United States EV Fast-Charging Corridor Road Map

A full-coverage future for long-distance electric vehicle charging infrastructure

Analysis & Design

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Prepared for the Great Plains Institute by Carbon Solutions.

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Introduction | The need for a convenient & reliable national EV charging network

Electric vehicles (EVs) have a critical role to play in enabling the US to achieve its midcentury climate targets. The transportation sector is one of the largest contributors to anthropogenic US greenhouse gas (GHG) emissions.[1] The federal government, states, and automakers continue to push for transportation electrification to tackle emissions from this sector. Automakers like General Motors, Bentley, Volvo, Jaguar, Land Rover, Mercedes Benz, and others have announced plans to only sell EVs by 2035.[2]

The federal government targets making half of all new vehicles sold in 2030 zero emission, including battery and fuel-cell EVs.[3] California's Advanced Clean Cars II Rule sets an even more ambitious target for zero-emission vehicle sales to make up 100 percent of all car sales by 2035 in the state and other states that adopt the rule.[4]

As a result of these commitments (and supporting incentives), EV adoption has grown rapidly in recent years, with 630,000 EVs sold in the US in 2021. Experts now believe that 18 percent of new car sales in the US could be electric by the end of 2025 and up to half of new car sales by 2030.[5]

With rapid EV adoption on the horizon, a major scale-up in supporting infrastructure is needed to create a national EV charging network that is convenient and reliable for all drivers across the country. Ensuring that long-distance EV travel along major travel corridors is both feasible and seamless is a key step in enabling widespread EV access and sustaining the growth in EV adoption. According to the International Council on Clean Transportation, 180,000 public direct current fast-charging (DCFC) ports will be needed to support the 26 million EVs expected on US roads in 2030. Comparatively, the US currently has 26,276 publicly available DCFC ports.[6]

This road map examines the national EV fast-charging network across the 48 contiguous states within the context of the Federal Highway Administration's (FHWA) National Electric Vehicle Infrastructure (NEVI) Formula Program. The NEVI program was established to guide and support the development of a comprehensive national EV fast-charging network.

The goals of this road map were twofold: first, to measure the driving distance between existing public, non-Tesla charging stations that comply with basic NEVI requirements, revealing where existing corridor segments are fully built out to NEVI specifications and, conversely, where gaps in the charging network exist. The road map's second goal was to model the most efficient way to resolve those network gaps and bring all designated corridors into full compliance with NEVI guidelines.

The road map focused on the physical and geographic requirements for charging infrastructure as outlined in the NEVI program guidance. This phase of the analysis did not examine equity considerations or the local context for individual station planning. That examination will be undertaken in a subsequent analysis to ensure that NEVI program benefits flow in large part to disadvantaged communities, in alignment with the Justice40 Initiative.

Additionally, the model did not account for electric distribution system hosting capacity; when using this analysis, states and others should work closely with electric utilities to ensure stations are sited in suitable locations.

Introduction | The NEVI program and opportunities for EV infrastructure

The NEVI Formula Program was established under the Infrastructure Investment & Jobs Act in November 2021 to support the development of a comprehensive fast-charging network along key national travel corridors.

The NEVI program provides $5 billion in dedicated funding for states to strategically deploy public EV charging infrastructure supporting long-distance EV travel. To access the NEVI Formula Program funds, each state must submit an EV infrastructure deployment plan to be approved by the FHWA.

Under the NEVI program, states must first use NEVI funds to build out infrastructure along designated FHWA EV Alternative Fuel Corridors. Among those corridors, states are encouraged to prioritize the construction of infrastructure along the interstate highway system. A state can also propose using NEVI funds for charging infrastructure development along other routes that are not designated as Alternative Fuel Corridors. However, its designated corridors must first be certified as fully built out by the FHWA according to the following criteria:

- EV charging stations are spaced no more than 50 miles apart along designated corridors and located within one travel mile of the corridor, and

- EV charging stations include at least four DCFC ports with Combined Charging System (CCS) connectors capable of simultaneously charging four EVs at 150 kilowatts (kW) each, with a total station power capacity of 600kW or more.[7]

The NEVI program also supports the federal government's Justice40 Initiative, which aims to distribute at least 40 percent of the program's benefits to disadvantaged communities. While this does not mean that 40 percent of the charging stations must be located in disadvantaged communities, state plans must include a section explaining how the plans are consistent with the Interim Justice40 Guidance issued by the White House and the US Department of Transportation.[8]

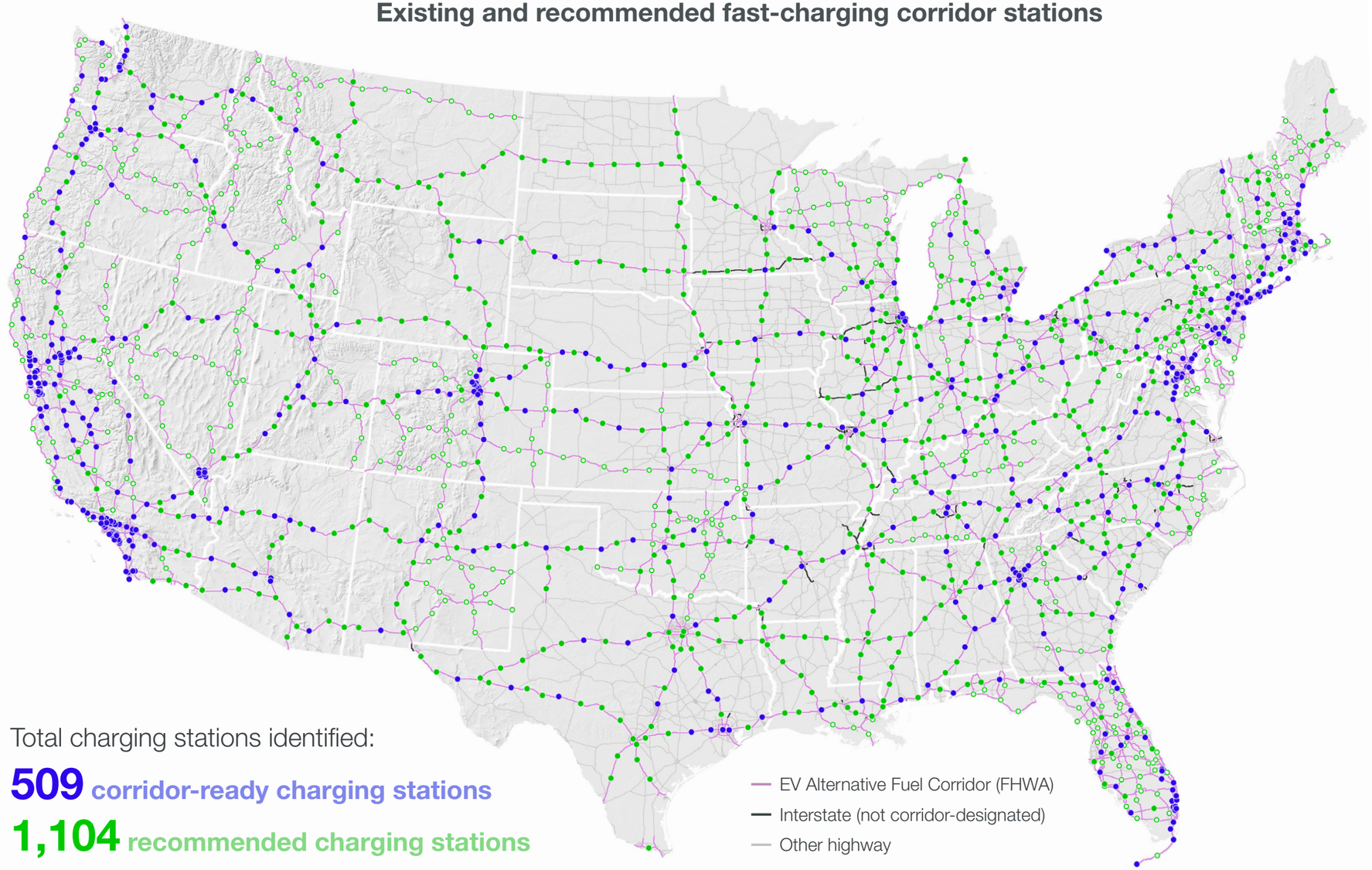
The FHWA will disperse NEVI program funding over five years, from fiscal year 2022 to fiscal year 2026.

Introduction | Building out a coordinated national fast-charging network

This analysis identified 509 public, non-Tesla charging stations that are NEVI-compliant (i.e., corridor-ready charging stations). It recommends adding 1,084 strategically placed charging stations to complete the first phase of the national fast-charging network along designated EV Alternative Fuel Corridors. Remaining interstate highways not currently designated as Alternative Fuel Corridors could be built out with 20 additional recommended charging stations.

The new charging stations recommended in this road map represent a minimum NEVI-compliant network. Future rounds of investment increasing network redundancy and expanding charging infrastructure in areas with high traffic intensity would be critical next steps in building out a robust national charging network. These factors are further discussed beginning on page 28.

Existing and recommended fast-charging corridor stations



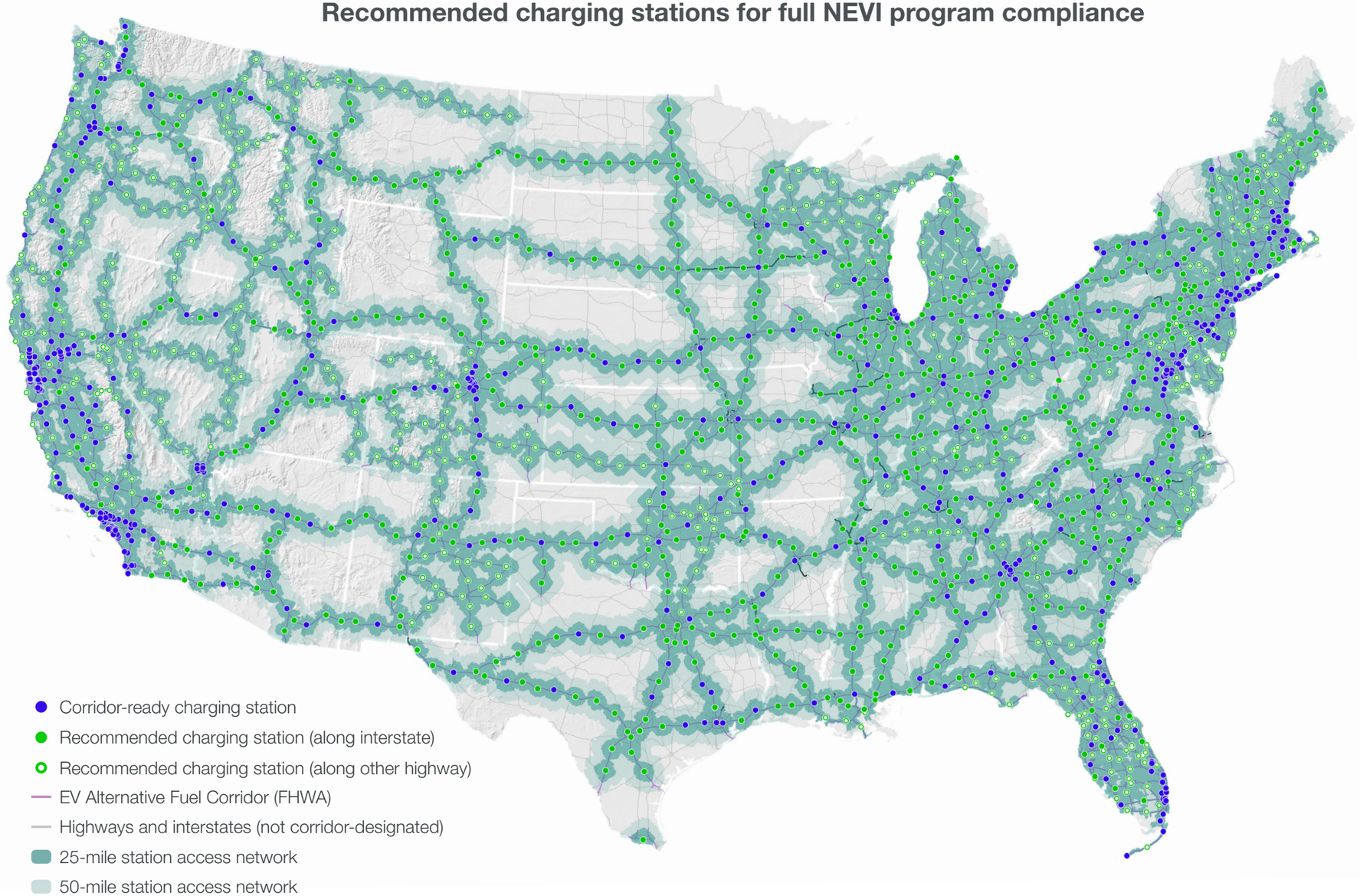
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Introduction | Full coverage across a national network of EV charging corridors

A NEVI-compliant system of charging stations along currently designated EV Alternative Fuel Corridors would result in a **nationally interconnected array of charging station access networks**.

This would mean that all designated corridors have qualifying stations spaced no more than 50 miles apart. This analysis also recommends charging locations along interstates that are not currently designated as EV Alternative Fuel Corridors.

Recommended charging stations for full NEVI program compliance



Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

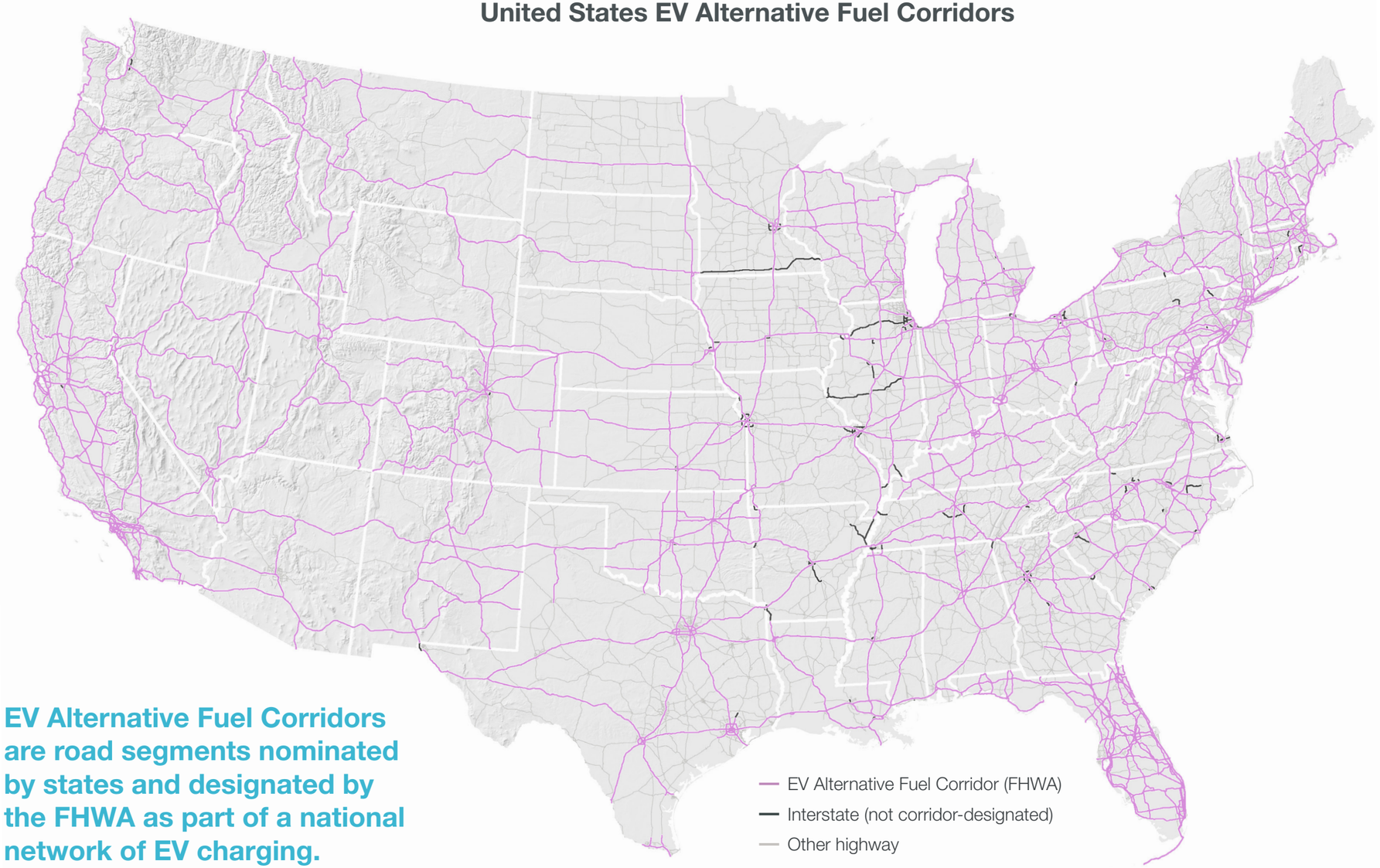
Station Identification | EV Alternative Fuel Corridors

The NEVI program provides funding for states to build out electric vehicle (EV) charging infrastructure for long-distance travel. Under this program, states must use NEVI funds to fully build out charging infrastructure along designated FHWA Alternative Fuel Corridors before using funds for investment along other routes.

Alternative Fuel Corridors are road segments nominated by states and designated by the FHWA as part of a national network of EV charging and hydrogen, propane, and natural gas fueling infrastructure along the national highway system. The Alternative Fuel Corridors shown in purple at right and throughout this road map include only segments designated specifically as EV charging corridors, current as of the 2022 Round 6 corridor designations.

Designated EV corridors cover most of the nation's interstates and many highways. Only a few segments of interstate, shown in dark gray, are not designated EV Alternative Fuel Corridors.

United States EV Alternative Fuel Corridors



EV Alternative Fuel Corridors are road segments nominated by states and designated by the FHWA as part of a national network of EV charging.

Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

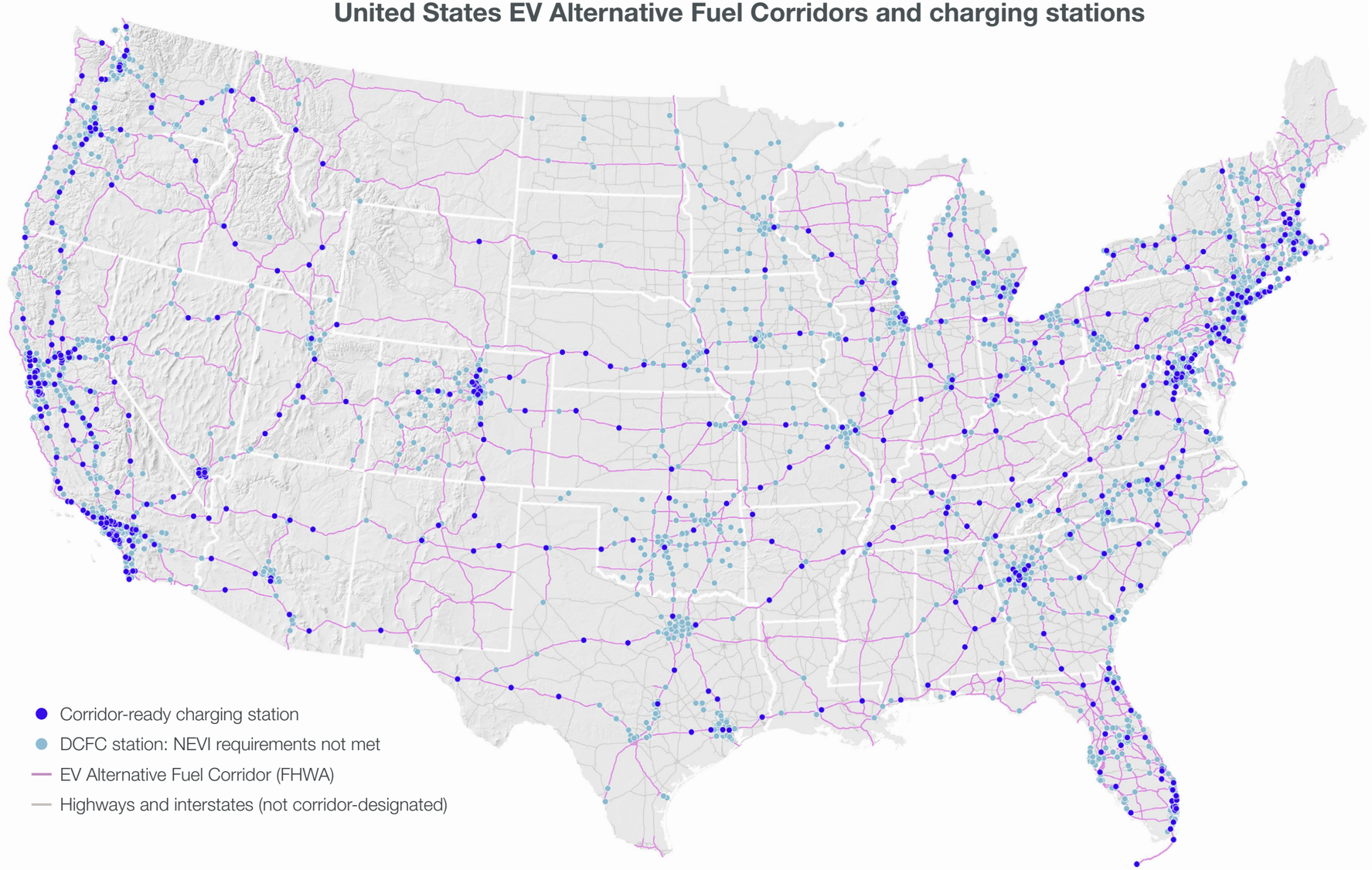
Station Identification | The national landscape of fast-charging stations

Among the nation's 4,943 public, non-Tesla stations with DCFC technology, 509 stations comply with the NEVI guidance that charging stations should include at least four DCFC ports with CCS connectors (CCS-1, specifically for US charging stations) capable of simultaneously charging four EVs at 150kW each and be located no more than one travel mile from the corridor. These compliant or **"corridor-ready" charging stations are shown in dark blue**.

The remaining 4,434 noncompliant fast-charging stations are shown in light blue. While these stations are still an important part of local and regional charging networks, they would not contribute to a fully built-out corridor under NEVI guidelines unless upgraded in some way.

Due to long required charging times at lower power charging stations, the future of long-distance EV travel will require fast-charging stations. As such, the nation's 42,212 public charging stations with a maximum of Level 2 capacity are also not included in this analysis.

United States EV Alternative Fuel Corridors and charging stations



Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Station Identification | Corridor-ready charging stations

This road map identified 509 corridor-ready fast-charging stations that meet basic NEVI requirements for station capacity, connector type, and distance from the highway or interstate. However, while these corridor-ready stations meet individual characteristic requirements, many stations are more than a 50-mile drive apart.

According to NEVI guidelines, corridor segments with charging stations spaced more than 50 miles apart cannot be certified as fully built out. As such, this road map considered any corridor segment with a greater than 50-mile driving distance between charging stations to be a network gap.

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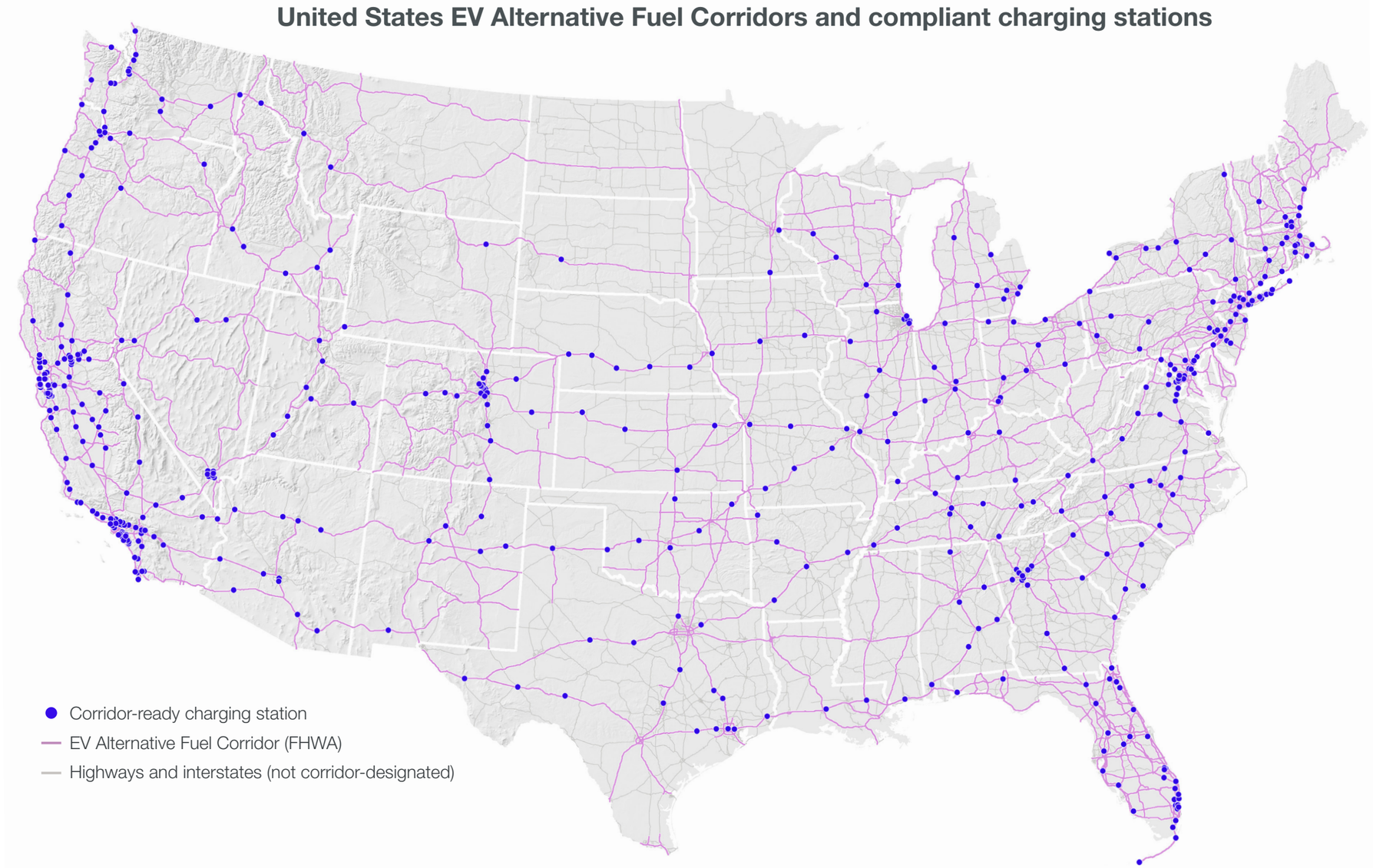


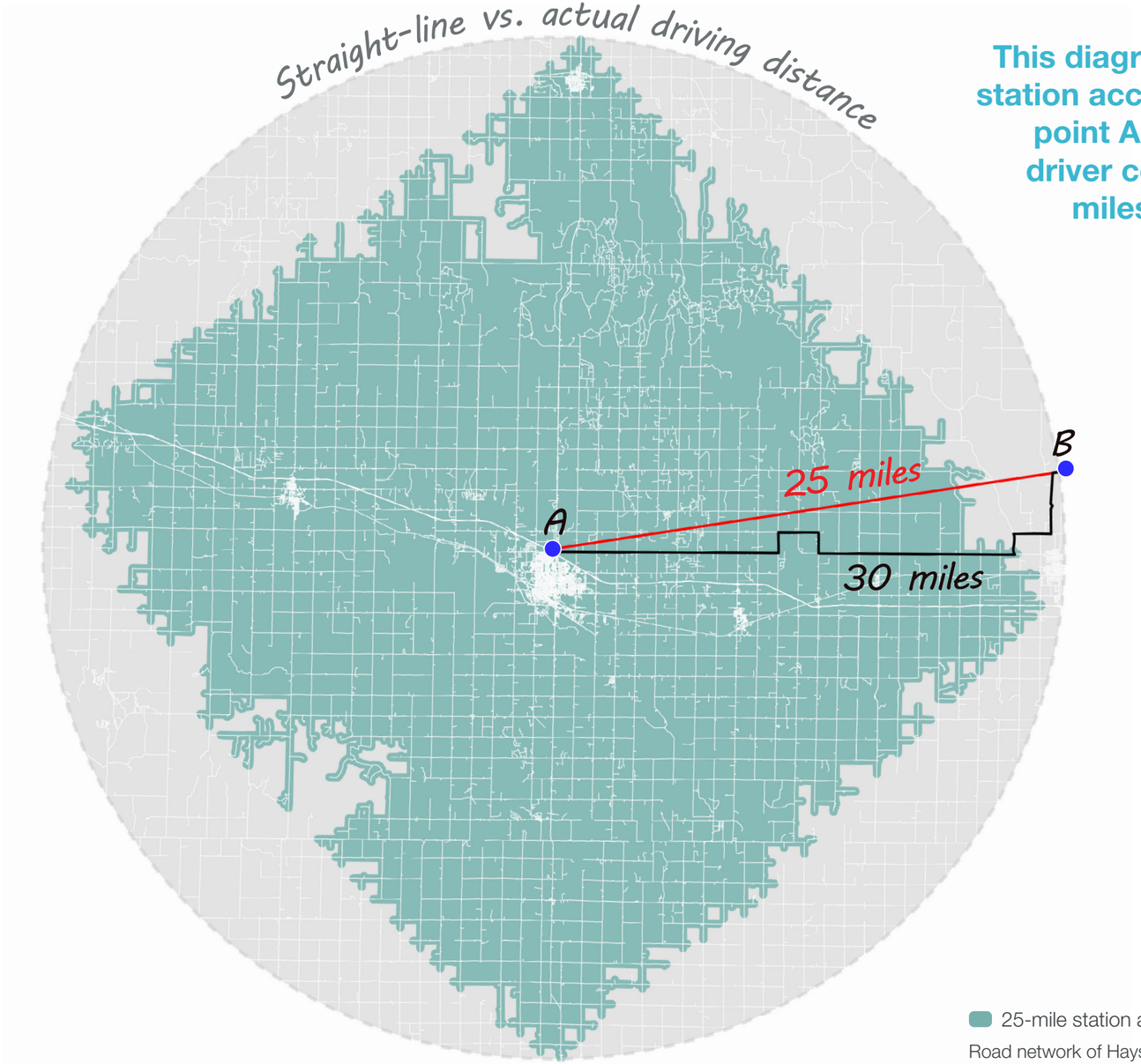
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Station Distance | Measuring real driving distance

This analysis used real road networks to measure driving distances between stations. As shown in the diagram at right, the straight-line distance between two points may actually be shorter than the real driving distance that a vehicle would travel. While a straight-line distance would indicate that there are 25 miles between point A and point B, a vehicle's route is constrained by the specific road network available to travel between the two points.

Here, the most direct route from point A to point B would mean driving 30 miles. Point B, therefore, falls outside of the teal-colored 25-mile station access network around point A. **This station access network shows the extent that a driver could reach within 25 miles of point A along all possible driving routes.**

Station access networks in this road map utilize roads data from the US Census Bureau, which includes all US roads.



This diagram shows a 25-mile station access network around point A. This is the extent a driver could reach within 25 miles of point A along all possible routes.

25-mile station access network

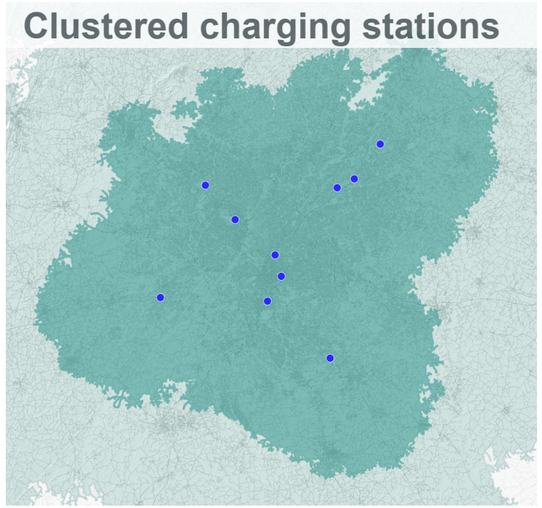
Road network of Hays, Kansas.

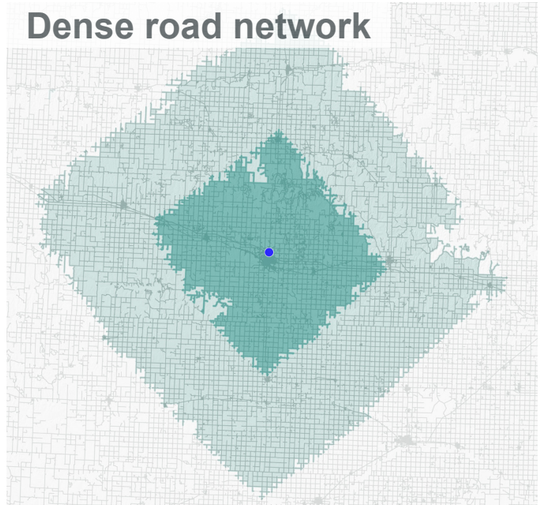
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

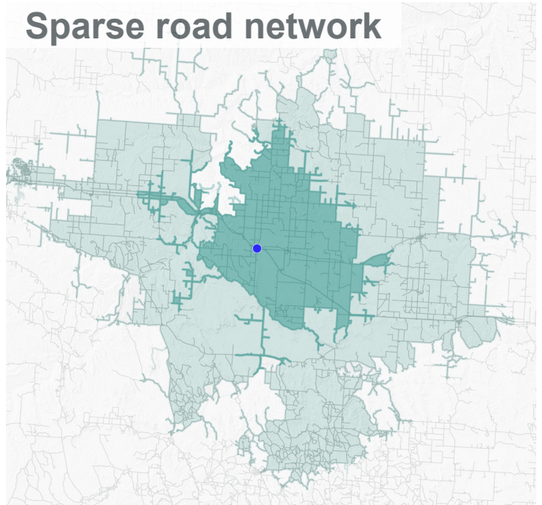
Station Distance | Types of station access networks

Given that each charging station access network is constrained by the specific network of local roads, each access network is unique. However, certain patterns emerge among access networks in similar contexts. Several observed access network shapes and patterns are shown at right. Each is defined by local patterns of infrastructure development and urban density and is often constrained by natural landscape and geographic features.

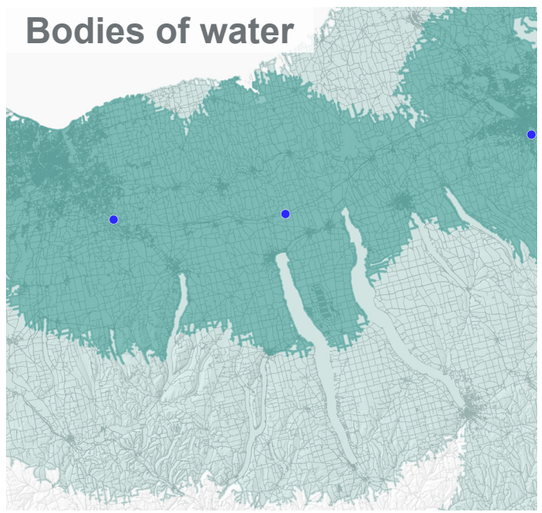
Station access networks are defined by local infrastructure development, urban density, and natural features.

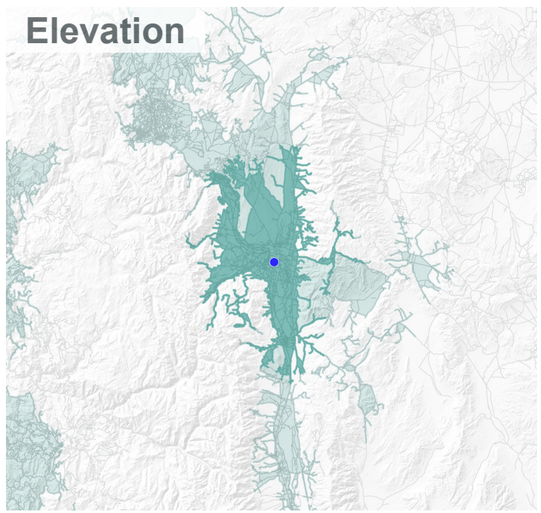






Landscape constrained



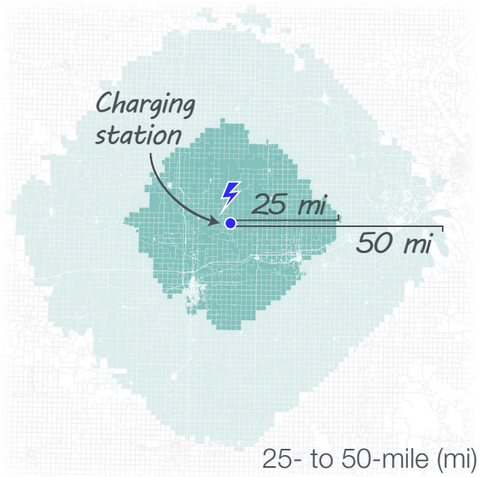


Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

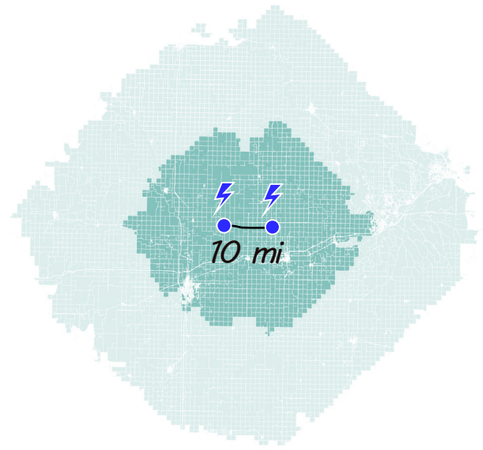
Station Distance | Network gaps

NEVI guidelines specify that charging stations must be spaced no more than 50 miles apart for a corridor segment to be certified as fully built out. Any segment with more than 50 miles between stations constitutes a gap.

Station access networks can quickly illustrate whether two stations have a gap of more than 50 miles between them. Suppose the 25-mile access network around one station touches the 25-mile access network around another station. In that case, the total driving distance between the two stations cannot be more than 50 miles. Meanwhile, if the 25-mile access networks do not touch at all, that means there is a total distance of greater than 50 miles between them.



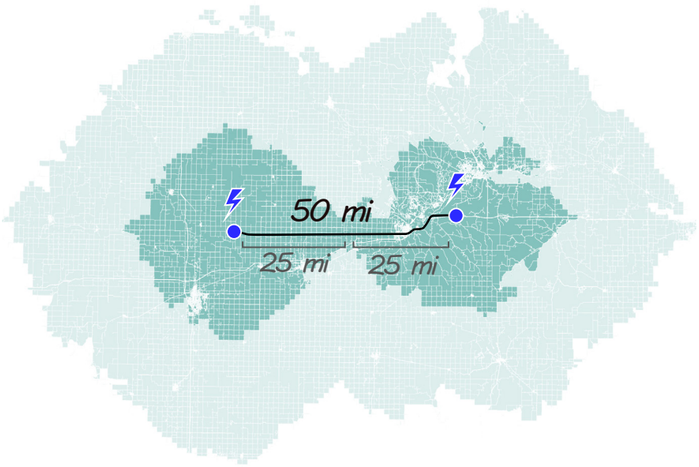
25- to 50-mile (mi) driving distance access network



NO GAP

These charging stations are only 10 miles apart.

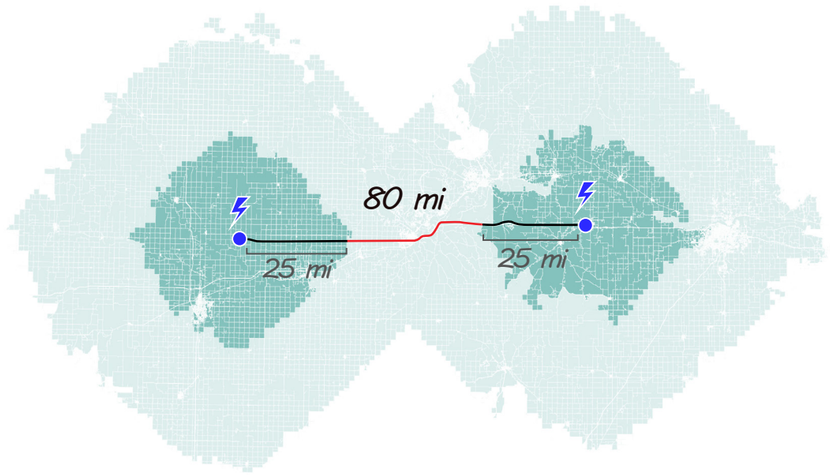
The darker teal 25-mile access networks around these stations overlap. No gap exists between them.



NO GAP

The 25-mile access networks around these stations still touch. There is no gap.

These stations are 50 miles apart—the maximum allowable distance.



GAP EXISTS

These 25-mile access networks do not overlap at all.

A driver must travel more than 50 miles from one station to the next. A gap exists between these stations.

Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

Station Distance | Network gaps across the national landscape

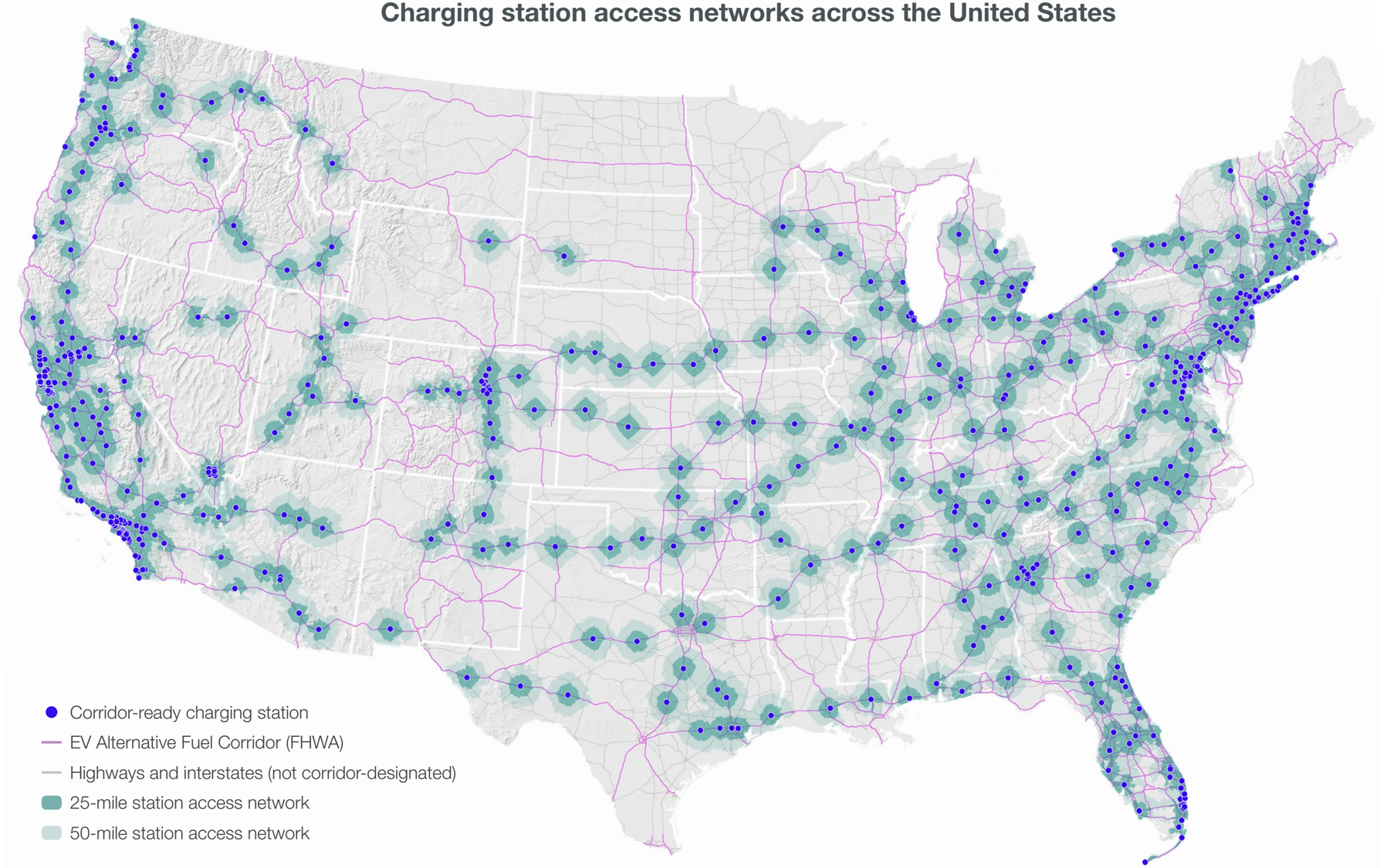
Generating 25- and 50-mile station access networks for all corridor-ready charging stations across the country reveals where there are gaps along the national network of Alternative Fuel Corridors.

A gap exceeding the 50-mile distance requirement exists between any stations where 25-mile access networks (darker, teal-colored areas) do not touch.

The areas on the map with a lighter teal shade indicate charging access within 50 miles of a single station but a longer distance to any station in the opposite direction.

The East and West coasts of the United States demonstrate widespread coverage of charging station access as a result of past investment and urban density. Likewise, parts of the Midwest and South Atlantic also have a relatively high degree of coverage. However, even these regions and much of the US contain major gaps between stations, where coverage is too sparse to satisfy NEVI requirements.

Charging station access networks across the United States



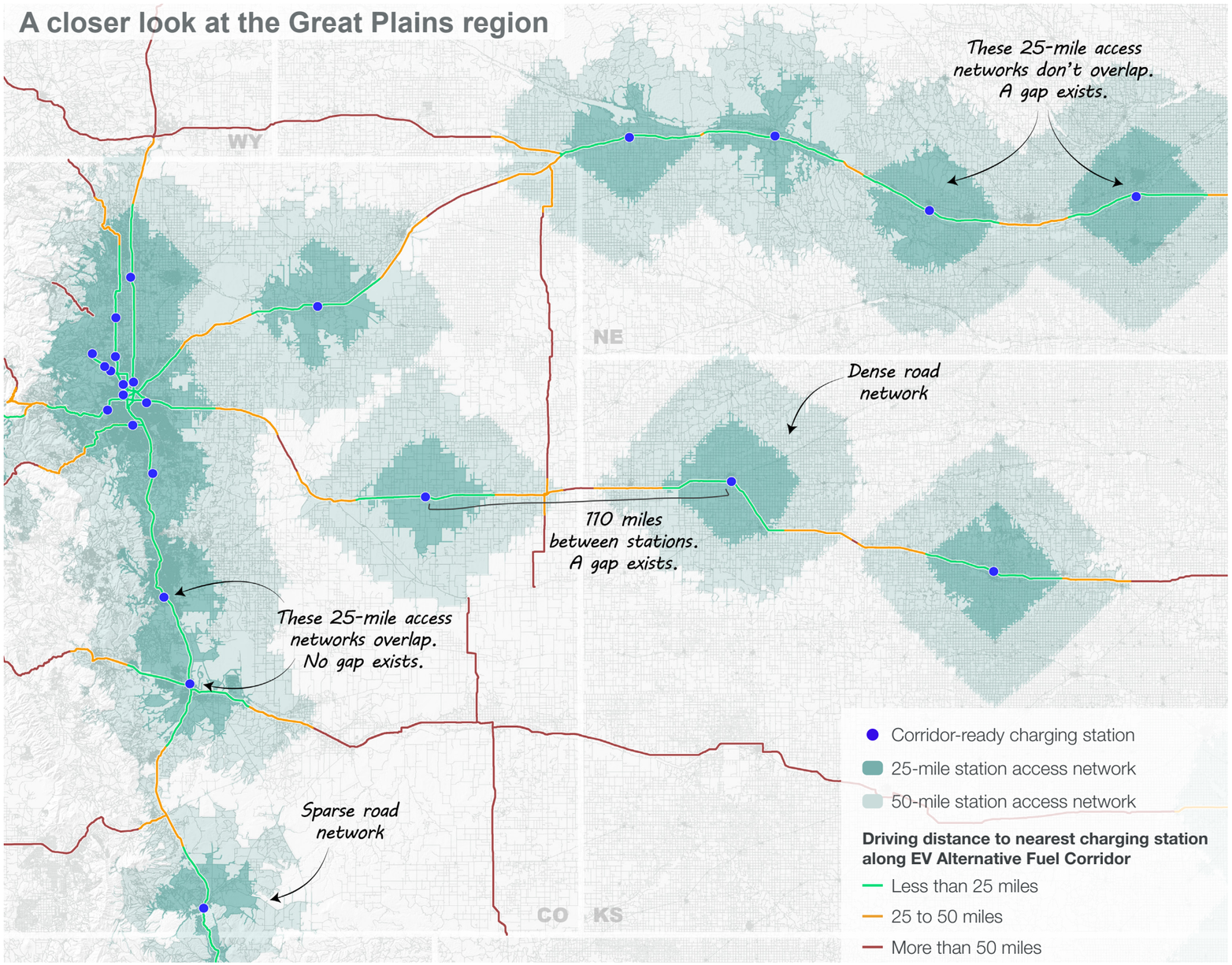
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Station Distance | Local variation in access networks

Within each region of the US, there are often a variety of dynamics in charging access and types of gaps in coverage.

In this area within the Great Plains region, several contiguous 25-mile station access networks extend up through Colorado. Meanwhile, the stations visible in Nebraska are just over 50 miles apart, resulting in network gaps between those stations. There are also long stretches of designated Alternative Fuel Corridors that lack qualifying charging stations altogether. Those stretches would require the addition of several new stations to comply with NEVI guidelines.

The following section of the report highlights gaps in the national charging network and recommends strategies for distributing new stations to resolve network gaps.



Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

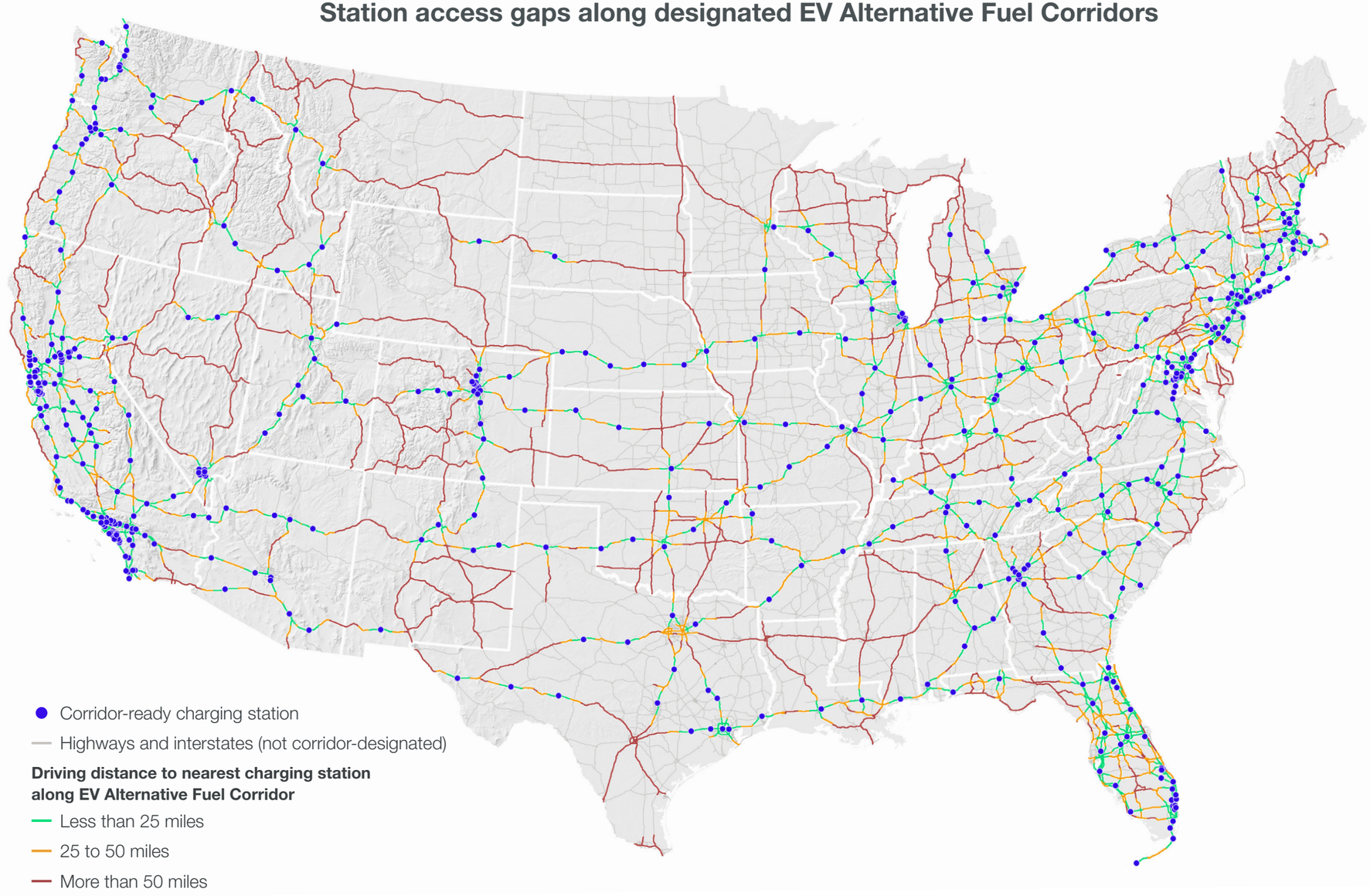
Station Distance | Highlighting gaps in the national charging network

The map at right highlights gaps in the national charging network along EV Alternative Fuel Corridors. A driver on a red road segment would need to drive over 50 miles to reach the nearest corridor-ready charging station. A driver on an orange road segment could reach a corridor-ready charging station within 50 miles driving in one direction, but not the other.

A driver on a green road segment is within 25 miles of a corridor-ready charging station. When two corridor-ready charging stations are connected by a continuous green road segment, that road segment is fully NEVI-compliant, with no more than 50 miles between corridor-ready stations.

Red and orange road segments, representing network gaps, often cross through multiple states. Examining the national landscape of coverage and gaps can enable coordinated planning to build a cohesive national charging network.

Station access gaps along designated EV Alternative Fuel Corridors



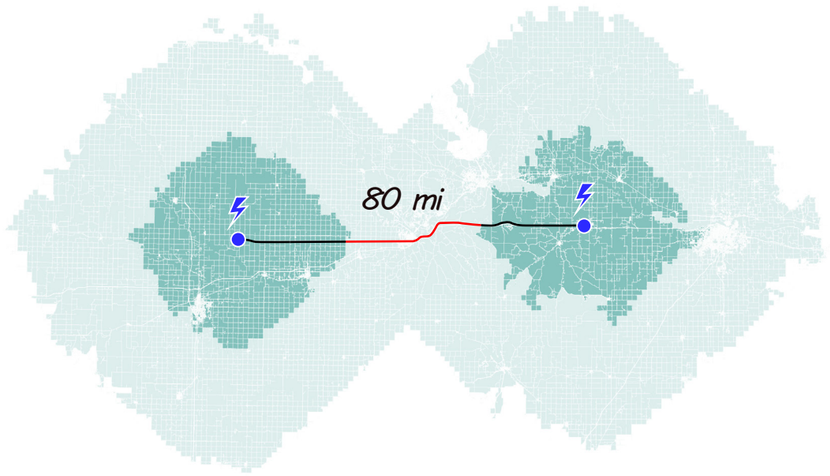
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Strategic Deployment | Resolving network gaps

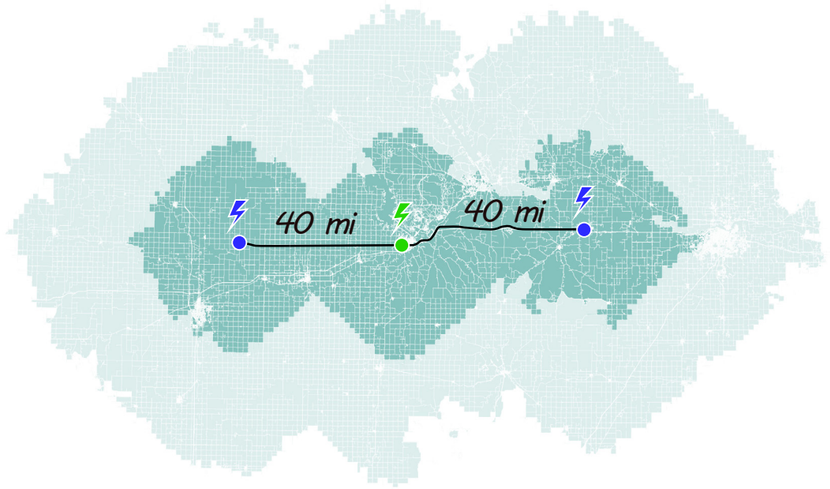
Some network gaps can be resolved by adding a single charging station.

After identifying gaps in the national charging network, the second focus of this analysis was to identify locations for new charging station locations that would fulfill NEVI corridor guidelines. Each gap represents a unique local context. However, there are general principles that can guide what is needed to fulfill minimum network requirements.

Stations located at a distance of 100 miles or less would only need a single new charging station installed between them. This analysis typically allocated each new charging station to the midpoint between the existing stations. However, the exact location of the new charging station could be adjusted as long as it remains within 50 miles of both existing stations. See page 22 for further siting considerations.



This gap can be resolved by adding a single charging station.



After adding one new charging station, a driver can now travel between stations without exceeding a distance of 50 miles.

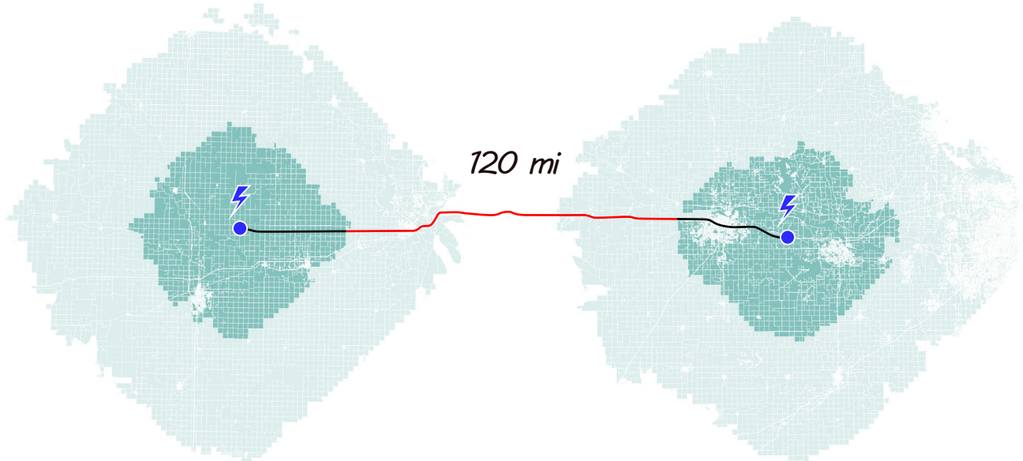
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

Strategic Deployment | Resolving network gaps (continued)

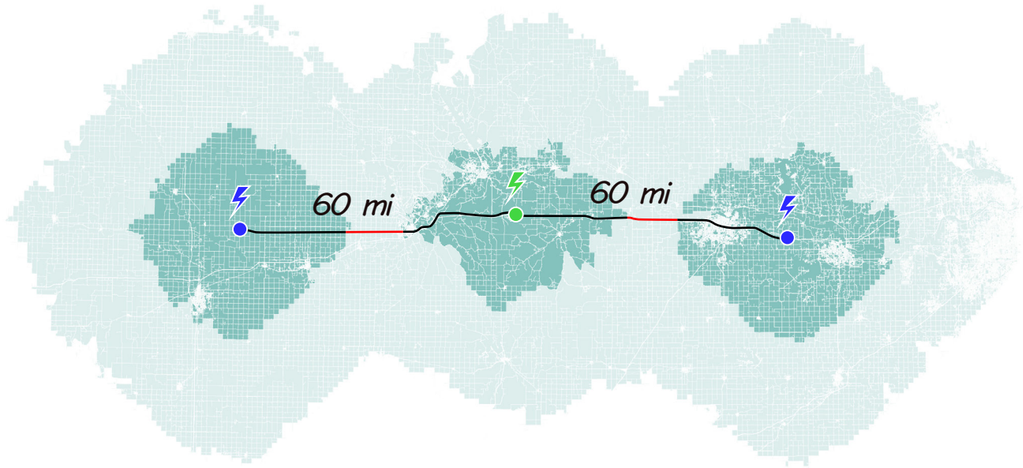
Longer network gaps need multiple charging stations to be resolved.

Multiple new stations are needed when there are more than 100 miles between existing charging stations. For example, in the diagram at right, there are 120 miles between stations. Adding a charging station at the midpoint between those stations still leaves 60 miles between each of the stations, exceeding the 50-mile maximum distance required to be compliant with NEVI guidelines.

Multiple new stations are needed when there is a distance of more than 100 miles between existing charging stations.



This gap is too lengthy to be resolved with a single additional charging station.



Adding one new station still leaves 60 miles between one station and the next.

Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

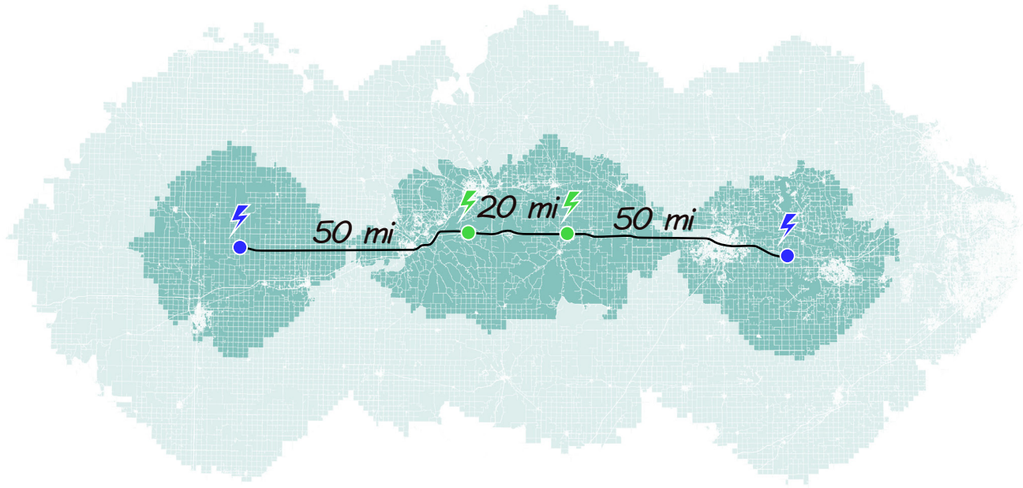
Strategic Deployment | Resolving network gaps (continued)

Longer network gaps need multiple charging stations to be resolved.

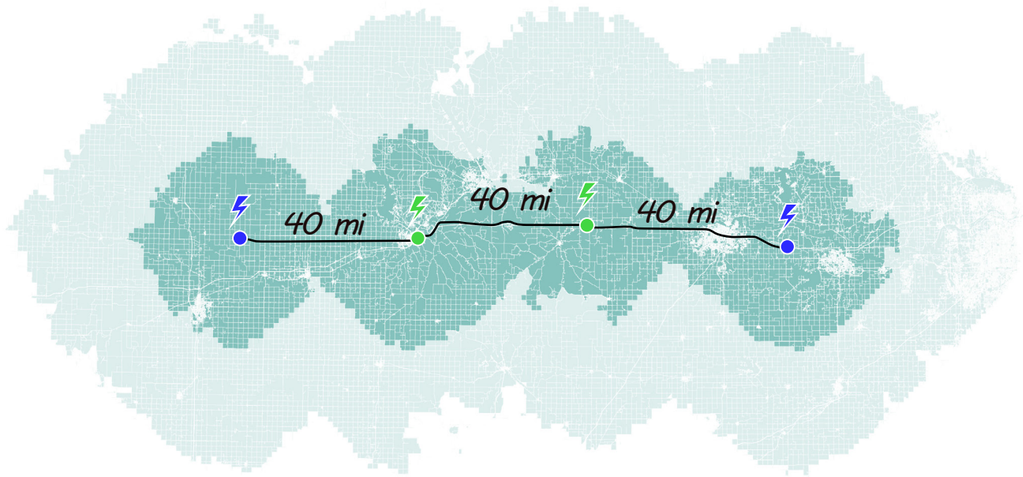
In this first example at right, the gap can be resolved by adding two stations, each 50 miles from the nearest charging station.

However, in this scenario, it is also possible to distribute the new stations more evenly along the road without exceeding 50 miles between any of them. As shown in the lower example, the stations could be spaced evenly at 40 miles apart from each other. Local planning and engagement efforts have a key role in determining how new charging stations should be distributed to best suit the local context.

In this scenario, it is possible to distribute the new stations evenly along the road without exceeding 50 miles between any of them.



This gap could be resolved by adding new stations 50 miles from each existing station.



As long as all charging stations are within 50 miles of each other, their exact locations can be adjusted to suit the local context.

Here, the stations could be spaced evenly along the road.

Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC.

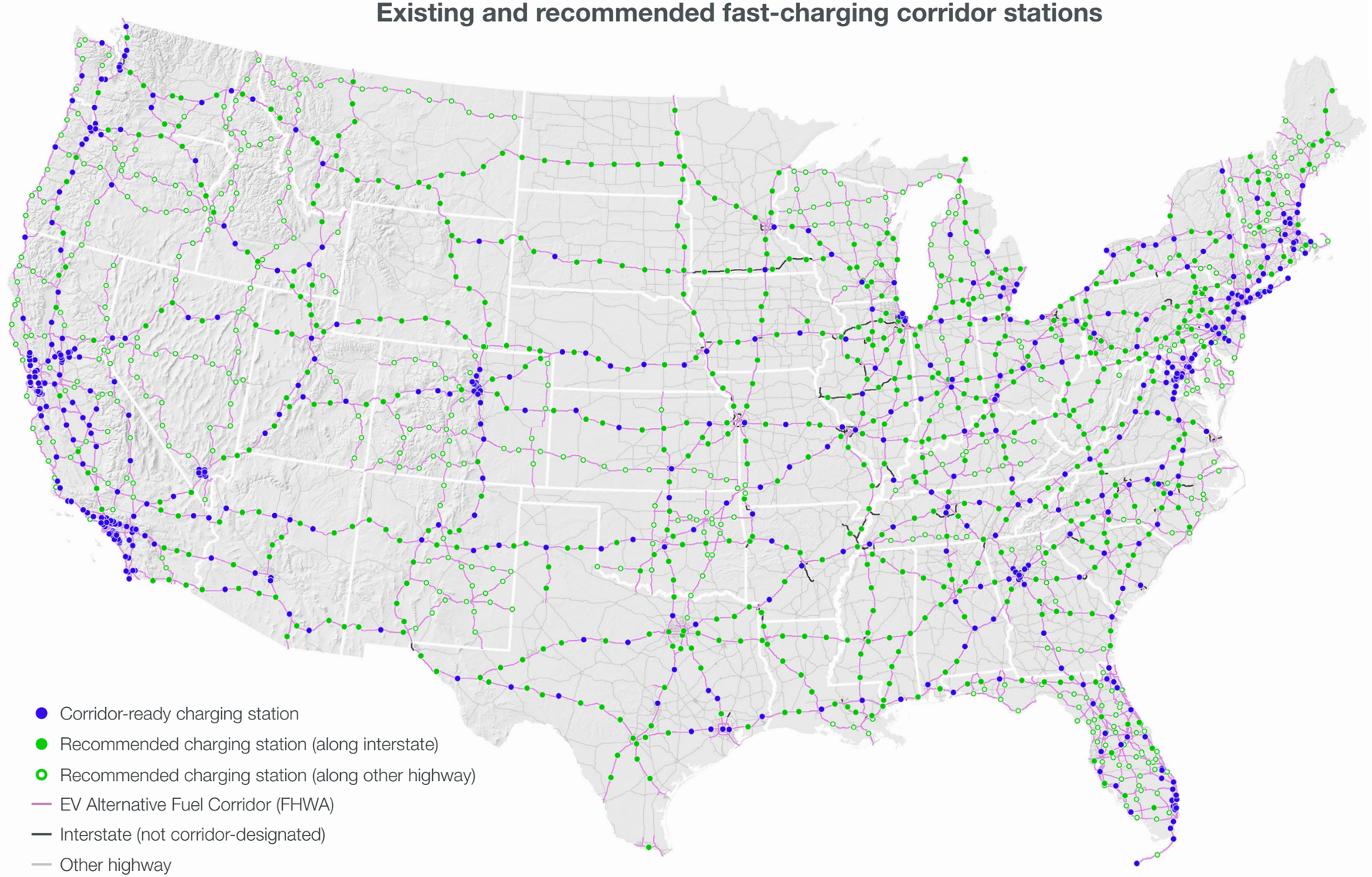
Strategic Deployment | Recommended stations for full network build-out

This analysis found that all existing EV Alternative Fuel Corridors and remaining non-designated interstates could be built out in full compliance with NEVI guidelines by adding 1,104 strategically placed charging stations.

The addition of these 1,104 charging stations could greatly contribute to the development of a seamless national EV travel network. However, build-out along additional highway and high-traffic routes will be needed to enable fully flexible long-distance EV travel throughout the country. Increasing the number of ports per station beyond the NEVI four-port minimum could also increase convenience and reliability, especially in areas of high usage.

All existing EV Alternative Fuel Corridors and non-designated interstates could be fully built out to NEVI standards through the addition of 1,104 strategically placed charging stations.

Existing and recommended fast-charging corridor stations



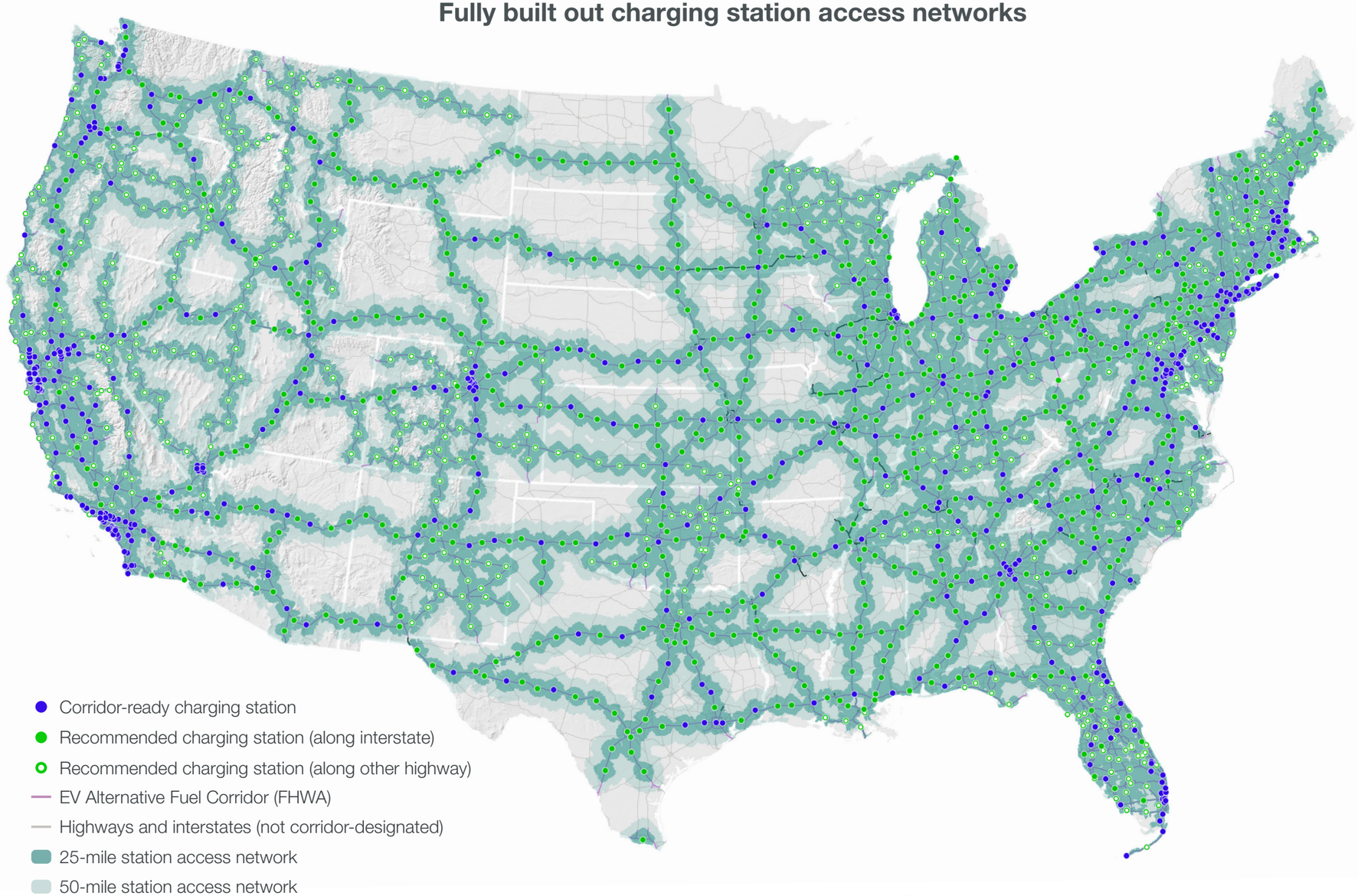
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Strategic Deployment | Full-coverage national charging access network

All current designated EV Alternative Fuel Corridors could achieve full build-out through the addition of 1,084 charging stations. An additional 20 stations could address remaining interstate highways that are not currently designated as EV Alternative Fuel Corridors. Build-out of these stations would result in the nationally interconnected array of station access networks at right, where all designated corridors have qualifying stations spaced no more than 50 miles apart.

In addition to facilitating long-distance travel along key corridors, the development of a fully built-out fast-charging network can support local station access as well, bringing much of the country within 25 to 50 miles of a qualifying fast-charging station. However, these stations are only one part of a much broader scale-up in the infrastructure needed to meet the charging demand for midcentury levels of EV deployment.

Fully built out charging station access networks



Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), and US Census Bureau (May 2021).

Strategic Deployment | A closer look at siting new charging stations

Each new charging station recommended by this road map represents a general location. Within the required 1-mile driving distance from a designated corridor, local siting considerations would determine the best exact location to site a new station. For example, there may be a town center, big box store, travel center, or suitable location on state or federal land within 1 mile of the corridor where the station could be placed. Electric distribution system hosting capacity must also be considered due to the high power requirements of charging station equipment.

Considerations including local land use, travel patterns, and electric distribution system capacity would determine the best exact location to site a new station.

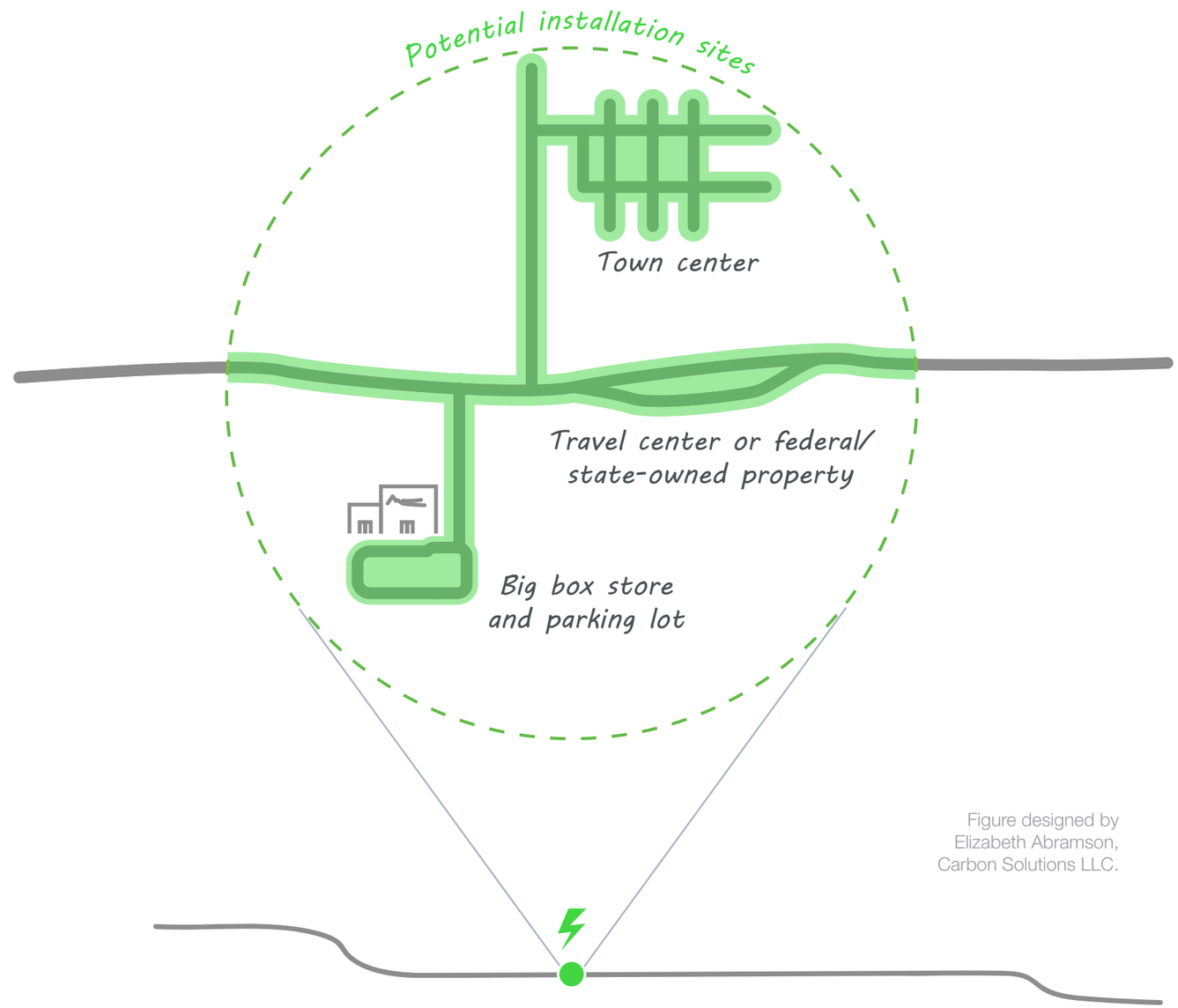


Figure designed by
Elizabeth Abramson,
Carbon Solutions LLC.

Potential installation sites near a recommended station location

Quantitative Summary | Existing charging stations

There are 4,943 DCFC stations nationwide. Among those, 509 meet the corridor-ready physical requirements laid out by the NEVI program. California, Florida, New York, and Virginia currently lead with the highest number of corridor-ready charging stations.

The US is also home to 42,212 charging stations with a maximum of Level 2 charging output. While the long charging times required at Level 2 stations reduce their utility for long-distance corridor travel, noncompliant DCFC and Level 2 stations could still play a role in achieving a full build-out of the charging network if upgraded to meet NEVI requirements.

Number of existing charging stations by state

State	DCFC stations	Corridor-ready (NEVI-compliant) DCFC stations	Non-compliant DCFC stations	Level 2 stations
Alabama	30	7	23	184
Alaska	10	Not assessed	Not assessed	43
Arizona	56	11	45	748
Arkansas	10	5	5	151
California	1,407	134	1,273	12,558
Colorado	209	21	188	1,345
Connecticut	41	4	37	419
Delaware	16	1	15	103
District of Columbia	6	1	5	240
Florida	232	34	198	2,196
Georgia	197	14	183	1,272
Hawaii	42	Not assessed	Not assessed	323
Idaho	15	6	9	86
Illinois	103	12	91	848
Indiana	25	6	19	268
Iowa	55	3	52	205
Kansas	20	4	16	428
Kentucky	13	4	9	207
Louisiana	12	2	10	130
Maine	37	2	35	326
Maryland	182	12	170	988
Massachusetts	95	9	86	2,091
Michigan	160	7	153	833
Minnesota	55	2	53	455
Mississippi	6	1	5	82
Missouri	70	6	64	897
Montana	12	2	10	59
Nebraska	31	5	26	157
Nevada	63	13	50	392
New Hampshire	15	5	10	131
New Jersey	93	10	83	587
New Mexico	22	6	16	154
New York	164	21	143	2,747
North Carolina	118	10	108	900
North Dakota	15	-	15	52
Ohio	131	12	119	886
Oklahoma	149	6	143	148
Oregon	153	15	138	707
Pennsylvania	84	12	72	1,022
Puerto Rico	-	Not assessed	Not assessed	6
Rhode Island	28	1	27	242
South Carolina	30	5	25	324
South Dakota	7	1	6	43
Tennessee	55	10	45	510
Texas	187	17	170	1,958
Utah	73	7	66	755
Vermont	32	-	32	282
Virginia	137	21	116	882
Washington	189	16	173	1,370
West Virginia	5	-	5	80
Wisconsin	41	4	37	346
Wyoming	5	2	3	46
National total	**4,943**	**509**	**4,434**	**42,212**

Table based on Carbon Solutions LLC analysis. Data sources include AFDC (July 2022) and US DOT (December 2021; July 2022).

Quantitative Summary | Recommended charging stations

NEVI guidance instructs states to prioritize building charging infrastructure along interstate portions of designated EV Alternative Fuel Corridors. The guidance also instructs states to plan for the eventual build-out of charging infrastructure along all remaining interstates, regardless of corridor designation. With this in mind, the recommended charging stations modeled in this road map are organized into the following categories:

- **Interstate stations:** charging stations to be built along interstates currently designated as EV Alternative Fuel Corridors
- **Highway stations:** charging stations to be built along remaining (non-interstate) routes designated as EV Alternative Fuel Corridors
- **Remaining interstate stations:** charging stations to be built along interstate routes not currently designated as EV Alternative Fuel Corridors

Charging stations and potential investment by state

State	Corridor-ready (NEVI-compliant) stations	Recommended charging stations	Interstate stations	Interstate station cost million dollars	Highway stations	Highway station cost million dollars	Remaining interstate stations	Remaining interstate station cost million dollars	Cost of all new stations million dollars
Alabama	7	13	13	$ 9.4 - 15.6	-	-	-	-	$ 9.4 - 15.6
Arizona	11	19	19	$ 13.7 - 22.8	-	-	-	-	$ 13.7 - 22.8
Arkansas	5	10	7	$ 5.0 - 8.4	-	-	3	$ 2.2 - 3.6	$ 7.2 - 12.0
California	134	70	18	$ 13.0 - 21.6	52	$ 37.4 - 62.4	-	-	$ 50.4 - 84.0
Colorado	21	41	9	$ 6.5 - 10.8	32	$ 23.0 - 38.4	-	-	$ 29.5 - 49.2
Connecticut	4	5	4	$ 2.9 - 4.8	1	$ 0.7 - 1.2	-	-	$ 3.6 - 6.0
Delaware	1	3	-	-	3	$ 2.2 - 3.6	-	-	$ 2.2 - 3.6
District of Columbia	1	-	-	-	-	-	-	-	-
Florida	34	73	16	$ 11.5 - 19.2	57	$ 41.0 - 68.4	-	-	$ 52.6 - 87.6
Georgia	14	23	14	$ 10.1 - 16.8	9	$ 6.5 - 10.8	-	-	$ 16.6 - 27.6
Idaho	6	37	8	$ 5.8 - 9.6	29	$ 20.9 - 34.8	-	-	$ 26.6 - 44.4
Illinois	12	29	23	$ 16.6 - 27.6	-	-	6	$ 4.3 - 7.2	$ 20.9 - 34.8
Indiana	6	24	21	$ 15.1 - 25.2	3	$ 2.2 - 3.6	-	-	$ 17.3 - 28.8
Iowa	3	11	11	$ 7.9 - 13.2	-	-	-	-	$ 7.9 - 13.2
Kansas	4	23	13	$ 9.4 - 15.6	10	$ 7.2 - 12.0	-	-	$ 16.6 - 27.6
Kentucky	4	25	13	$ 9.4 - 15.6	12	$ 8.6 - 14.4	-	-	$ 18.0 - 30.0
Louisiana	2	21	16	$ 11.5 - 19.2	4	$ 2.9 - 4.8	1	$ 0.7 - 1.2	$ 15.1 - 25.2
Maine	2	17	7	$ 5.0 - 8.4	10	$ 7.2 - 12.0	-	-	$ 12.2 - 20.4
Maryland	12	11	3	$ 2.2 - 3.6	8	$ 5.8 - 9.6	-	-	$ 7.9 - 13.2
Massachusetts	9	9	3	$ 2.2 - 3.6	6	$ 4.3 - 7.2	-	-	$ 6.5 - 10.8
Michigan	7	34	19	$ 13.7 - 22.8	15	$ 10.8 - 18.0	-	-	$ 24.5 - 40.8
Minnesota	2	16	10	$ 7.2 - 12.0	-	-	6	$ 4.3 - 7.2	$ 11.5 - 19.2
Mississippi	1	17	17	$ 12.2 - 20.4	-	-	-	-	$ 12.2 - 20.4
Missouri	6	20	17	$ 12.2 - 20.4	2	$ 1.4 - 2.4	1	$ 0.7 - 1.2	$ 14.4 - 24.0
Montana	2	39	22	$ 15.8 - 26.4	17	$ 12.2 - 20.4	-	-	$ 28.1 - 46.8
Nebraska	5	8	8	$ 5.8 - 9.6	-	-	-	-	$ 5.8 - 9.6

Table based on Carbon Solutions LLC analysis. Data sources include AFDC (July 2022) and US DOT (December 2021; July 2022).

Quantitative Summary | Recommended charging stations (continued)

The cost of installing a new NEVI-compliant EV charging station will vary based on factors including local land use and ease of connection to energy infrastructure. Meanwhile, additional costs for station planning, operation, maintenance, and reporting will affect total costs and are not included in the totals estimated at right.

This analysis assumed a range of $720 thousand to $1.2 million per station for equipment installation.[9] The total cost of installing the 1,104 recommended charging stations identified in this road map is estimated to fall between $794 million and $1.3 billion.

Charging stations and potential investment by state

State	Corridor-ready (NEVI-compliant) stations	Recommended charging stations	Interstate stations	Interstate station cost million dollars	Highway stations	Highway station cost million dollars	Remaining interstate stations	Remaining interstate station cost million dollars	Cost of all new stations million dollars
Nevada	13	37	6	$ 4.3 - 7.2	31	$ 22.3 - 37.2	-	-	$ 26.6 - 44.4
New Hampshire	5	11	3	$ 2.2 - 3.6	8	$ 5.8 - 9.6	-	-	$ 7.9 - 13.2
New Jersey	10	5	1	$ 0.7 - 1.2	4	$ 2.9 - 4.8	-	-	$ 3.6 - 6.0
New Mexico	6	39	17	$ 12.2 - 20.4	22	$ 15.8 - 26.4	-	-	$ 28.1 - 46.8
New York	21	23	17	$ 12.2 - 20.4	6	$ 4.3 - 7.2	-	-	$ 16.6 - 27.6
North Carolina	10	29	16	$ 11.5 - 19.2	12	$ 8.6 - 14.4	1	$ 0.7 - 1.2	$ 20.9 - 34.8
North Dakota	-	11	11	$ 7.9 - 13.2	-	-	-	-	$ 7.9 - 13.2
Ohio	12	24	20	$ 14.4 - 24.0	4	$ 2.9 - 4.8	-	-	$ 17.3 - 28.8
Oklahoma	6	31	12	$ 8.6 - 14.4	19	$ 13.7 - 22.8	-	-	$ 22.3 - 37.2
Oregon	15	39	10	$ 7.2 - 12.0	29	$ 20.9 - 34.8	-	-	$ 28.1 - 46.8
Pennsylvania	12	40	33	$ 23.8 - 39.6	6	$ 4.3 - 7.2	1	$ 0.7 - 1.2	$ 28.8 - 48.0
Rhode Island	1	1	1	$ 0.7 - 1.2	-	-	-	-	$ 0.7 - 1.2
South Carolina	5	13	13	$ 9.4 - 15.6	-	-	-	-	$ 9.4 - 15.6
South Dakota	1	12	12	$ 8.6 - 14.4	-	-	-	-	$ 8.6 - 14.4
Tennessee	10	19	13	$ 9.4 - 15.6	6	$ 4.3 - 7.2	-	-	$ 13.7 - 22.8
Texas	17	48	46	$ 33.1 - 55.2	2	$ 1.4 - 2.4	-	-	$ 34.6 - 57.6
Utah	7	20	15	$ 10.8 - 18.0	5	$ 3.6 - 6.0	-	-	$ 14.4 - 24.0
Vermont	-	10	6	$ 4.3 - 7.2	4	$ 2.9 - 4.8	-	-	$ 7.2 - 12.0
Virginia	21	13	13	$ 9.4 - 15.6	-	-	-	-	$ 9.4 - 15.6
Washington	16	18	9	$ 6.5 - 10.8	9	$ 6.5 - 10.8	-	-	$ 13.0 - 21.6
West Virginia	-	11	11	$ 7.9 - 13.2	-	-	-	-	$ 7.9 - 13.2
Wisconsin	4	35	14	$ 10.1 - 16.8	20	$ 14.4 - 24.0	1	$ 0.7 - 1.2	$ 25.2 - 42.0
Wyoming	2	17	17	$ 12.2 - 20.4	-	-	-	-	$ 12.2 - 20.4
National total	**509**	**1,104**	**627**	**$ 451.4 - 752.4**	**457**	**$ 329.0 - 548.4**	**20**	**$ 14.4 - 24.0**	**$ 794.9 - 1,324.8**

Table based on Carbon Solutions LLC analysis. Data sources include AFDC (July 2022) and US DOT (December 2021; July 2022).

Quantitative Summary | NEVI funding

The NEVI program will award a total of $5.0 billion from 2022 through 2026, with $1.0 billion appropriated each fiscal year (FY).[10] Projects awarded under the NEVI program must meet a 20 percent cost share, which can be covered through state or private funds.[11] The table at right shows the amount of funding each state will receive in 2022 and how far that funding could go toward building out the charging stations recommended in this road map.

While this analysis assumed that all NEVI funding would go toward station deployment, federal guidelines indicate that the funding can also be used to develop state plans, station operation and maintenance, charging station upgrades, mapping and analysis activities, data sharing, and other eligible expenses.[12]

Estimated NEVI funding coverage for recommended charging stations by state

State	FY22 NEVI funding million dollars	Recommended charging stations	New stations that can be funded through NEVI FY22 funding	Remaining stations to be built after NEVI FY22 funding	Funding needed for remaining stations million dollars
Alabama	$11.7	13	12 - 20	0 - 1	$0 - 1.2
Alaska	$7.8	Not assessed	8 - 13	Not assessed	Not assessed
Arizona	$11.3	19	11 - 19	0 - 8	$0 - 9.6
Arkansas	$8.0	10	8 - 13	0 - 2	$0 - 2.4
California	$56.8	70	59 - 98	0 - 11	$0 - 13.2
Colorado	$8.4	41	8 - 14	27 - 33	$19.4 - 39.6
Connecticut	$7.8	5	8 - 13	-	-
Delaware	$2.6	3	2 - 4	0 - 1	$0 - 1.2
District of Columbia	$2.5	-	2 - 4	-	-
Florida	$29.3	73	30 - 50	23 - 43	$16.6 - 51.6
Georgia	$20.0	23	20 - 34	0 - 3	$0 - 3.6
Hawaii	$2.6	Not assessed	2 - 4	Not assessed	Not assessed
Idaho	$4.4	37	4 - 7	30 - 33	$21.6 - 39.6
Illinois	$22.0	29	22 - 38	0 - 7	$0 - 8.4
Indiana	$14.7	24	15 - 25	0 - 9	$0 - 10.8
Iowa	$7.6	11	7 - 13	0 - 4	$0 - 4.8
Kansas	$5.8	23	6 - 10	13 - 17	$9.4 - 20.4
Kentucky	$10.3	25	10 - 17	8 - 15	$5.8 - 18.0
Louisiana	$10.9	21	11 - 18	3 - 10	$2.2 - 12.0
Maine	$2.9	17	3 - 5	12 - 14	$8.6 - 16.8
Maryland	$9.3	11	9 - 16	0 - 2	$0 - 2.4
Massachusetts	$9.4	9	10 - 16	-	-
Michigan	$16.3	34	17 - 28	6 - 17	$4.3 - 20.4
Minnesota	$10.1	16	10 - 17	0 - 6	$0 - 7.2
Mississippi	$7.5	17	7 - 13	4 - 10	$2.9 - 12.0
Missouri	$14.6	20	15 - 25	0 - 5	$0 - 6.0

Table based on Carbon Solutions LLC and Great Plains Institute analyses. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), "5-year National Electric Vehicle Infrastructure Funding by State," US Department of Transportation Federal Highway Administration, updated September 13, 2022, https://www.fhwa.dot.gov/bipartisan-infrastructure-law/evs_5year_nevi_funding_by_state.cfm.

Quantitative Summary | NEVI funding (continued)

Based on the road map's results and estimated equipment installation cost ($720 thousand to $1.2 million per station), several states might have FY22 NEVI funding remaining after building out the number of stations recommended in this study. However, many states will need to prioritize how they spend their dollars since the first year of NEVI funding will not fund all stations recommended in this road map.

Estimated NEVI funding coverage for recommended charging stations by state

State	FY22 NEVI funding million dollars	Recommended charging stations	New stations that can be funded through NEVI FY22 funding	Remaining stations to be built after NEVI FY22 funding	Funding needed for remaining stations million dollars
Montana	$6.3	39	6 - 11	28 - 33	$20.2 - 39.6
Nebraska	$4.5	8	4 - 7	1 - 4	$0.7 - 4.8
Nevada	$5.6	37	5 - 9	28 - 32	$20.2 - 38.4
New Hampshire	$2.6	11	2 - 4	7 - 9	$5.0 - 10.8
New Jersey	$15.4	5	16 - 26	-	-
New Mexico	$5.7	39	5 - 9	30 - 34	$21.6 - 40.8
New York	$26.0	23	27 - 45	-	-
North Carolina	$16.1	29	16 - 28	1 - 13	$0.7 - 15.6
North Dakota	$3.8	11	4 - 6	5 - 7	$3.6 - 8.4
Ohio	$20.7	24	21 - 36	0 - 3	$0 - 3.6
Oklahoma	$9.8	31	10 - 17	14 - 21	$10.1 - 25.2
Oregon	$7.7	39	8 - 13	26 - 31	$18.7 - 37.2
Pennsylvania	$25.4	40	26 - 44	0 - 14	$0 - 16.8
Puerto Rico	$2.0	Not assessed	2 - 3	Not assessed	Not assessed
Rhode Island	$3.4	1	3 - 5	-	-
South Carolina	$10.4	13	10 - 18	0 - 3	$0 - 3.6
South Dakota	$4.4	12	4 - 7	5 - 8	$3.6 - 9.6
Tennessee	$13.1	19	13 - 22	0 - 6	$0 - 7.2
Texas	$60.4	48	62 - 104	-	-
Utah	$5.4	20	5 - 9	11 - 15	$7.9 - 18.0
Vermont	$3.1	10	3 - 5	5 - 7	$3.6 - 8.4
Virginia	$15.7	13	16 - 27	-	-
Washington	$10.5	18	10 - 18	0 - 8	$0 - 9.6
West Virginia	$6.8	11	7 - 11	0 - 4	$0 - 4.8
Wisconsin	$11.6	35	12 - 20	15 - 23	$10.8 - 27.6
Wyoming	$4.0	17	4 - 6	11 - 13	$7.9 - 15.6
National total	**$615.0**	**1,104**	**640 - 1,067**	**315- 504**	**$225.4 - 646.8**

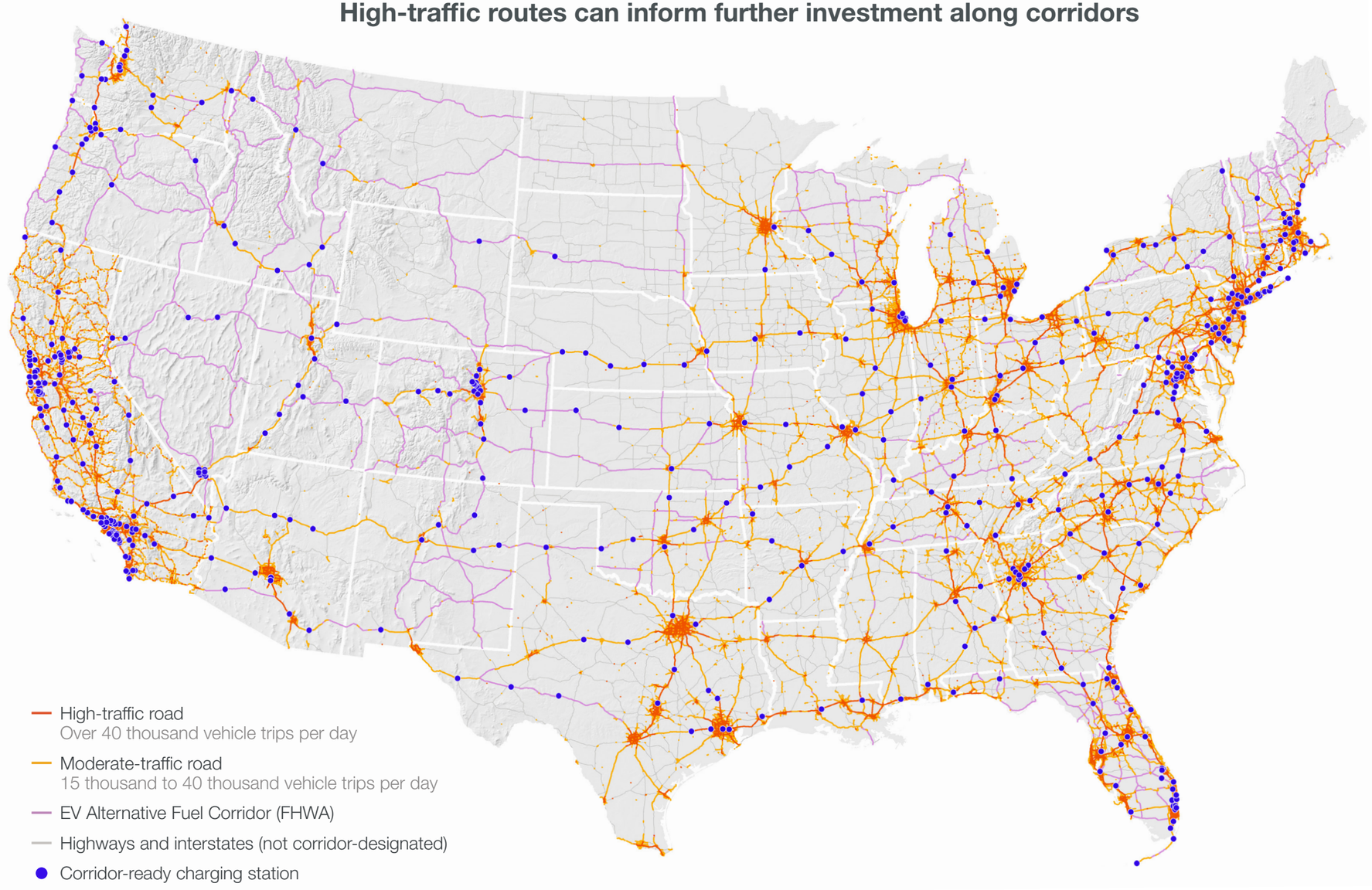
Table based on Carbon Solutions LLC and Great Plains Institute analyses. Data sources include AFDC (July 2022), US DOT (December 2021; July 2022), "5-year National Electric Vehicle Infrastructure Funding by State," US Department of Transportation Federal Highway Administration, updated September 13, 2022, https://www.fhwa.dot.gov/bipartisan-infrastructure-law/evs_5year_nevi_funding_by_state.cfm.

High-Traffic Driving Routes Across the United States

Identifying routes with high daily traffic flow and associated charging demand reveals additional insights for strategic station planning. NEVI guidelines provide a strong baseline for the build-out of nationwide charging infrastructure. In many areas, it may also make sense to increase station capacity beyond the 4-port minimum set out by NEVI guidelines and increase the frequency of charging stations along high-demand routes.

It may make sense to increase station capacity beyond the 4-plug minimum set out by NEVI and increase the frequency of charging stations along high-demand routes.

High-traffic routes can inform further investment along corridors



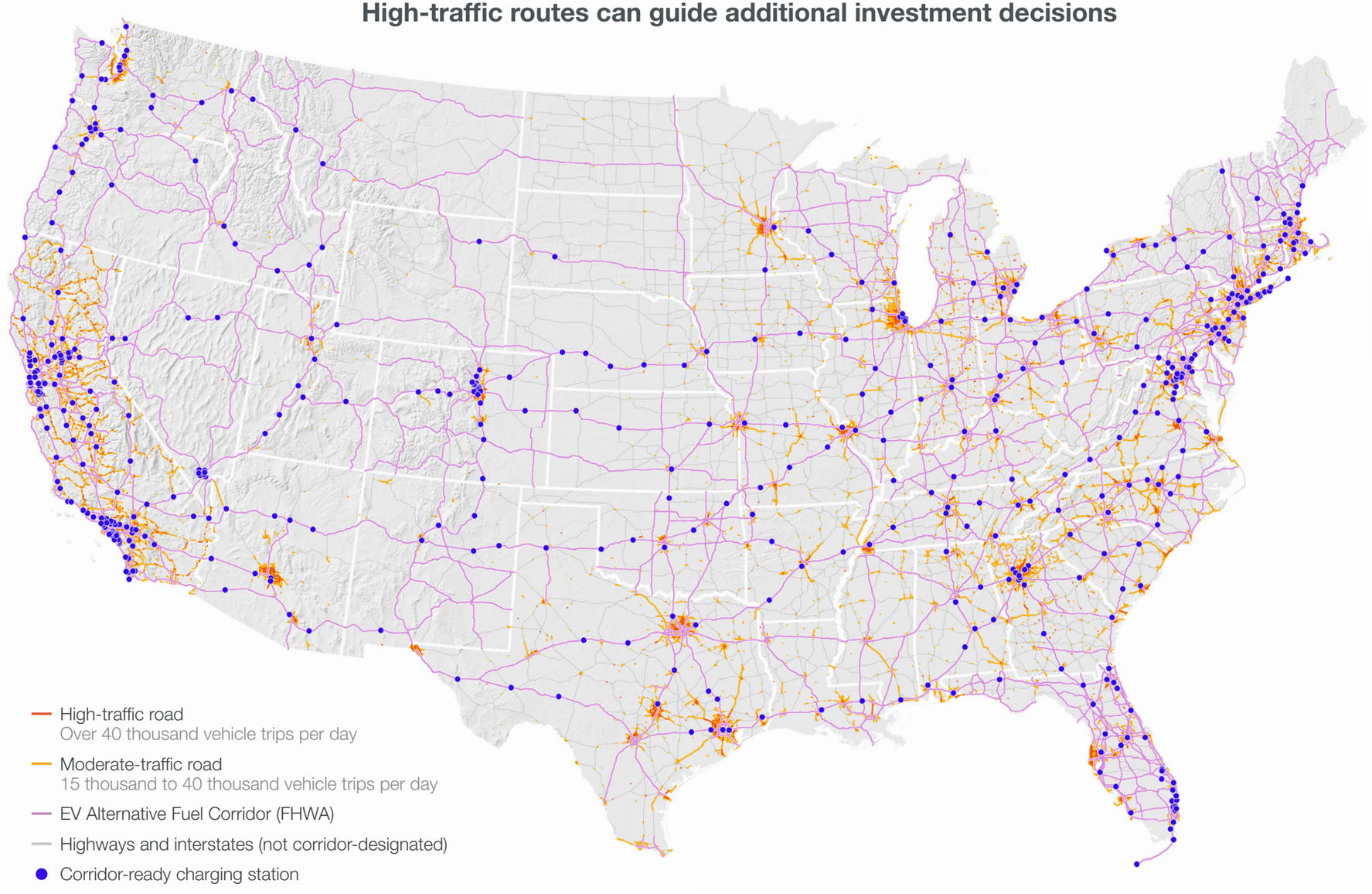
Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (2018; December 2021; July 2022), and US Census Bureau (May 2021).

High-Traffic Driving Routes Across the United States (cont.)

High-traffic roads that are not designated EV Alternative Fuel Corridors should be considered for future corridor designation or alternative forms of investment to ensure that charging infrastructure is sufficient to meet current and future demand.

Many high-traffic road segments are concentrated around urban metropolitan areas. While the charging stations available for long-distance travel can help support urban charging networks, additional study of local charging needs presents unique considerations for station siting and demand.

High-traffic routes can guide additional investment decisions

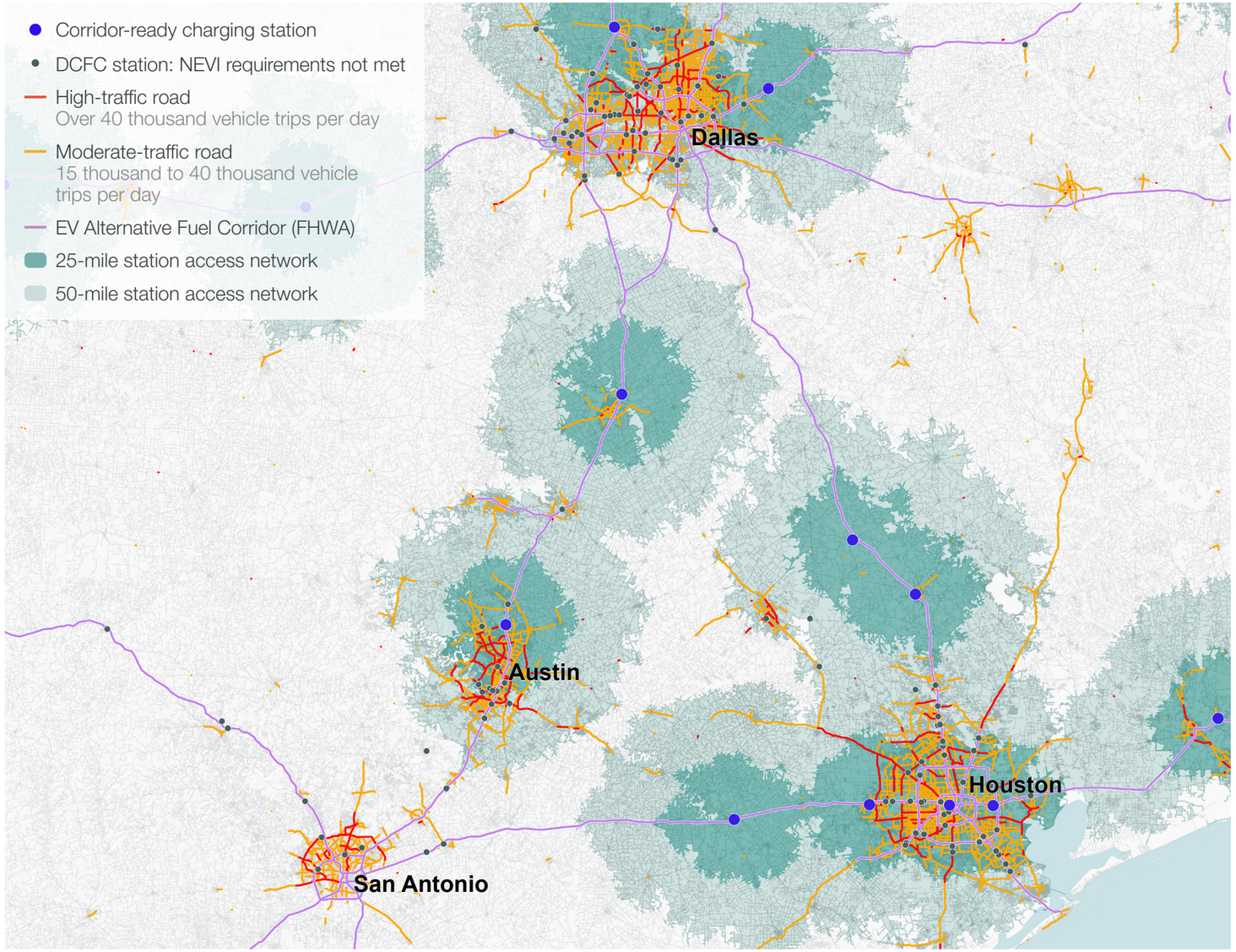


Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (2018; December 2021; July 2022), and US Census Bureau (May 2021).

High-Traffic Driving Routes | Case study: Texas Triangle

Many high-traffic roads not covered by designated EV Alternative Fuel Corridors are visible in the area between Houston, San Antonio, and Dallas. While the access networks around existing NEVI-compliant stations cover many of these high-traffic road segments, that coverage may belie major gaps in local charging infrastructure.

Achieving NEVI-compliant build-out of charging stations along designated corridors is only one part of the puzzle. Providing sufficient capacity to support the scale-up of EV adoption in a given area will require additional investment, consideration of local charging needs, and study of the equity and environmental justice implications of charging station siting.

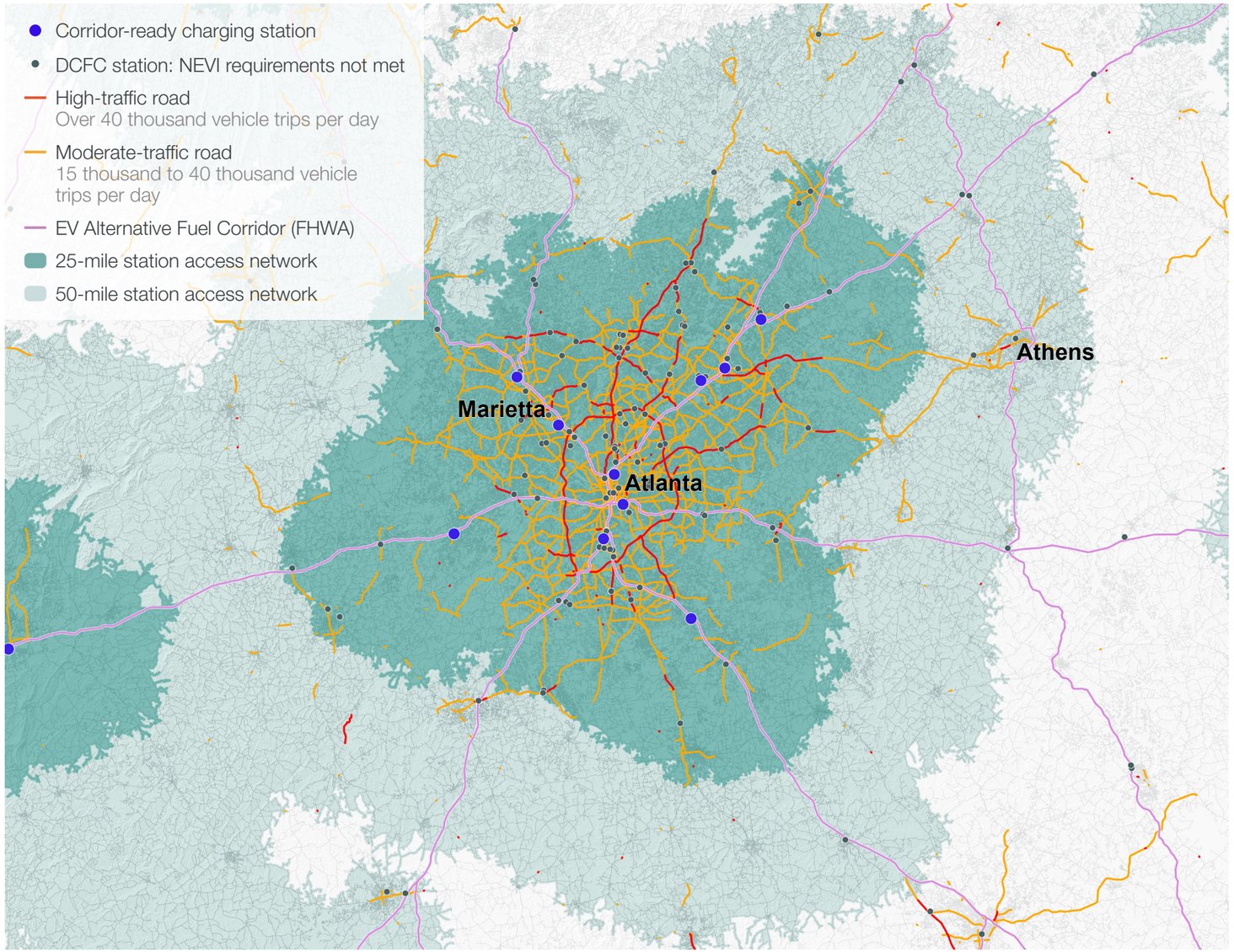


Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (2018; December 2021; July 2022), and US Census Bureau (May 2021).

High-Traffic Driving Routes | Case study: Atlanta

Much of the Atlanta metropolitan region is covered by the 25-mile access networks around existing NEVI-compliant stations. While a 25-mile distance is suitable for assessing long-distance corridor travel connectivity, it may not be appropriate for providing practical access to local communities in dense urban areas.

Many high-traffic routes in this area are not designated as EV Alternative Fuel Corridors, which means that the corridor program alone may not induce sufficient infrastructure development to fully serve potential vehicle electrification in population centers. It will be important to scale up charging infrastructure in high-usage areas, whether through designation as an Alternative Fuel Corridor or other means. Other planning considerations would need to be included to provide sufficient local access to residents, workers, and retail locations as passenger vehicles continue to electrify in the coming years.

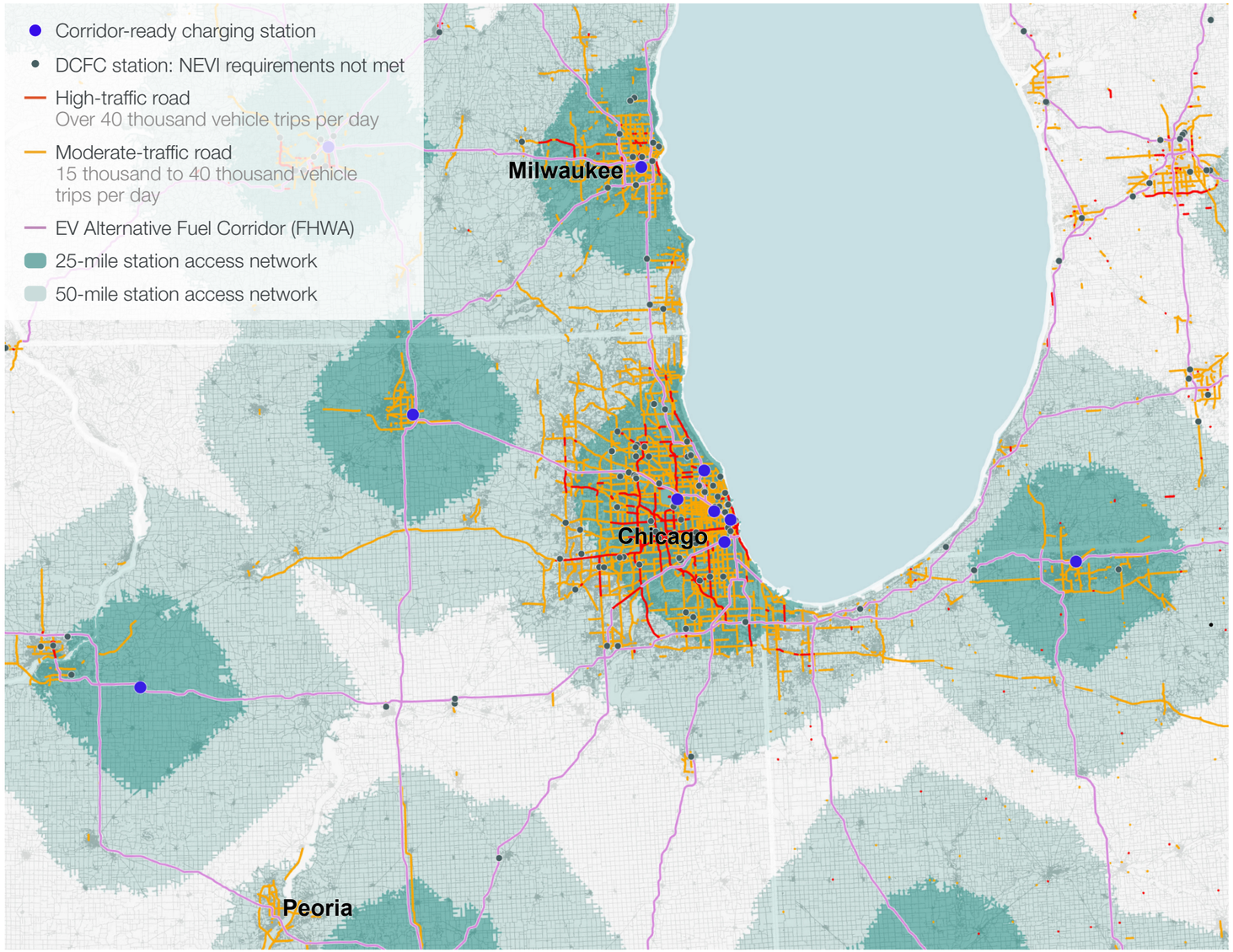


Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (2018; December 2021; July 2022), and US Census Bureau (May 2021).

High-Traffic Driving Routes | Case study: Chicago

Chicago and surrounding suburbs are largely covered by 25- or 50-mile station access networks around existing NEVI-compliant stations. However, network gaps are visible along designated corridors extending out from the Chicago metro area, limiting the feasibility of long-distance travel in the region.

Additionally, many of the Chicago area's high-traffic roads covered within 25- or 50-mile access networks will need targeted infrastructure development to support EV travel along those key routes.



Analysis and figure design by Elizabeth Abramson, Carbon Solutions LLC. Data sources include AFDC (July 2022), US DOT (2018; December 2021; July 2022), and US Census Bureau (May 2021).

Conclusion

In the coming years, the US must achieve a comprehensive transition to zero-emission vehicles to meet midcentury greenhouse gas reduction goals. The NEVI program provides funding to take a major step toward building out a national network of electric vehicle (EV) charging infrastructure that will be able to support a seamless long-distance travel experience for EV drivers across the country and thus accelerate EV adoption.

This analysis found that all currently designated EV Alternative Fuel Corridors and non-designated interstates could comply with NEVI guidelines through the strategic addition of 1,104 new charging stations. This would represent an estimated investment of $750 million to $1.3 billion in equipment installation costs. Station planning, operation, maintenance, and reporting would incur additional costs but would likely be covered in part by charging customer payments, private investment, and state and federal funding.

While NEVI funds are distributed at the state level to support implementation of state EV deployment plans, this national scale analysis enables assessment of regional cohesion and collaboration opportunities in planning EV charging infrastructure.

This road map focused strictly on the physical and geographic requirements for charging infrastructure build-out outlined in NEVI program guidance. Further analysis should closely examine the equity considerations and local context for individual station planning, specifically in ensuring that NEVI program benefits flow in large part to disadvantaged communities, in alignment with the Justice40 Initiative.

Data Sources

The analysis was based on data from the following sources.

Roads

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