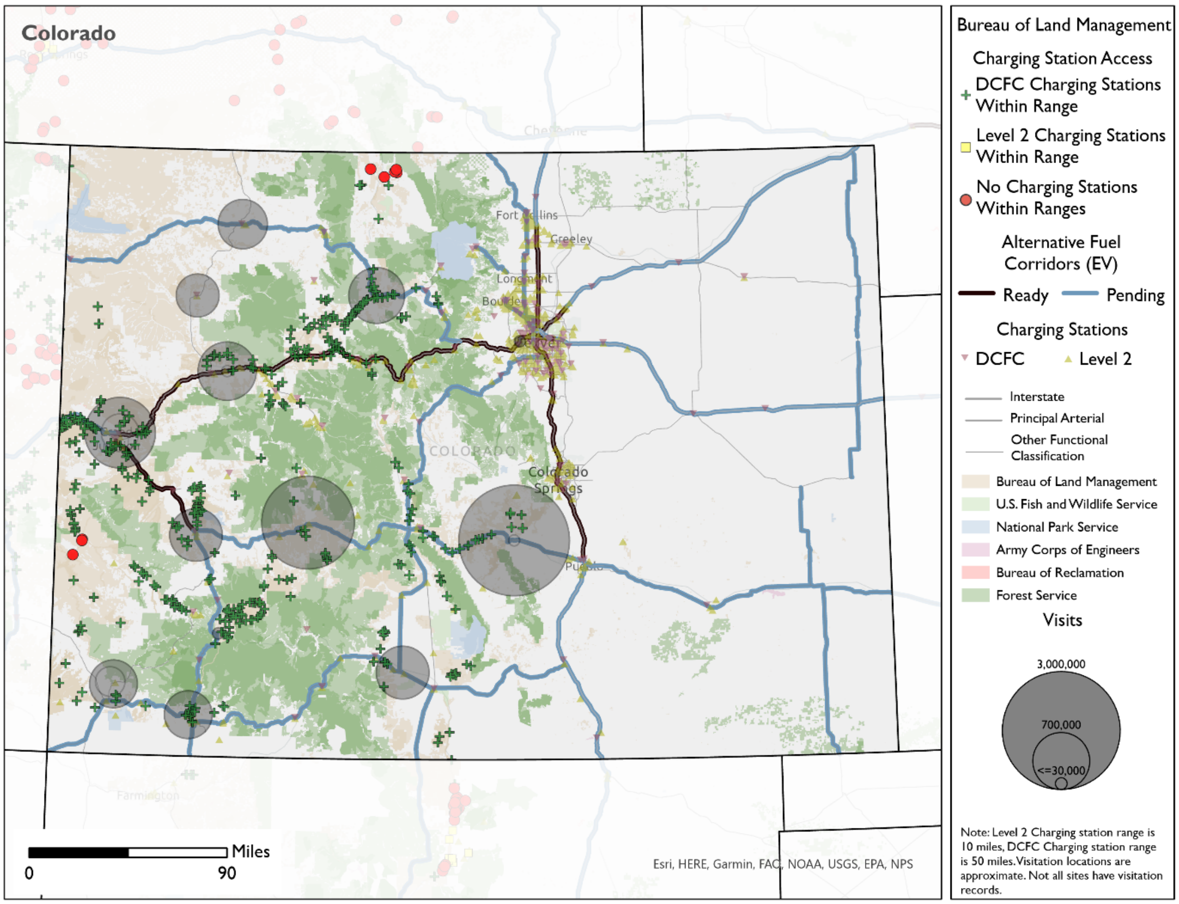
Electric Vehicle Supply Equipment Gap Analysis for Federal Land Management Agencies

Summary Report

Benjamin Rasmussen, David Lamb, Andrew Breck



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This report summarizes an electric vehicle (EV) charging stations (i.e., electric vehicle supply equipment, or EVSE) gap analysis for selected Department of Interior (DOI) lands, U.S. Forest Service (USFS) lands, and U.S. Army Corps of Engineers (USACE) lands.

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SI* (MODERN METRIC) CONVERSION FACTORS

Symbol	When You Know	Multiply By	To Find	Symbol
APPROXIMATE CONVERSIONS TO SI UNITS				
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
oz	ounces	28.35	grams	g
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
mL	milliliters	0.034	fluid ounces	fl oz
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
g	grams	0.035	ounces	oz
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	Kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

Acknowledgments

The authors would like to thank the members of the steering group for their guidance on this analysis, and for providing the supporting data.

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List of Abbreviations

Abbreviation	Term
DCFC	Direct current fast charging (describing EVSE) – typically provide 100-200 miles of range per 30 minutes of charging[1]
EV	Electric vehicle
EVSE	Electric vehicle supply equipment, i.e. charging station
FLMA	Federal land management agency
Level 2	Describing EVSE (typically provide 25 miles of range per 60 minutes of charging[2])
PDF	Portable document format
Unit	Represents a national park, national forest, national refuge, or other administrative unit designation used by the FLMA in question
Volpe	U.S. Department of Transportation Volpe Center

[1] https://afdc.energy.gov/files/u/publication/EV_Charger_Selection_Guide_2018-01-112.pdf.
[2] https://afdc.energy.gov/files/u/publication/EV_Charger_Selection_Guide_2018-01-112.pdf.

Executive Summary

Building on past work with the National Park Service (NPS), the U.S. Department of Transportation Volpe Center (Volpe) performed an electric vehicle (EV) charging stations (i.e., electric vehicle supply equipment, or EVSE) gap analysis for selected Department of Interior (DOI) lands, U.S. Forest Service (USFS) lands, and U.S. Army Corps of Engineers (USACE) lands. Code from the analysis (in Python 3.7 and ArcGIS Pro) is available on GitHub.[3]

After a scan of relevant existing studies and data sources (section 2 and appendix A), the analysis produced the following:

- National map books, showing the proximity of federal land management agency (FLMA) parking lots to EVSE (3.2 National Maps);
- Maps of corridors with limited EV access that may be especially important for FLMAs (3.3 Identification of Priority Corridors);
- Strip diagrams showing attributes that provide context for gaps on priority corridors (3.4 Strip Diagrams for Priority Corridors); and
- Tables that summarize the proximity to EVSE for all parking lots within each FLMA unit (3.5 Tables of Access by Unit).

A steering group composed of staff representatives from each FLMA guided Volpe's work on this project. Each of the FLMAs participating in this project are using the research products to plan for transportation electrification and communicate with partners on priorities and shared interests to close gaps in the EVSE network. This project did not attempt to assess whether EVSE are sufficient to meet current or projected demand. Future analyses could investigate that type of research question. The National Renewable Energy Lab has conducted related research and built related tools, as described in Appendix A: Research Scan Results.

[3] Scripts are available through (https://github.com/VolpeUSDOT/GIS_FLTP_EV_Gap_Analysis_public)

1. Introduction

The use of electric vehicles (EV) has been increasing over the past decade and is projected to increase in future years as well. In 2021, new plug-in electric vehicle sales nearly doubled compared to sales in 2018, 2019, and 2020 (Figure 1).[4] In 2022, the US passed what has become a critical EV tipping point: five percent of new car sales are powered only by electricity.[5]

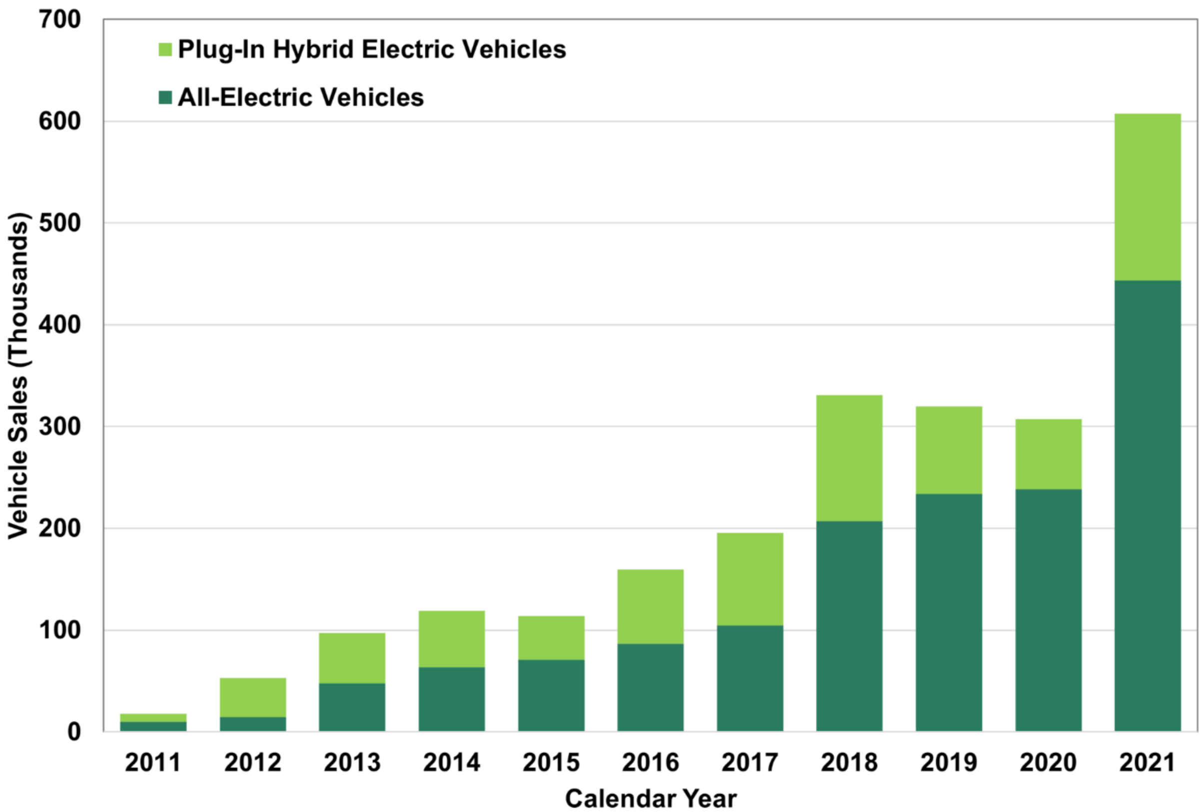


Figure 1: U.S. Light-Duty Plug-in Vehicle Sales by Type, 2011-2021

Using an automated tool that the US DOT Volpe Center previously developed for the National Park Service, the Department of Interior (DOI) asked the Volpe Center to perform an electric vehicle (EV) charging station (i.e., electric vehicle supply equipment, or EVSE) gap analysis along highways and interstates connecting to Department of Interior (DOI) lands. Soon after this work began, the Forest Service and Army Corps of Engineers joined the project and the scope increased to cover all Federal land management agency (FLMA) units.

The Volpe Center's analysis consisted of multiple parts: 1) performing a brief scan of relevant existing

[4] https://www.energy.gov/energysaver/articles/new-plug-electric-vehicle-sales-united-states-nearly-doubled-2020-2021

[5] https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone

studies and data sources, and 2) new analysis, including the creation of:

- National map books, showing the proximity of FLMA parking lots to EVSE (3.2 National Maps);
- Maps of corridors with limited EV access that may be especially important for FLMAs (3.3 Identification of Priority Corridors);
- Strip diagrams showing attributes that provide context for gaps on priority corridors (3.4 Strip Diagrams for Priority Corridors); and
- Tables that summarize the proximity to EVSE for all parking lots within each FLMA unit (3.5 Tables of Access by Unit).

A steering group composed of staff representatives from each FLMA guided Volpe's work on this project. The FLMAs will use this project's work products to inform decisions on which units they choose to install EVSE. The FLMAs will also use these products to identify corridors in which they would like to see partner State DOTs invest in additional EVSE to better connect to their units.

2. Scan of Relevant Past Studies and Their Sources

Prior to conducting its analysis, the study team identified and reviewed past studies and data sources to avoid a duplication of effort and to leverage existing resources. The study team was well aware of a precursor project that Volpe completed in 2019 for the National Park Service.[6] This project identified and mapped:

- Existing and proposed EV-accessible routes connecting parks to key population centers and transportation hubs and
- Potential gaps in EVSE infrastructure along proposed routes.

Aside from that study, the literature scan identified several other relevant past studies, but none that fulfilled all of the goals of the current project. Appendix A: Research Scan Results at the end of this report contains more detailed findings from the scan.

To date, most of the existing research was commissioned by or focused on the needs of state or municipal governments. For these governments, "gaps" in infrastructure were not defined based on an assessment of EV accessibility to specific destinations; instead, a "gap" was defined as the difference between a target versus actual amount of EVSE in a region. Often this was the difference between projected demand for EVSE based on expected EV adoption versus current availability of residential and public EVSE. Some of these studies also assessed gaps based on goals for mitigating environmental injustice related to local air quality.

The most germane past studies found in the scan were:

- National Renewable Energy Laboratory analysis of EVSE demand on routes important for "recreational travel" in 7 western states.
- National Association of State Energy Offices Intermountain West EV Charging Needs Assessment, which identified all national parks in 8 western states that were farther than 50 miles from the nearest DCFC EVSE, as of 2020.

Since Volpe completed its project for the NPS in 2019, several new EV-related data sources have become available. These sources are listed in the Appendix and include FHWA's Alternative Fuel Corridors, which did not exist a few years ago and were a key part of the analysis in this report.

3. Analysis

The review of existing resources outlined above confirmed a need for further analysis to meet the needs of the federal land management agencies (FLMAs) participating in this project. This section describes the analytical approaches used in this project and their outputs.

[6] Available here: https://rosap.ntl.bts.gov/view/dot/42561.

3.1 Overview of Methods

The analysis included multiple components:

- National map books, showing the proximity of FLMA parking lots to EVSE (3.2 National Maps)
- Identification of corridors with limited EV access that may be especially important for FLMAs (3.3 Identification of Priority Corridors)
- Strip diagrams showing attributes that provide context for gaps on priority corridors (3.4 Strip Diagrams for Priority Corridors)
- Tables that summarize the proximity to EVSE for all parking lots within each FLMA unit (3.5 Tables of Access by Unit).

For each of these analytical components, the two core datasets were (1) the parking lot locations (or proxies for parking lot), and (2) EVSE. Data sources for each agency are presented in Table 1. When available, the polygon of each parking lot was converted to a point location. In some cases, the road network served as an indicator of parking locations when the data were not available. In the case of the National Park Service, the parking lot dataset was missing some information for the Great Smoky Mountains National Park, and the analysis includes a road network supplement.

Table 1. Data sources for parking lots.

Agency	Data Source
Bureau of Land Management	National Recreation Site Points (3,973 sites)
Bureau of Reclamation	Federal Land Management Agency roads within Federal Lands Transportation Program network (2,200 sites)
US Fish and Wildlife Service	Public Parking Lots (4,687 sites)
National Park Service	Parking Areas and Federal Land Management Agency roads within Federal Lands Transportation Program network (3,412)
US Army Corps of Engineers	Recreation Project Site Areas (3,914 sites)
US Forest Service	Points of Interest (916 sites)

The second important dataset was EVSE locations. The study team downloaded data from the US Department of Energy's Alternative Fuels Data Center Application Programming Interface (API) (https://afdc.energy.gov/fuels/electricity_locations.html). The stations were filtered by public access and port type, and classified as Direct Current Fast Charging (DCFC) or Level 2 stations. Port types with CHADEMO, Tesla and J177COMBO were assigned to DCFC, and J1772COMBO to Level 2. Level 2 EVSE typically provide 25 miles of range per 60 minutes, and DCFC provide 100-200 miles of range per 30 minutes of charging.[7] As of the most recent download (approximately March 2023), there were 11,029 DCFC (3,806 Tesla) and 44,459 Level 2 EVSE in the dataset. Telsa stations were included in the most recent download following the decision that Tesla stations would become open to the public.

The team used supplementary datasets to link site visitation data to the parking lot information (see

[7] https://afdc.energy.gov/files/u/publication/EV_Charger_Selection_Guide_2018-01-112.pdf.

Table 2). Visitation data supplied by each FLMA was often aggregated and not available at the parking lot level. For example, the Bureau of Land Management's visitation data was collected at the Area Office level, incorporating many different sites. The team used a common identifier to link visitation data and visualize it relative to the parking lot information. All analysis, and products were scripted in Python 3.7 and ArcGIS Pro.[8]

Table 2. Data sources for site locations matched to visitation information.

Agency	Data Source
Bureau of Land Management	Administrative Units (2021 FY)
Bureau of Reclamation	Area Office Boundaries (2021 FY)
U.S. Fish and Wildlife Service	National Wildlife Refuge System Boundaries (2021 FY)
National Park Service	Land Resources Division Boundary and Tract Data (2021)
U.S. Army Corps of Engineers	Not applicable (Visitation data not supplied)
U.S. Forest Service	Administrative Forest Boundaries (Varies, most recent is 2019 FY)

3.2 National Maps

This analysis produced map books with a page for each state showing both parking lot level proximity to EVSE and the most recent visitation data available. Parking lots classified "within range" of a DCFC EVSE were at most 50 miles from the nearest DCFC EVSE. Parking lots classified "within range" of a Level 2 EVSE were within 10 miles of the nearest Level 2 EVSE. Manhattan distance[9] between parking lots and EVSE was chosen as a proxy indicator of actual road network distances instead of the more common "as the crow flies" (Euclidean) distance. This distance metric was selected because it was a compromise between the straight-line Euclidean distance, and the more complicated road network distances, while remaining a simple calculation.

Figure 2 presents an example of the outputs at the state level produced for each agency. In addition to EVSE, sites, and visitation, each map included Ready and Pending EV Corridors designated through the US Department of Transportation Federal Highway Administration National Alternative Fuel Corridors Program.[10] "Ready corridors" are those that meet the criteria of the National Alternative Fuel Corridors Program, while "pending corridors" are those that do not yet meet the criteria, but where states have committed to building them out to "ready" status. These maps helped identify areas that lacked access to either Level 2 and DCFC stations.

[8] Scripts are available through (https://github.com/VolpeUSDOT/GIS_FLTP_EV_Gap_Analysis_public)
[9] Manhattan distance is calculated as the absolute value difference between two locations. The more traditional approach is the squared differences for Euclidean distance. Manhattan was chosen because it approximates network distances slightly better than Euclidean.
[10] https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/.

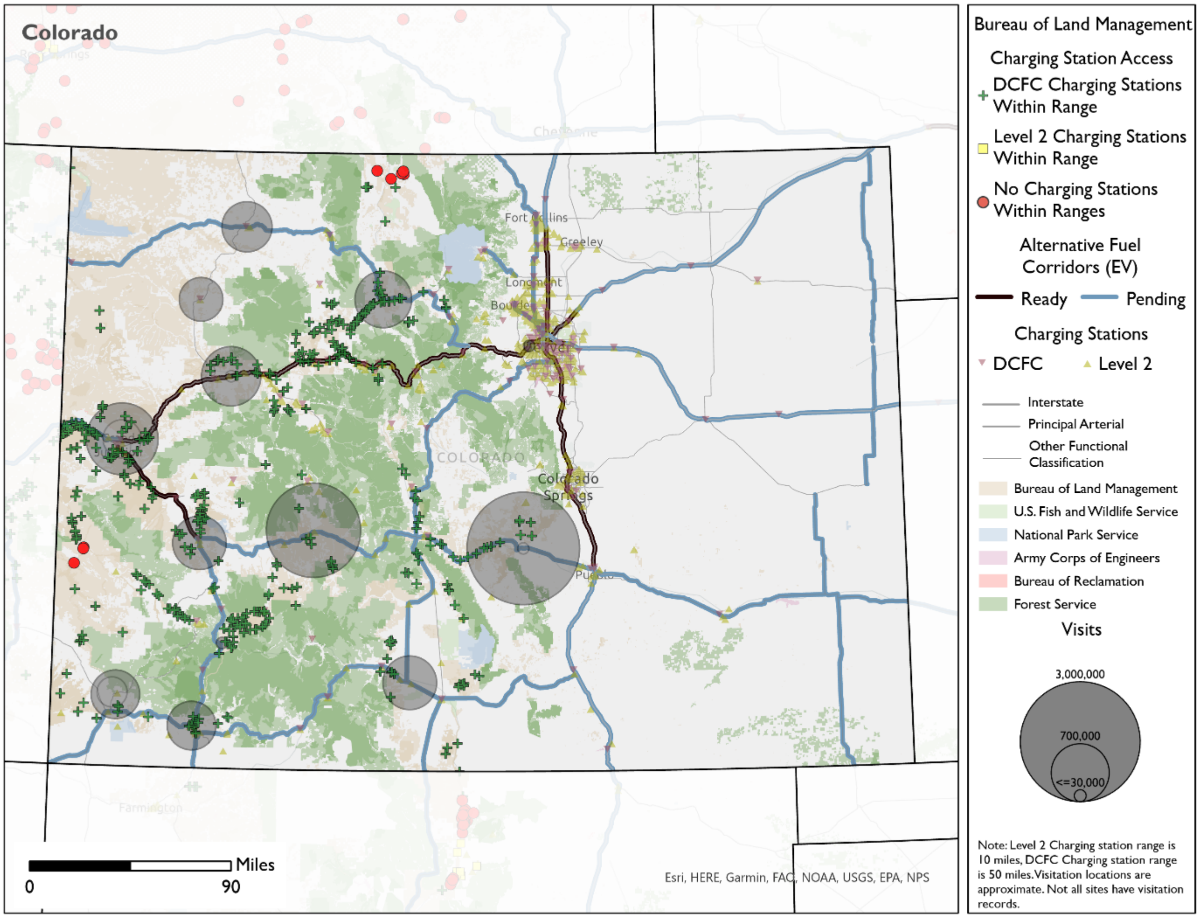


Figure 2: Example map showing visitation data and access to EVSE.

3.3 Identification of Priority Corridors

After completing the above analysis, the team reviewed all the map books (one for each FLMA and a combined map book that showed all sites for all FLMAs) and flagged roadway corridors that seemed particularly important for one or more FLMAs. The criteria for identifying priority corridors were as follows:

- No EVSE in range,
- Not near a “pending” or “ready” National Alternative Fuel Corridor, and
- High visitation.

The team identified 60 total priority corridors of importance to at least one FLMA, and identified 8 priority corridors that rose to the top when looking across all FLMA sites. The team did not identify priority corridors for the Army Corps of Engineers with these criteria because at the time of this study, the Army Corps of Engineers was focused on federal fleet EVSE needs (rather than visitor-facing EVSE). Figure 3 shows an example of some identified priority corridors, which appear in yellow highlighting.

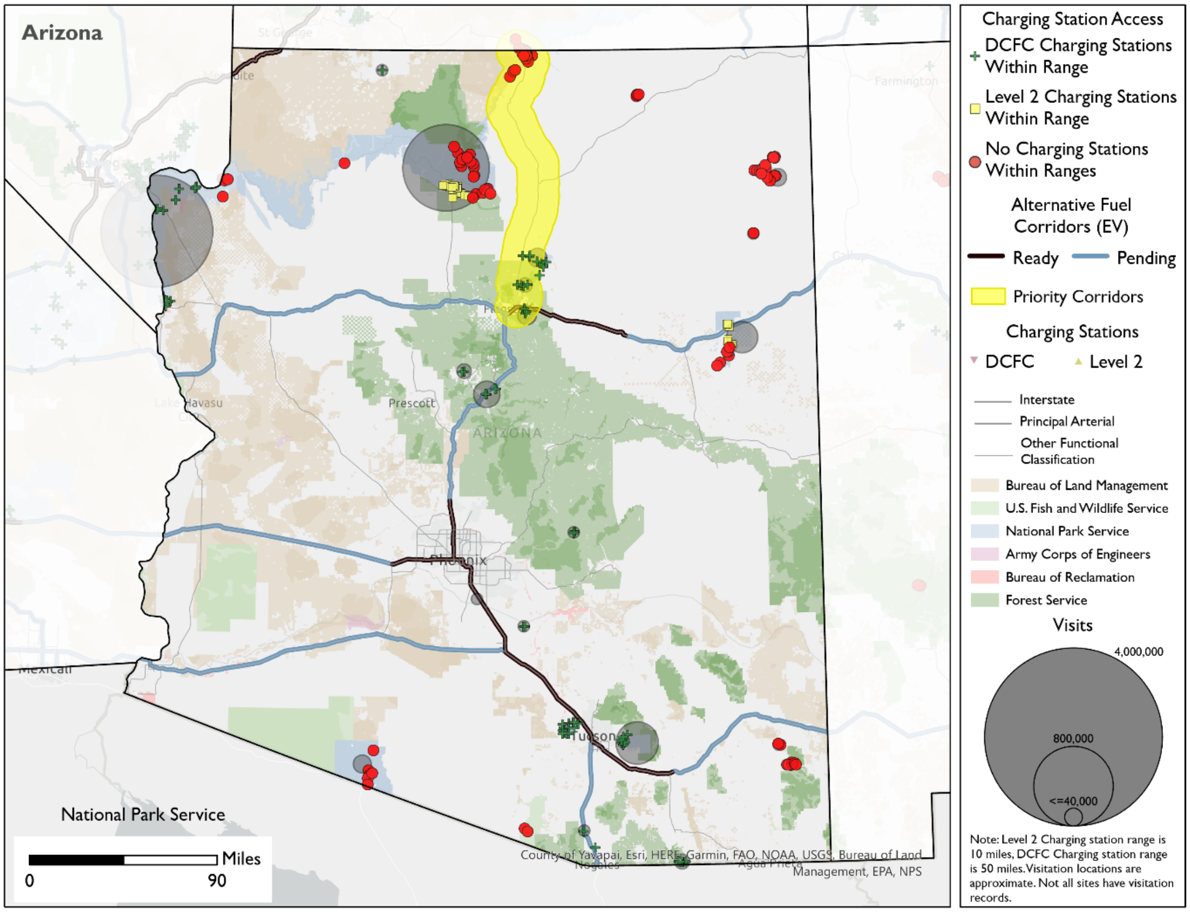


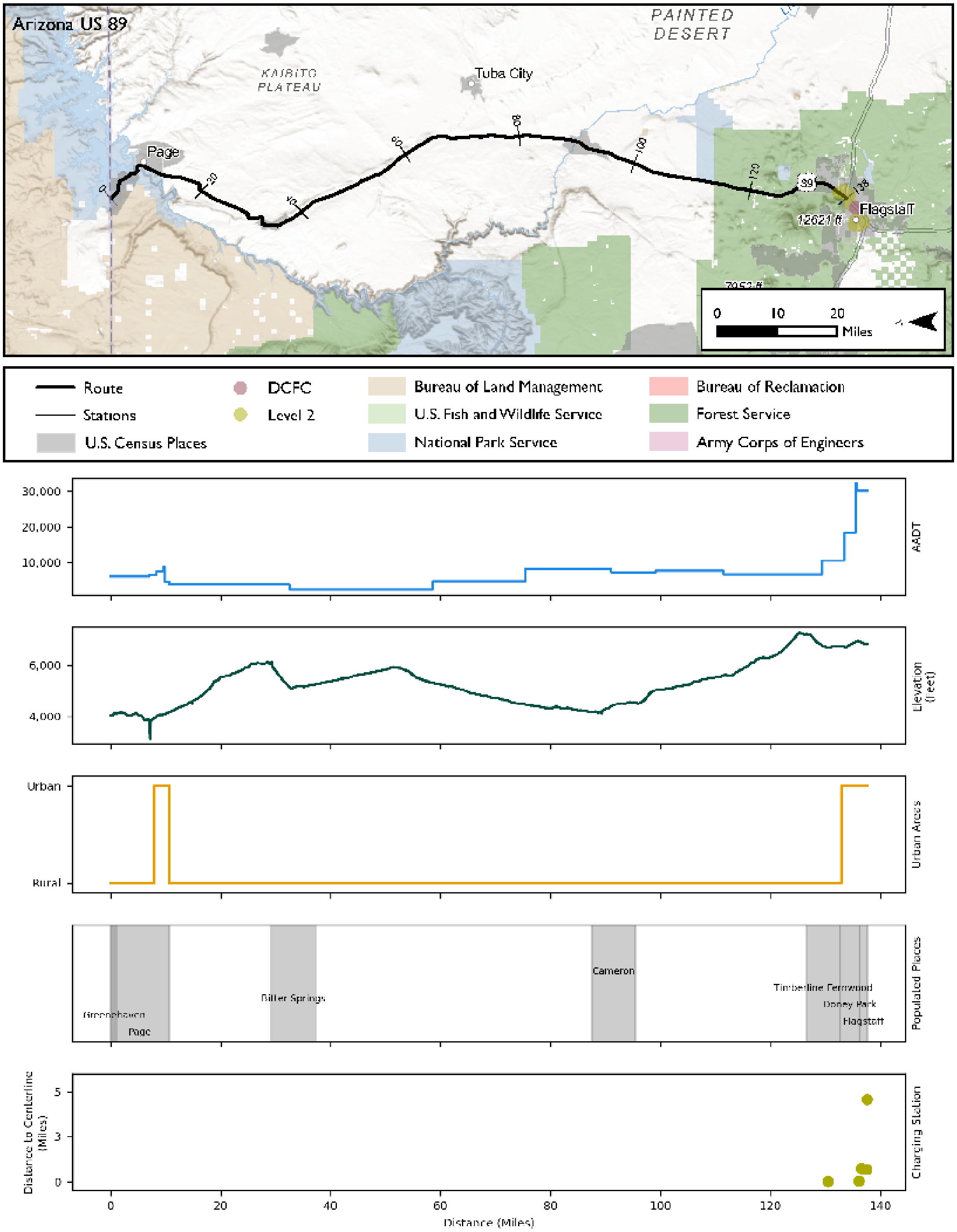
Figure 3. Example map of priority corridor for Arizona.

3.4 Strip Diagrams for Priority Corridors

Strip diagrams provide a way to visualize several variables along a linear diagram. In the case of Figure 4, the priority corridor (US 89 in Arizona) shows from the Arizona/California border to Flagstaff. Below the map are the different variables of interest that are related to the possible placement of stations (including existing locations). Variables for the different charts include annual average daily traffic (AADT), elevation, urban or rural status, populated places, and nearby existing EVSE. AADT and urban/rural status were from the Highway Performance Monitoring System 2018 National Highway System dataset, elevation data was derived from 10-meter Digital Elevation Model data[11] (converted to feet), and populated places were from the US Census Place designations. EVSE locations were collected as described above. EVSE located beyond five miles from the road centerline were not included in the diagrams.[12]

[11] Obtained from the U.S. Geological Survey's The National Map. A repository for national datasets, including elevation.

[12] Five miles was based on the Pending or Ready Alternative Fuel Corridor criteria.



Esri, USGS, Esri, HERE, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS

Figure 4: Example strip chart for priority corridor US 89 in Arizona.

3.5 Tables of Access by Unit

The FLMAs also needed summary information on EVSE access at a unit level (where a "unit" represents a national park, national forest, national wildlife refuge, national fish hatchery, or other administrative unit designation used by the FLMA in question). Since some of the units are very large in geographic extent, it is difficult to assign an overall access score; certain parking lots within the unit may be very close to EVSE, while others are very far. The team developed a table of information summarizing distances to DCFC EVSE for parking lots within each unit and provided this output to the FLMAs (see **Error! Reference source not found.**). Calculating network distances from each parking lot to the nearest charging station was a two-step process. First, charging stations within 60 miles[13] of a parking lot were selected, and compiled together by site. Second, distances to each of these stations were calculated using ArcGIS Online's road network datasets. By filtering for charging stations within sixty miles, this limited the number of queries required to calculate the road network distance. If no charging stations were within 60 miles of a parking lot, then the top three closest charging stations were included regardless of the distance. In addition, the percentage of lots within 50 miles of ready or pending National Alternative Fuel Corridors were included. This information was summarized as an average, and visualized as a histogram.

Visitation data were linked through the site identifier in previous phases, and parking lots were linked to the site name. The table separates sites crossing multiple states into different rows; however, the visitation data were not split to reflect the proportion of visitation in each part of the state.

As with the map books, there are separate PDF files for each FLMA participating in the analysis. The columns are as follows:

- **Name:** the full name of the unit.
- **State:** the state in which the unit boundary is located. Units are listed in each state their boundary is in.
- **Visitation:** average annual visitation for the unit (when available).
- **Average Miles to Existing DCFC:** the average distance to the nearest DCFC EVSE (for all parking lots within the unit and the state). It appears red if greater than 50 miles and green if less than or equal to 50 miles.
- **Miles to Existing DCFC:** a histogram of parking lots, grouped by distance to nearest DCFC EVSE. The scale of the y-axis varies by unit, and the scale of the x-axis varies by state. A dashed vertical line shows the 50-mile threshold. A solid vertical line shows the average distance for unit parking lots (green if less than or equal to 50 miles and red if greater than 50 miles). The upper right corner of the unit's histogram shows the total number of parking lots within that unit that are represented in the histogram.
- **% Near Ready or Pending Corridor:** shows the percent of parking lots near a "pending" or "ready" Federal Highway Administration National Alternative Fuel EV corridor. "Near" means

[13] Sixty miles was used instead of 50 to compensate for any along the edge of the cut off.

within 50 miles. If the percentage is between 0 and 100 it shows a pie chart, with the near lots in blue and the far lots in red.

National Park Service
Distance from Parking Lots to Nearest Stations

Name	State	Visitation	Average Miles to Existing DCFC	Miles to Existing DCFC	% Near Ready or Pending Corridor
Guilford Courthouse NMP	NC	211,689	10.7	1; 0; 54; Lots: 1*	100%
Moores Creek NB	NC	60,727	22.0	1; 0; 54; Lots: 1*	100%
Wright Brothers NMEM	NC	482,191	49.9	2; 0; 54; Lots: 2*	100%
Fort Union Trading Post NHS	ND	11,479	25.3	1; 0; 75; Lots: 2*	100%
Theodore Roosevelt NP	ND	796,085	55.2	4; 0; 75; Lots: 29*	100%
Agate Fossil Beds NM	NE	18,264	109.9	1; 0; 112; Lots: 2*	0%
Homestead NHP	NE	54,113	47.0	1; 0; 112; Lots: 2*	100%
Scotts Bluff NM	NE	194,027	63.2	1; 0; 112; Lots: 2*	100%
Saint-Gaudens NHP	NH	26,058	11.1	1; 0; 12; Lots: 2*	100%
Delaware Water Gap NRA**	NJ	4,340,902	16.2	4; 0; 28; Lots: 31*	100%
Gateway Arch NP**	NJ	1,145,081	12.1	3; 0; 28; Lots: 9*	100%

*May not include all lots.
**Visitation for multiple states.

Figure 5: Example table showing visitation data and access to EVSE.

4. Next Steps

Each of the FLMAs participating in this project are using the research products to plan for transportation electrification and communicate with partners on priorities and shared interests to close gaps in the EVSE network.

Circumstances are constantly changing (in particular, there is continual growth in the number of EVSE stations). To ensure accuracy in the face of these changing conditions, the FLMAs may wish to re-run the analyses described in this report in the future (either at some regular interval, or ad-hoc in response to specific needs).The USDOT Volpe Center will continue to update data on an annual basis to reflect these developments. For example, the most recent data download included Telsa stations following the decision that Tesla stations would become open to the public.

This project did not attempt to assess whether EVSE are sufficient to meet current or projected demand. Future analyses could investigate that type of research question. The National Renewable Energy Lab has conducted related research and built related tools, as described in Appendix A: Research Scan Results.

Appendix A: Research Scan Results

The below table lists the findings from a scan of relevant past studies.

Approach	Date	States Covered	Data Sources Used	Criteria Used
DOE National Renewable Energy Laboratory (NREL)	2021	OR, WA, ID, WY, UT, NV, AZ	• Existing DCFC EVSE • Recreational destinations (e.g., national parks) • State and interstate highways	• Identified highway corridors relevant to "recreational travel" (for 7 western states) and assessed "gaps" based on capacity rather than access. Modeled the projected demand for EVSE based on (1) a certain EV adoption/penetration rate and (2) overall modeled traffic volumes. Based on this, they asked: **"how many ports would be needed at what density along highway corridors?"** The analysis looked at routes relevant for recreational travel, in part based on the locations of national parks, but it did not attempt to verify the ability of EVs to access national parks, other federal lands, or any specific destinations.
Regional EV Charging Infrastructure Location Identification Toolkit (ILIT)	Aug. 2021	CT, DE, DC, ME, MD, MA, NH, NJ, NY, NC, PA, RI, VT, VA	• DCFC plug types • U.S. EPA EJSCREEN EJ Index Metrics • National Air Toxics Assessment (NATA) respiratory hazard index, Ozone, and diesel 2.5 particulate matter index • Census data	• Prioritizes EVSE infrastructure based on equity metrics.
NASEO Intermountain West EV Charging Needs Assessment	2021	ID, MT, WY, UT, NV, AZ, CO, NM	• Questionnaire for local government, parks and tourism agencies, electric service providers, others • EV infrastructure geospatial data from the Alternative Fuels Data Center Station Locator (AFDC) and REV West DCFC Map	• Mapped 36 Parks farther than 50 miles from DCFC station as of 2020, as well as 50 mile service areas around existing EVSE in the regions to illustrate gaps • Average time visitors spend at parks (and could potentially use for charging) • Questionnaires asking perceived barriers to EV adoption

Approach	Date	States Covered	Data Sources Used	Criteria Used
			• NREL EV registration data	
Florida FDACS EV Roadmaps	Dec. 2020	FL	• Statewide EV sales analysis and projections • Statewide Infrastructure Analysis and Projections • Lit review • Interactive webinars • Stakeholder written input • Stakeholder interviews • FL EV owners survey	• EV charging behavior ○ Commercial land use ○ Places of employment ○ High-density residential land use ○ Population ○ Registered EVs ○ Existing station placement • Forecasting ○ Rate of EV adoption seen as primary indicator
Oregon Transportation Electrification Infrastructure Needs Analysis (TEINA)	June 2021	OR	• Used assumed values for infrastructure adoption over time and use behavior • National Renewable Energy Laboratory's (NREL's) Electric Vehicle Infrastructure Projection (EVI-Pro) Lite modeling tool	• Separate models by use case: ○ Urban Light-Duty Vehicles ○ Rural Light-Duty Vehicles ○ Corridor Light-Duty Vehicles ○ Local Commercial and Industrial Vehicles ○ Transit and School Buses ○ Transportation Network Companies ○ Long-Haul Trucking ○ Micromobility ○ Disadvantaged Communities
The International Council on Clean Transportation (ICCT) Quantifying the Electric Vehicle Charging Infrastructure Gap Across U.S. Markets	2019	National	• Metropolitan area statistics (US Census Bureau) • EV and EV infrastructure deployment (past and planned) • EV charging behavior patterns • Commute data • Travel behavior	• Relates planned EV deployment and EV infrastructure deployment with existing levels to estimate gaps, absent policy and investment changes/acceleration • Distinguishes home, workplace, public level 2, and DCFC spots • Gaps defined as ratio of existing EVSE infrastructure to what is needed by 2025

Selection of Data Sources

To aide in Volpe's EV gap analysis task, the following table presents a selection of data sources referenced in the above studies of EV infrastructure gaps. While the above studies vary in their focus and methods, these data sources have broad application. Some of the following include relatively current primary data about the location or registration of EV vehicles or EVSE infrastructure. Other sources below document projections or deployment plans for the recent past and future. It is worth noting that even the best projections may lag behind reality. Some of the following continue to be updated, while others may be of most use as inspiration for researchers planning future work. Lastly, all of the sources below are either available to the public or offered to government employees after the creation of a free account.

Data Source	States Covered	Information Provided	URL
US DOE Alternative Fuels Data Center (AFDC)	All	Current EVSE locations	https://afdc.energy.gov/
FHWA Alternative Fuel Corridors (EV)	All	Geospatial data on roadways that are: (1) "Corridor-Ready" (nominated by an agency and meet minimum criteria for EVSE coverage) and (2) "Corridor-Pending" (nominated by agency and do not yet meet minimum criteria but have plans to achieve it)	https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/
Atlas EV Hub	CA, CO, CT, FL, MT, MI, MN, NJ, NY, OR, TN, TX, VT, VA, WA, WI	EV registration data to ZIP code or county level (no account required) EVSE deployment data (requires login, accounts free to government users)	https://www.atlasevhub.com/materials/state-ev-registration-data/ https://www.atlasevhub.com/materials/market-data/
NREL Electric Vehicle Infrastructure Projection (EVI-Pro) modeling tool and EVI-Pro Lite version	All	Developed in collaboration with the California Energy Commission, EVI-Pro draws on detailed data about personal vehicle travel patterns, EV attributes, and EVSE characteristics to estimate the required quantity and type of EVSE.	https://www.nrel.gov/transportation/evi-pro.html https://afdc.energy.gov/evi-pro-lite
Electrify America utility investment plans	All	Electric vehicle charging infrastructure deployment roadmap from 2017-2026	https://www.electrifyamerica.com/our-plan/
PlugShare DataTool	All	EVSE database with geospatial and Tableau integration, noting EVSE type, cost, access, and more	https://company.plugshare.com/data.html

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