

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
2015 Year	12,109	1,218	1,421	9,429	4,486	833	14,748	6,778	42,078	4,168	597	53,621	3.22	3.13
2016 Year	15,866	1,717	1,466	12,542	4,993	1,514	19,049	10,538	56,159	4,042	362	71,101	3.56	3.29
2017 Year	19,465	1,780	1,377	15,395	5,187	2,040	22,622	12,203	69,774	3,721	453	86,151	3.76	3.41
2018 Year	21,560	1,842	1,355	16,790	5,353	2,614	24,757	11,355	76,653	2,857	108	90,973	3.92	3.36
2019 Year	23,786	2,138	1,214	18,620	5,919	2,599	27,138	14,433	83,254	2,982	92	100,761	3.97	3.38
2020 Year	27,707	1,842	1,125	21,860	6,210	2,604	30,674	18,772	93,896	2,708	61	115,437	4.19	3.41
2021 January	37,900	2,275	1,124	31,985	6,697	2,617	41,299	18,393	97,680	3,415	58	119,546	3.66	2.62
February	38,478	2,290	1,124	32,466	6,811	2,615	41,892	18,979	98,656	3,413	58	121,106	3.70	2.61
March	38,905	2,259	1,126	32,816	6,858	2,616	42,290	19,390	99,222	3,406	58	122,076	3.73	2.61
April	39,584	2,248	1,130	33,487	6,860	2,615	42,962	19,799	100,734	3,389	58	123,980	3.75	2.61
May	40,358	2,264	1,141	34,268	6,877	2,618	43,763	20,557	102,480	3,389	58	126,484	3.82	2.60
June	40,834	2,249	1,136	34,751	6,852	2,616	44,219	20,800	103,260	3,329	58	127,447	3.82	2.60
July	41,365	2,254	1,140	35,284	6,859	2,616	44,759	21,292	104,371	3,328	57	129,048	3.84	2.60
August	41,780	2,251	1,144	35,700	6,858	2,617	45,175	21,616	105,278	3,288	57	130,239	3.86	2.60
September	42,225	2,366	1,137	36,105	7,006	2,617	45,728	22,081	104,542	3,536	57	130,216	3.88	2.55
October	43,046	2,361	1,136	36,772	7,154	2,617	46,543	24,272	106,552	3,533	57	134,414	4.17	2.56
November	43,596	2,346	1,131	37,304	7,158	2,611	47,073	23,336	107,077	3,526	56	133,995	3.98	2.54
December	44,503	2,345	1,133	38,212	7,161	2,608	47,981	23,866	108,790	3,521	56	136,233	3.98	2.54
2022 January	44,563	2,342	1,127	40,637	7,220	175	48,032	24,105	108,802	3,384	53	136,344	3.99	2.54
February	44,111	2,348	1,125	40,113	7,309	162	47,584	24,585	107,660	3,380	51	135,676	4.03	2.54
March	44,457	2,351	1,128	40,424	7,348	164	47,936	25,119	108,463	3,285	51	136,918	4.06	2.54
April	45,190	2,368	1,137	41,139	7,393	163	48,695	25,615	110,330	3,155	51	139,151	4.07	2.54
May	46,108	2,371	1,142	41,798	7,659	164	49,621	26,311	112,312	3,157	51	141,831	4.11	2.54
June	46,809	2,362	1,147	42,455	7,701	162	50,318	26,859	113,580	3,154	51	143,644	4.16	2.53
July	47,526	2,364	1,151	43,148	7,720	173	51,041	27,405	114,827	3,122	46	145,400	4.18	2.52
August	48,402	2,369	1,154	43,917	7,825	183	51,925	27,869	116,287	3,086	46	147,288	4.17	2.51
September	48,112	2,454	1,155	43,668	7,877	176	51,721	26,662	117,104	3,032	45	146,843	3.97	2.54
October	48,467	2,484	1,148	43,975	7,953	171	52,099	27,267	117,215	3,026	45	147,553	3.99	2.53
November	48,805	2,494	1,142	44,315	7,966	160	52,441	27,630	118,026	3,025	45	148,726	4.01	2.53
December	49,656	2,530	1,140	45,207	7,971	148	53,326	28,809	119,582	3,034	45	151,470	4.09	2.53
2023 January	49,839	2,474	1,128	45,446	7,860	135	53,441	29,187	118,013	2,994	39	150,233	4.08	2.49
February	50,501	2,418	889	45,868	7,815	125	53,808	29,677	117,477	2,942	36	150,132	4.09	2.47
March	51,130	2,426	886	46,418	7,911	113	54,442	30,591	118,685	2,939	35	152,250	4.14	2.47
April	51,312	2,448	871	46,599	7,926	106	54,631	31,002	118,983	2,932	34	152,951	4.15	2.47
May	51,668	2,447	871	46,958	7,927	101	54,986	31,408	120,056	2,933	33	154,430	4.17	2.48
June	52,169	2,513	874	47,499	7,959	98	55,556	32,416	121,117	2,921	30	156,484	4.22	2.48
July	52,528	2,512	884	47,856	7,968	100	55,924	32,973	121,628	3,033	29	157,663	4.26	2.47

^a Includes all of the electric vehicle 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.

^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 locations with DC fast charging ports only.

^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 locations with Level 2 charging ports only.

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.

Appendix F Methodology and Sources

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 providers². 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 service⁴.

Historical (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 updates⁶. 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 pairings 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 October MERs, to correspond with the release of data in the State Energy Data System (SEDS)⁸.

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>.

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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/>

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