networked ports are not connected to the internet and provide only basic charging capabilities.
 4. Details on the EV charging infrastructure data received by AFDC: https://afdc.energy.gov/stations/#/find/nearest?show_about=true
 5. AFDC API details: <https://developer.nrel.gov/docs/transportation/alt-fuel-stations-v1/all/>
 6. For more details of the networked providers NREL is currently receiving daily updates from see: https://afdc.energy.gov/stations/#/find/nearest?show_about=true
 7. For more details on the OCIP see https://afdc.energy.gov/stations/#/find/nearest?show_about=true
 8. For more information on SEDS see <https://www.eia.gov/state/seds/>