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Charger Data Transparency

Curing Range Anxiety and Powering Electric Vehicle Adoption

Omar Isaac Asensio, Elaine Buckberg, Cassandra Cole, Luke Heeney, Christopher R. Knittel, and James H. Stock

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Executive Summary

Electric vehicle (EV) drivers want a seamless charging experience, but finding a working, available public charger on US interstates is difficult. Across six of the busiest interstates, traversing 40 states, only 34 percent of EV charging stations make real-time data available to PlugShare (a major charger-finding app), creating gaps of up to 1,308 miles with no charger status data.

The solution is simple and cheap—and readily advanced by states. If all fast chargers on highways reported their status in real time so that any software developer could put it in a mapping app, EV drivers could reliably navigate to working, available chargers on a road trip—effectively eliminating their range anxiety. We estimate that making real-time data universal for highway fast chargers would raise the EV share of new vehicle sales by 6.4 percentage points in 2030, expanding the 2030 EV fleet 9.2 percent above baseline projections.

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Electric vehicle (EV) drivers want a seamless charging experience, but finding a working, available public charger on US interstates is difficult because mapping apps have limited real-time data for many of these chargers. Along six major US interstates—I-5, I-10, I-75, I-80, I-90, and I-95—only 34 percent of charging stations have real-time data on PlugShare, a major free website and app for EV drivers that has more real-time data on chargers than Google Maps or Apple Maps.[1]

We have documented real-time "data deserts"[2] as long as 1,300 miles along major US interstates—something truly chilling for many EV drivers, as an EV with a 300-mile range would need to successfully charge at least four times to cross that distance.[3] On a road trip, verifying that a charging station will have an available, in-service charger often requires cross-referencing multiple apps—something no driver can safely do while driving.

The solution is simple and cheap—and readily advanced by states. If all direct current fast chargers (DCFCs)[4] on highways reported their status in real time so that any software developer could put it in a mapping app, EV drivers could reliably navigate to working, available chargers on a road trip—effectively eliminating their range anxiety.[5]

It's technologically feasible. Charge point operators (CPOs) could post their chargers' real-time data to an application programming interface (API), where software developers could access it. A model is the 2022 Infrastructure Investment and Jobs Act (IIJA), which requires this reporting for all the highway fast chargers it funds.[6] Some CPOs already report these data, but they may limit the data's access and use.

As the Trump administration moves to sweep away federal support for EV adoption, state action to support it is becoming more important.[7] In particular, less federal investment in charging makes it critical to make the most of existing chargers. The One Big Beautiful Bill Act (OBBBA) eliminates tax credits for business and residential investment in charging. The Department of Transportation froze IIJA charging funds until a court ordered it to free them; it then issued new interim guidance and reopened the program.[8] Previous research has shown that investing in public charging is more cost-effective than offering tax credits to induce EV sales.[9]

Other policy changes will further chill EV adoption and slow charger rollout, increasing the urgency of making the most of existing chargers to advance EV adoption. OBBBA also eliminated tax credits for EV purchases and leases, effectively widening the price gap between buying an EV and an internal combustion engine (ICE) vehicle for consumers and businesses.[10] The tariffs on autos and parts—as well as on steel, aluminum, and copper—will increase the cost of new vehicles, impair automaker profitability, and likely slow automaker investment in new EV programs. The metals and "reciprocal" tariffs, if sustained, will make DCFCs and supporting transformers, many of which are imported, more expensive, likely slowing charger rollout.

The federal government is also effectively eliminating its environmental regulation of vehicles that has incentivized automakers to sell EVs, and it is undermining states' ability to set their own, tougher standards. OBBBA eliminates penalties on automakers for failing to meet fuel economy standards, dramatically reducing incentives to comply. On July 29, 2025, the Environmental Protection Agency proposed rescinding the endangerment finding that greenhouse gases are harmful, which would nullify the tailpipe emissions standards that rested on that finding.[11] In addition, on June 12, 2025, President Donald Trump signed a law revoking California's longtime emissions waiver, which enabled it to set tougher vehicle emission limits than the federal government's. If it survives court challenges, the new law would prevent California, and other states that used its waiver, from phasing out ICE vehicle sales by 2035. California has sued, arguing that the waiver is not subject to the Congressional Review Act, which Congress used to eliminate it.[12]

Many states should be interested in supporting EV adoption: both "Battery Belt" states, which want to see more jobs in their state from EV production and battery supply-chain investments, and the 17 states (plus the District of Columbia) that followed California's Zero-Emission Vehicle (ZEV) or Advanced Clean Cars II regulations, committing to EV adoption to reduce emissions.[13] Selling US-made EVs at home supports the US auto industry's ability to compete in the global transition away from ICE vehicles and toward EVs. Every new EV sold means fewer carbon emissions than if the same driver were behind the wheel of a vehicle running on gasoline, and the emissions from each of those EVs will fall over time as the grid decarbonizes.[14] Between the Battery Belt, ZEV, and Clean Car states, at least 28 may be interested in advancing EV adoption.

Likewise, all states should agree that US EV sales help the US auto industry compete in the global transition away from ICE vehicles. In 2024, China sold 11 million EVs and Europe sold three million,[15] while the US sold just 1.3 million.[16] If the United States continues to fall behind China in EV manufacturing, US automakers may never be able to compete. That could mean not only fewer jobs in EV assembly, battery production, and the EV supply chain but fewer US auto jobs overall.

Our recent research finds that real-time data transparency is a powerful way to spur EV adoption. We estimate that making real-time data universal for highway DCFCs would raise the 2030 EV share of new vehicle sales by 6.4 percentage points—raising the estimated EV share to 46 percent of new vehicle sales from a 40 percent baseline projection.[17] (Our projection incorporates EV policy changes in OBBBA while retaining charger investments in the IIJA and the surviving EV provisions of the IRA and California waiver.)[18]

As a result of open charger data, there would be 3.5 million more EVs on the road by 2030, a 9 percent increase compared with baseline projections. Putting these additional EVs on the road would reduce carbon emissions by up to 15.2 million metric tons in 2030 alone—with corresponding reductions in emissions every year those EVs are used. These estimates assume that putting real-time data for all DCFCs in centralized apps will lead CPOs to repair them more rapidly and improve their reporting accuracy, raising the share of successful charging attempts and enabling EV drivers to trust what their phones tell them—thereby erasing range anxiety.[19]

To be clear, apps to find EV chargers already exist, but they have large coverage gaps because some large charging providers do not share real-time data with them. Moreover, transmitting real-time data is technically feasible—thanks to the IIJA requirement, the capability is standard in the current generation of chargers. The problem is how to induce more real-time data disclosure.

One way to conceptualize the problem is seeing it as a choice between two future states of the charging market: either all CPOs provide real-time data in centralized apps or none do. Both outcomes would be stable, but the information-sharing outcome is better from a societal perspective. The question is how to get there. The market has not yielded the information-sharing outcome, creating a role for policy to do so.

States should follow the IIJA's example and require open real-time data for chargers in their state. California, Maryland, and Massachusetts have already taken steps in that direction. The model legislation presented in this report can help states adopt common real-time data disclosure standards that are consistent with the IIJA's. Common requirements will be easier for CPOs to follow and will therefore reduce resistance to data sharing.

In fact, only a few states need to require data disclosure to tip the market outcome toward the information-sharing equilibrium. Even without such tipping, the regional nature of the Battery Belt, ZEV, and Clean Car states also means that long, multistate stretches of major highways could be made EV travel friendly by state action alone, alleviating range anxiety for many road trips. If all 17 ZEV and Clean Car states[20] plus another 11 Battery Belt states[21]—which together account for 67 percent of the nation's registered vehicles[22]—set real-time data disclosure requirements, it would cover highways in 28 states, including Washington, DC.[23]

This report discusses the importance of real-time data to accelerate EV adoption; it then proposes a menu of policy solutions, emphasizing state action. In assessing real-time data's value, current availability, and impact on EV adoption, this report relies extensively on our 2025 working paper, "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption."[24]

The Current State of Real-Time Data and Why It's Critical to EV Adoption

Why Charging Is Critical to EV Adoption

Economic research consistently finds that charging infrastructure plays a big role in drivers' choice between EV and traditional ICE vehicles.[25] But whether charging infrastructure will spur EV adoption in practice depends on whether consumers believe public chargers will be reliable. A 2024 Pew Research Center survey found that "56% of Americans are not too or not at all confident that the U.S. will build the necessary infrastructure to support large numbers of EVs."[26] Insufficient charging infrastructure means that drivers may be unable to charge promptly simply because chargers are occupied and other EVs may already be waiting.[27] Open data about whether public chargers are working and available can influence drivers' decision to buy an EV and help steer them to working chargers.

The popular narrative about EV public charging is negative. Over the past several years, newspaper columnists[28] and industry studies[29] have documented EV drivers' frustration with public charging infrastructure, specifically the number of chargers and their reliability. J.D. Power surveyed new vehicle buyers in 2025's first quarter and found that four of the top five reasons why drivers rejected EVs were related to charging.[30]

Academic research yields similar conclusions. A study of reviews on a major EV charger locator app from 2011 to 2015 reported that nearly half of reviews represented negative charging experiences.[31] A more recent study documented the many reasons drivers may fail to successfully charge at California's DCFCs: nonfunctioning screens, payment failures, charging cables that are too short for some EV models, and so on.[32]

The two most important use cases for public charging are highways and cities. In cities, drivers are more likely to live in multifamily housing,[33] rent their homes,[34] or park on the street, all of which lower the odds of being able to install EV chargers in their homes. The US Department of Energy predicts that urban EV owners will rely on public charging for 62 percent of their needs, compared with only 32 percent for suburban residents and 16 percent for rural residents.[35] Because driving speeds are lower in cities, drivers could lose substantial time driving to chargers that are out of service or occupied. At the Level 2 chargers common in cities, charging sessions are longer, turnover is less frequent, and stations are often small, so waiting for another vehicle to finish charging is not practical.

Traveling via highways poses a different set of concerning problems for EV drivers. Consumers considering buying an EV often anticipate range anxiety in public charging's most extreme use case: long road trips far from home, where drivers are likely unfamiliar with local charging infrastructure and where running out of charge can involve an expensive and time-consuming tow. Few households actually take major road trips annually, but the possibility of taking one has outsized importance for potential vehicle buyers.[36] The data analysis in this report focuses on the availability of real-time data on highways.

How Real-Time Data Help EV Drivers

This report proposes providing real-time data as a transparency solution for drivers' anxiety about public EV charging. By "real-time data," we mean that centralized, free apps report the locations and types of EV chargers and whether they are working and available. The necessary condition for this is that all CPOs make the status of their chargers available, for free, to software developers so they can create those centralized apps. That is not the case today.

The absence of a one-stop shop for centralized and searchable data on EV chargers may be a real barrier to EV adoption for drivers accustomed to easily finding gas along highways thanks to prominent signs. Range anxiety is exacerbated by the difficulty of finding EV chargers, the longer time needed to recharge an EV, and the possibility of unreliable EV chargers. Open data can make it easier to find a successful charger and play a key role in mitigating range anxiety, making EVs more accessible to the American public.

While most CPOs provide data on their own chargers through a proprietary mobile app, this falls short of the benefits of centralized real-time data. First, cross-referencing apps puts a substantial search burden on EV drivers. Second, it's simply not safe for drivers to cross-reference apps *while* driving. Many drivers do not have the advantage of a passenger who can research chargers across apps—for example, those driving solo and drivers whose only passengers are young children.

The compatibility of plugs—the equivalent of gasoline nozzles—complicates real-world charge finding for EV drivers, as not all EVs are compatible with all charging plugs, although that is changing. Tesla's opening of part of its charging network is alleviating this matching problem. EVs with Combined Charging System and CHAdeMO plugs can use Magic Dock adapters provided at certain open Tesla chargers. The matching problem will further improve with time as Tesla's North American Charging Standard plug becomes the national standard in new vehicles.[37]

Some CPOs provide their real-time data to automakers for in-vehicle and brand-owner apps, but that also falls short of open data. Automaker apps may require subscriptions, especially when a vehicle is no longer new. Real-time data in subscription-only apps will become a worse substitute for open data as the market grows and EVs age. As the used-EV market matures, more prospective EV buyers will be from low- and middle-income households and therefore more sensitive to subscription costs.

CPOs may not voluntarily provide centralized real-time data out of concern that competitors will use it to their advantage or because proprietary data are a valuable part of their business.[38] The IIJA's

$5 billion National Electric Vehicle Infrastructure (NEVI) Formula Program, however, requires the highway DCFCs it funds to report real-time data. Moreover, the Trump administration retained this requirement when it issued its new NEVI guidance.[39] Specifically, the program has required "third-party data sharing" (i.e., data accessible to aggregators via an API) on "real-time status by port" and "real-time price to charge" at the plug level for all NEVI-funded chargers.[40] The NEVI requirement has also ensured that DCFC manufacturers make transmitting real-time data a standard feature of current DCFCs.

But the IIJA imposes no requirements on non-NEVI chargers, and there is no other national requirement. As a result, providing centralized real-time data is voluntary for the majority of DCFCs that do not receive NEVI funds. As we document below, only a minority supply it voluntarily today. If DCFC plugs cost $100,000 on average, NEVI's $5 billion (and states' mandatory 20 percent contribution) could fund only up to 62,500 DCFC ports.[41] That's about one-third of the 182,000 DCFC ports that the National Renewable Energy Lab forecasted would be needed in 2030, implying two in three DCFC ports would not need to supply real-time data.[42]

Consumers Trust Chargers with Real-Time Data More Than Those Without

Charging infrastructure build-out can only spur EV adoption if consumers who are considering buying EVs trust that chargers work and that they can find an available one when they need it. We conducted two consumer surveys to understand how important charging reliability is to potential EV buyers and the possible impact that providing better charging information could have on EV adoption. The surveys asked consumers about the probability of successfully charging at DCFCs with and without real-time data along US highways. Our survey results documented beliefs about charging reliability among current EV drivers and potential buyers, and this fed into our modeling of the impact that improved real-time data provision has on EV adoption.[43]

We asked the same questions to two groups of survey respondents: US-based EV drivers (for which we received 1,006 responses) and US-based non-EV drivers who expect to buy a new car soon (814 responses).[44] For different DCFC stations (shown as images from PlugShare), we asked respondents about their perceived likelihood of successfully charging their vehicle with at least one plug in the time they were willing to wait (if all working chargers were occupied).

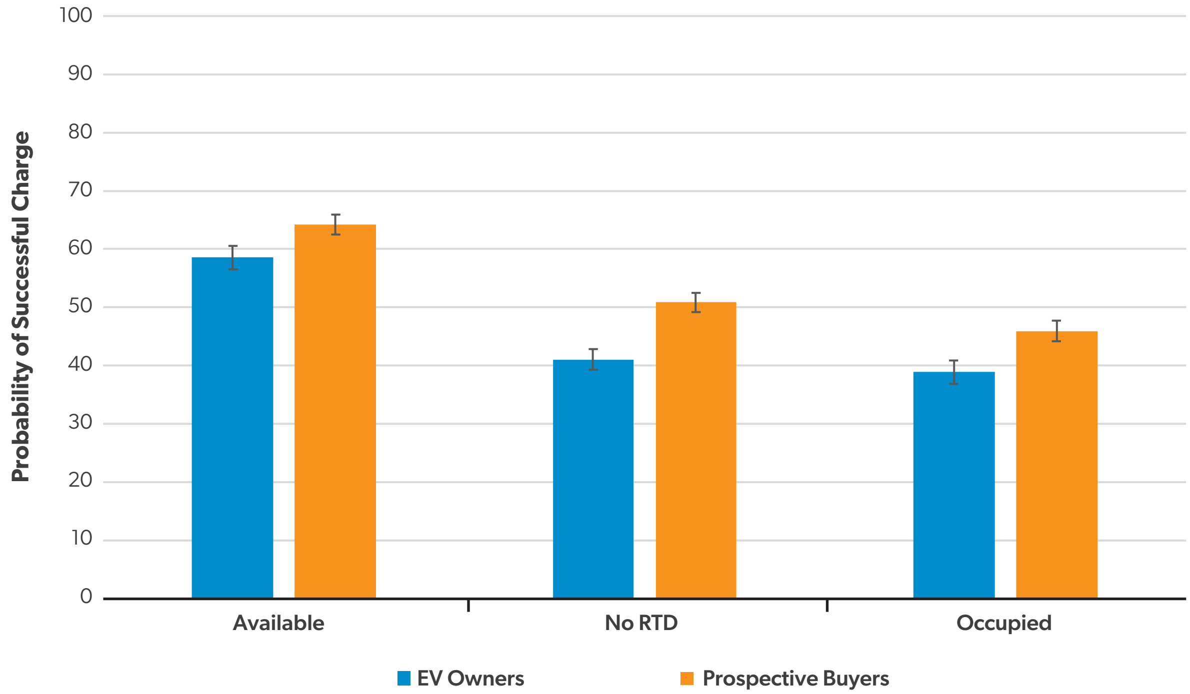
The survey revealed that respondents consistently were more confident that they could charge at a charger that was reported as available with real-time data than one that had no real-time data, as shown in Figure 1. But survey respondents also had low confidence even in chargers that reported being working and available.

Showing a striking level of doubt about charger reliability, EV drivers and prospective buyers believed they would have less than a two-thirds chance of a successful charge even at chargers that provide real-time data and are reported to be working and available. Prospective car buyers estimated that they could successfully charge at such a station 64.6 percent of the time, and current EV drivers estimated that they could successfully charge at such a station only 58.6 percent of the time.

Strikingly, EV owners are statistically significantly more pessimistic than prospective buyers were in all three scenarios.[45] Real-time data and higher reliability would clearly reduce existing EV drivers' uncertainty, raise their consumer surplus, and help retain them as EV drivers.

Still, EV drivers and prospective buyers had substantially less confidence—around 40–50 percent—in chargers without real-time data and the odds of an occupied charger freeing up in the time they would be willing to wait. Respondents estimated a slightly higher chance of successfully charging at a station that had no real-time data (52.4 percent for prospective buyers and 41.1 percent for EV drivers) compared with the odds of being able to charge at one where all chargers were occupied (47.9 percent for prospective buyers and 39.0 percent for EV drivers). This may indicate that they think occupied chargers will not open up in a time frame that they are willing to wait.

Figure 1. Survey Respondents' Perceived Probability of a Successful Charge at Available Chargers, Occupied Chargers, and Chargers Without Real-Time Data



Source: Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), 17, Figure 7, https://www.nber.org/papers/w33342.
Note: "RTD" is real-time data.

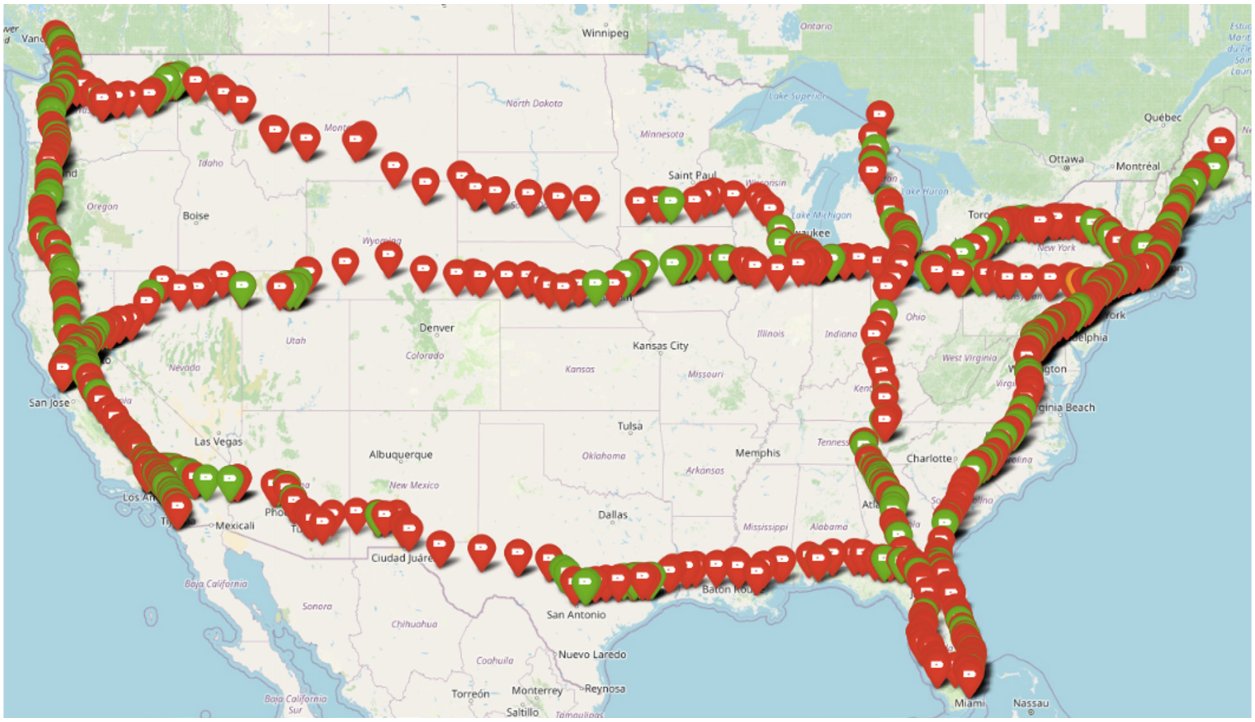
We see two main reasons why drivers may believe that a charger reported to be working and available may provide a successful charge only less than two-thirds of the time: congestion and overreporting of uptime. While the survey states that a charger is available when the driver checks PlugShare, drivers are likely aware that other drivers may arrive at and plug in to any free chargers before they reach the station. In their 2024 Annual Reliability Report, ChargerHelp stated that true uptime often falls short of reported uptime—and reported uptime is what real-time data captures. In particular, ChargerHelp found that 15 percent of stations they tested failed despite the app and the charger itself reporting that the station was online and available. These failures can happen because chargers are physically blocked, network connections or payments fail, or cords are too short.[46]

One in Three Highway DCFC Stations Posts Centralized Real-Time Data

In assessing the availability of centralized real-time data, we focus specifically on real-time data in charger locator apps for DCFCs on major US highways. Real-time data on chargers are available in mainstream general-purpose mapping apps, such as Apple Maps and Google Maps, and in specialized third-party charging locator apps, such as PlugShare. These apps report EV charger locations across the country and generally also cover plug type and maximum charging speed.

We find that PlugShare has the best real-time data coverage of these three main apps.[47] This section presents results from repeatedly scraping PlugShare, in which we focused on six major US highways: I-5, I-10, I-75, I-80, I-90, and I-95. We report the fraction of DCFCs providing real-time data, the CPOs that do

Figure 2. DCFCs with and Without Real-Time Data on Six Interstates



Source: Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), 13, Figure 5, https://www.nber.org/papers/w33342.
Note: Stations in green supply real-time data on at least one plug; stations in red supply no real-time data. Data are from a PlugShare scrape on August 18, 2024.

and do not provide real-time data to PlugShare, and locations where real-time data are particularly sparse.

Across our six interstates on August 18, 2024, 34.4 percent of DCFC stations and 18.6 percent of plugs on average reported real-time data on PlugShare.[48] Figure 2 shows whether chargers offer real-time data along these six interstates. Table 1 shows the number and share of highway-adjacent charging stations, with real-time data for each interstate.

The CPOs with the most stations and plugs in our sample, Tesla and EA, do not provide real-time data to PlugShare, Google Maps, or Apple Maps. The second set of rows in Table 1 provides these statistics for all non-Tesla stations. Excluding Tesla chargers brings the overall share of DCFC stations providing real-time data to 53.4 percent, with a range from 39.6 percent on I-90 to 64.1 percent on I-5.

The last two rows in Table 1 exclude Tesla and Electrify America (EA) stations. EA chargers are available to non-Tesla drivers, but they do not provide centralized real-time data. Excluding Tesla and EA chargers brings the total share of stations providing real-time data to 70.9 percent, with a range of 54.3 percent on I-90 to 80.7 percent on I-5. Excluding them substantially improves the perceived fraction of stations providing real-time data, but it reduces the number of stations overall by over 53 percent (1,426 total stations vs. 669 when Tesla's and EA's are excluded). Tesla's and EA's share of plugs providing real-time data is lower, at 19.9 percent (vs. 33.2 percent for stations overall), because they tend to have large stations and subsequently more plugs.

The availability of centralized real-time data was stable from March to August 2024, as shown in Figure 3. Table B1 shows that there was also

Table 1. Real-Time Data Provision on August 18, 2024

Interstate	I-5	I-10	I-75	I-80	I-90	I-95	Total
Total Stations	350	187	150	214	189	336	1,426
Percentage of Stations with Real-Time Data	45.4%	31.6%	33.5%	30.0%	23.3%	28.6%	33.2%
Total Non-Tesla Stations	248	116	91	133	111	188	887
Percentage of Non-Tesla Stations with Real-Time Data	64.1%	50.9%	49.5%	53.4%	39.6%	51.1%	53.4%
Total Stations (Excluding Tesla and EA)	197	82	70	89	81	150	669
Percentage of Stations with Real-Time Data (Excluding Tesla and EA)	80.7%	72.0%	64.3%	79.8%	54.3%	64.0%	70.9%

Source: Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), 6, Table 1, https://www.nber.org/papers/w33342.
Note: Authors' analysis of data from PlugShare.

limited change in the availability of real-time data on November 19, 2024; for all six interstates, overall real-time data availability improved by only 0.6 percent.

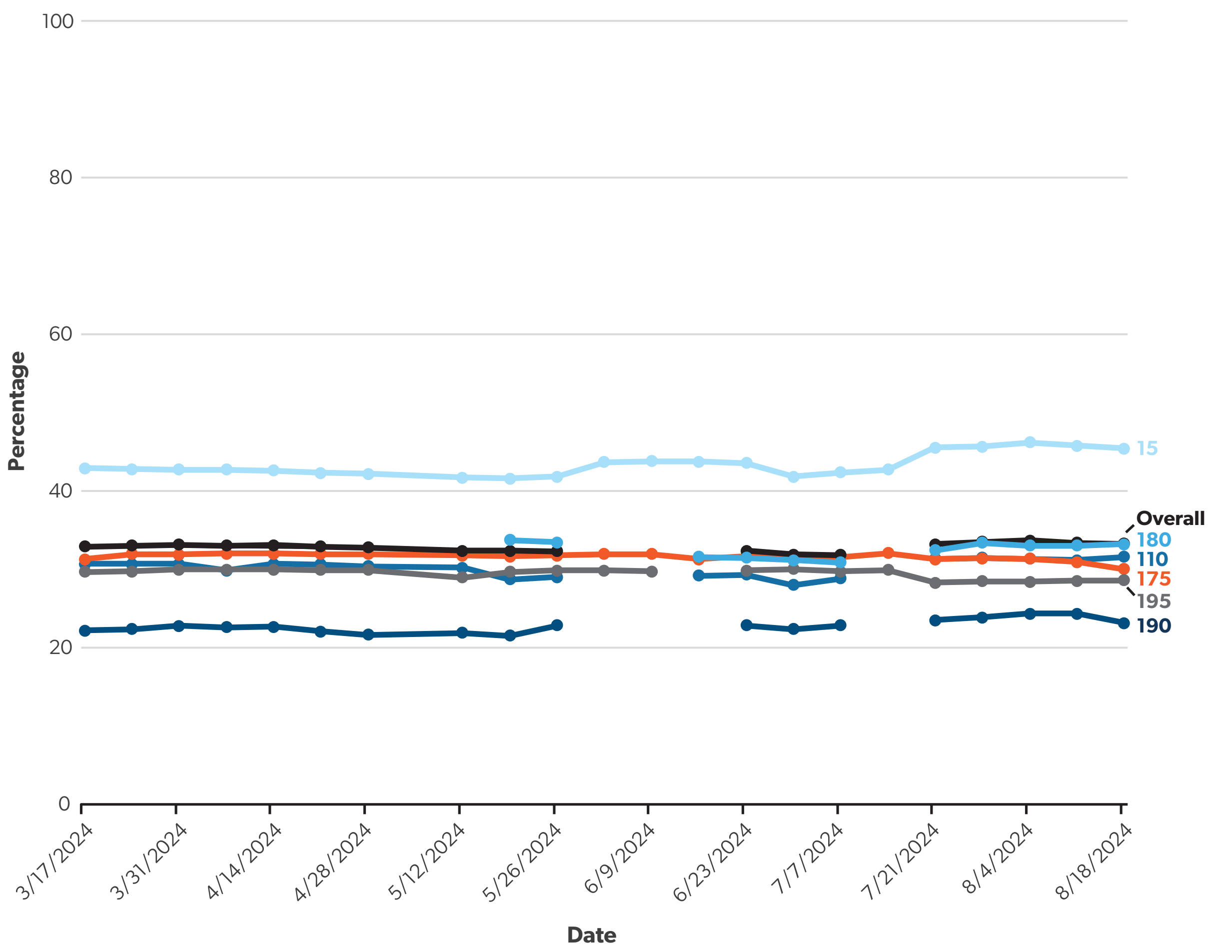
Data Deserts Exacerbate Limited Real-Time Data

Data deserts magnify the low share of highway-adjacent charging stations offering centralized real-time data. Some of these data deserts span distances longer than even the longest stated range of existing EV models,[49] and therefore, road trips in these areas require careful research and planning in advance. EV drivers have no way of knowing whether a functioning charger exists over distances of several hundred miles unless they cross-reference apps or can access more data through an in-vehicle automaker app (which may require a subscription). The cost of an error could be high: a tow to the next working DCFC (that is compatible with the driver's vehicle) or hours spent at a Level 2 charger to gain enough charge to drive to the next working DCFC.

Figure 4 shows data deserts of 150 miles or longer on the six major interstates we studied on August 18, 2024. As Table 2 details, we found 13 data deserts: four on I-10, six on I-80, two on I-90, and one on I-95. I-5 and I-75 had none. Four of the data deserts were over 300 miles long, longer than the stated range of most current EV models: Deming, New Mexico, to Kerrville, Texas, (586 miles) and Baytown, Texas, to Robertsdale, Alabama, (466 miles) on I-10; Coalville, Utah, to Kearney, Nebraska, (709 miles) on I-80; and Post Falls, Idaho, to Blue Earth, Minnesota, (1,308 miles) on I-90. In identifying data deserts, we exclude chargers at auto dealerships, as many restrict chargers to their own customers only or allow charging only during certain hours.[50]

Several of these data deserts are adjacent, as Table 2 shows. On the 795 miles of I-10 between chargers in Tucson, Arizona, and Kerrville, Texas, the only intermediate chargers with real-time data are in Deming, New Mexico. On I-80, the 148-mile data desert from Truckee, California, to Lovelock,

Figure 3. Percentage of Stations Reporting Real-Time Data for at Least One Plug: Weekly Average



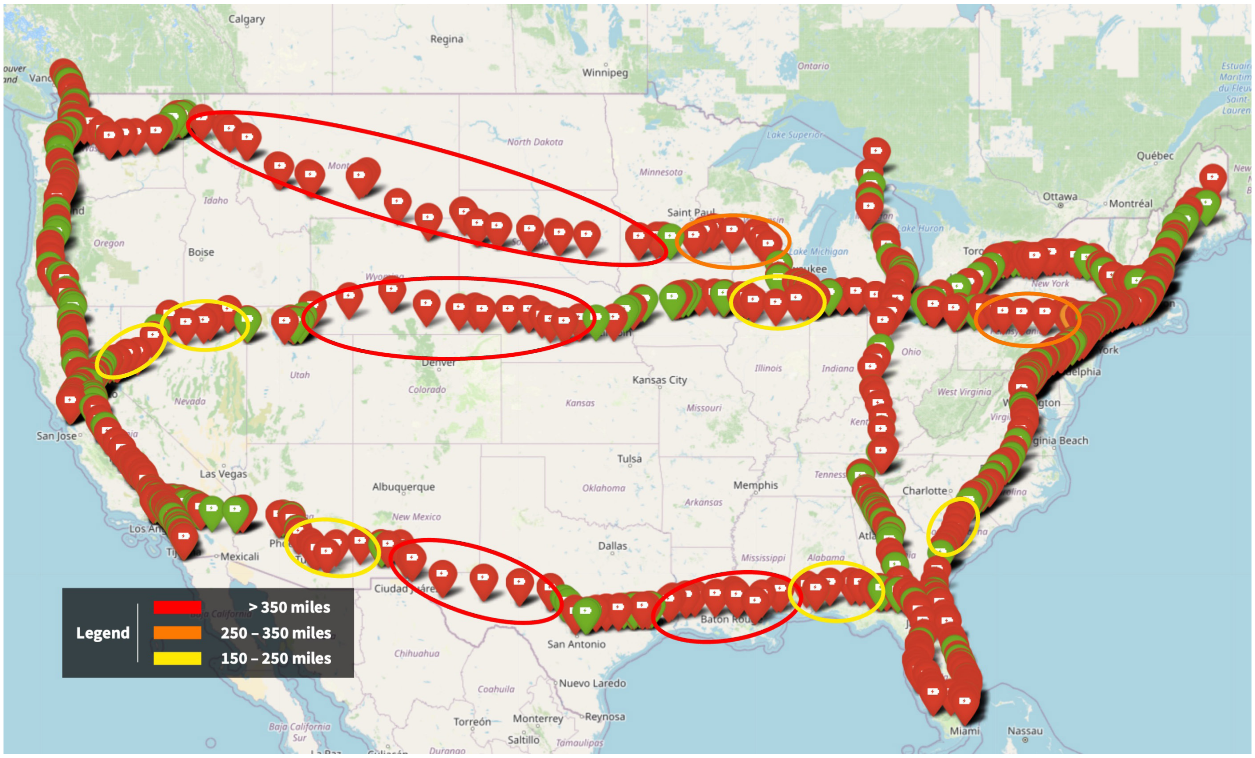
Source: Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), 8, Figure 1, https://www.nber.org/papers/w33342.
Note: Authors' analysis of data from PlugShare.

Nevada, is immediately adjacent to another 153-mile data desert to Carlin, Nevada. Between Perrysburg, Ohio, and Columbia, New Jersey, the only chargers with real-time data are in Emlenton, Pennsylvania. Real-time data availability is the worst on I-90, where across the 1,600-mile stretch from Post Falls, Idaho, to Madison, Wisconsin, there is a single station with real-time data in Blue Earth, Minnesota.

To be clear, these data deserts are not charging deserts; even on the 1,308 miles of I-90 between Post Falls and Blue Earth, publicly accessible DCFCs are available within two miles of the highway every 34 miles on average. The major problem we document is not an insufficient number of chargers along these highway stretches (although this may also be the case) but rather that there is insufficient information about those chargers to ensure these trips will be feasible and ease range anxiety.

In recent months, data deserts have improved marginally on our six interstates. What is now a 226-mile data desert between Tallahassee, Florida, and Robertsdale, Alabama, was a 385-mile desert between

Figure 4. Real-Time Data Deserts (Excluding Auto Dealerships)



Source: Authors' analysis of data from PlugShare.
Note: Red ovals indicate data deserts stretching over 350 miles. Orange ovals indicate data deserts stretching between 250 and 350 miles. Yellow ovals indicate data deserts between 150 and 250 miles.

Jacksonville, Florida, and Daphne, Alabama, as of April 2024. The addition of a ChargePoint charger in Pensacola, Florida, and an EVConnect charger in Tallahassee, both reporting real-time data, have improved EV drivers' ability to find charging on the Florida Panhandle.

These data deserts may continue to shrink and even disappear as NEVI chargers requiring real-time data reporting are built throughout the country, but progress on this front has been slow. As of November 26, 2024, 31 NEVI charging stations with 126 total ports were operating across nine states—as compared with the program's original objective of four NEVI DCFCs posting real-time data every 50 miles.[51] A total of 41 states had initiated their NEVI procurement process, while 11 had not.[52]

The Impact of Real-Time Data on EV Adoption

Using a model of driver choice between buying an EV and buying an ICE vehicle, we estimate that centralized real-time data would substantially increase EV sales, raise the number of registered EVs in the US, and reduce carbon emissions.[53] Specifically, we estimate that the EV share of new vehicle sales would be 6.4 percentage points higher in 2030, raising the number of registered EVs in the US by 9.2 percent, both versus baseline forecasts.

These estimates assume not only that universal, centralized real-time data will be available but also that the data will shine light on nonworking chargers, leading CPOs to achieve higher reliability, which will in turn enable drivers to trust real-time data and have more confidence in their ability to reliably charge. In effect, real-time data can eliminate

Table 2. Data Deserts (Excluding Auto Dealerships)

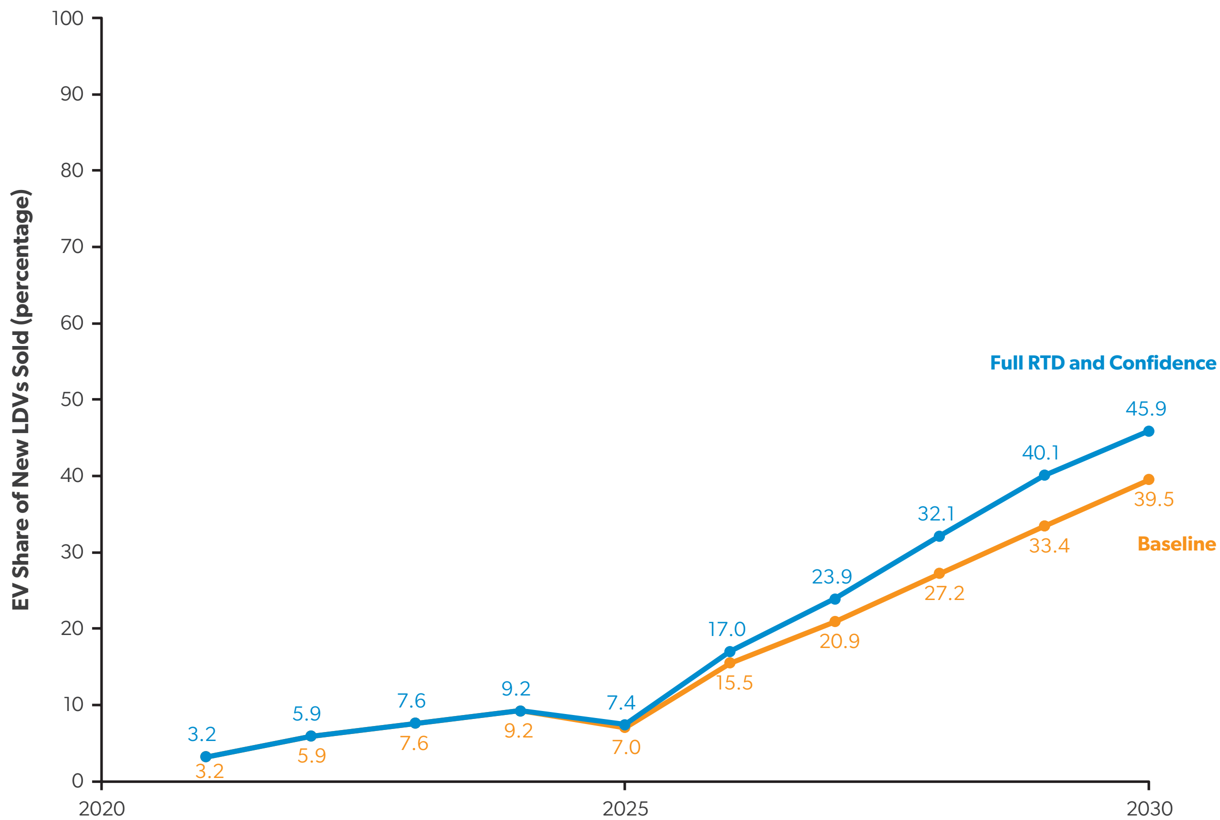
Interstate	Start Location	End Location	Length (Miles)	Total Stations	Tesla Stations	EA Stations	Other CPOs
I-10	Tucson, Arizona	Deming, New Mexico	209	4	2	2	0
	Deming, New Mexico	Kerrville, Texas	586	15	9	5	1
	Baytown, Texas	Robertsdale, Alabama	466	17	10	4	3
	Robertsdale, Alabama	Tallahassee, Florida	266	12	6	4	2
I-80	Truckee, California	Lovelock, Nevada	148	7	4	3	0
	Lovelock, Nevada	Carlin, Nevada	153	3	1	2	0
	Coalville, Utah	Kearney, Nebraska	709	16	8	6	2
	Bettendorf, Iowa	Rolling Prairie, Indiana	221	12	6	2	4
	Perrysburg, Ohio	Emlenton, Pennsylvania	209	9	5	3	1
	Emlenton, Pennsylvania	Columbia, New Jersey	274	12	8	4	0
I-90	Post Falls, Idaho	Blue Earth, Minnesota	1,308	38	23	8	7
	Blue Earth, Minnesota	Madison, Wisconsin	293	11	5	1	5
I-95	Lynchburg, South Carolina	Savannah, Georgia	145	8	7	1	0

Source: Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), 14, Table 5, https://www.nber.org/papers/w33342.
Note: Authors' analysis of data from PlugShare.

range anxiety. Figures 5 and 6 illustrate the increase in EV adoption and the EV fleet size as a result of universal real-time data. Our modeling methodology is detailed in our working paper, updated with several changes from Elaine Buckberg and Cassandra Cole's 2025 report.[54]

The positive effect of real-time data on EV adoption is robust to these modeling changes and the change in the 2024 policy baseline (used in our working paper) and the OBBBA baseline, including the termination of the IRA's EV and charger tax credits. Estimates from our working paper indicate that full real-time data plus reliability and consumer trust would increase the 2030 EV share of new vehicle sales by 8.0 percentage points, from 48 to 56 percent, against a December 31, 2024, policy baseline. The updated estimates predict an impact of 6.4 percentage points on top of the OBBBA baseline, from 39.5 to 45.9 percent. We have estimated the impact of real-time data on the EV share of new vehicle sales in 2030 at different tax-credit levels and find essentially zero variation.[55] We have also confirmed with more recent modeling that real-time data can yield a similar increase in EV adoption against alternative baseline scenarios. Buckberg and Cole have modeled how potential changes in federal EV policy under the Trump administration would change the trajectory of EV adoption.[56]

Figure 5. EV Share of New Vehicle Sales with and Without Universal Real-Time Data, Resulting in Higher Reliability and Driver Confidence in Data



Source: Authors' calculations.
Note: "LDV" is light-duty vehicle. "RTD" is real-time data.

Improving real-time data, uptime, and consumer confidence in the data could lead to more EVs on the road and reduce carbon emissions by up to an additional 15.2 million metric tons—or an added 18.7 percent—relative to the carbon emissions reductions projected under the IRA and IIJA without these improvements.[57] Figure 7 shows the difference in carbon emissions by year. Moreover, compared with the $451 billion in government expenditures for the IRA and IIJA's EV provisions estimated in Cole et al., requiring real-time data would be comparatively costless to the government.[58]

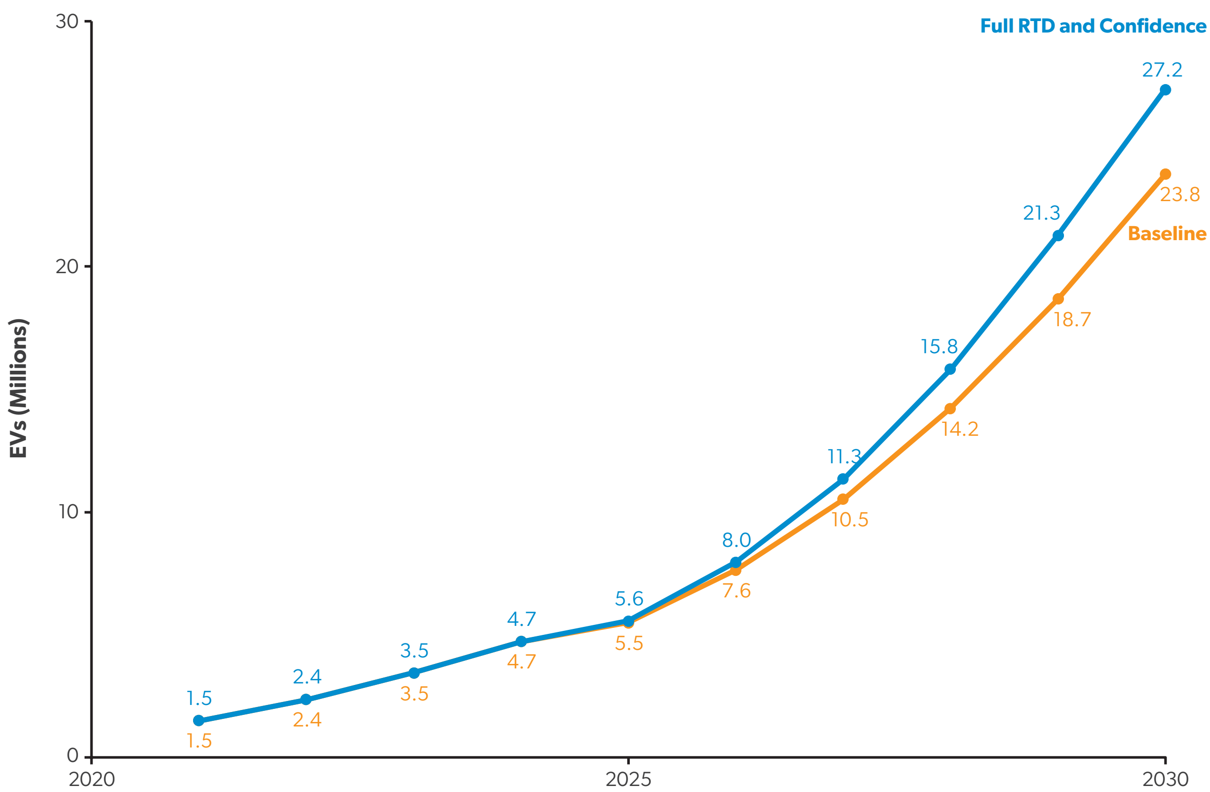
Policy and Market Solutions to Yield Real-Time Data Sharing

As mentioned previously, the EV charging market today has the potential to evolve in two ways: Either all CPOs will provide real-time data, yielding higher EV adoption and lower carbon emissions, or no CPOs will provide real-time data outside a limited set of chargers that require it, including the NEVI chargers. The information-sharing equilibrium is better from a societal perspective.

Options for Achieving Real-Time Data Sharing

An obstacle to achieving universal real-time data sharing is incentivizing CPOs to provide open real-

Figure 6. EV Fleet Growth with and Without Universal Real-Time Data, Resulting in Higher Reliability and Driver Confidence in Data



Source: Authors' calculations.
Note: This figure projects the number of registered EVs in the US. "RTD" is real-time data.

time DCFC data. A variety of private-sector apps exist for finding EV routes and chargers, including Google Maps, Apple Maps, PlugShare, Chargeway, and automakers' proprietary apps. Proprietary apps often negotiate access to more CPOs than the free apps offer—but automaker apps are free for a limited time, after which the vehicle owner must pay for access, as noted earlier.[59]

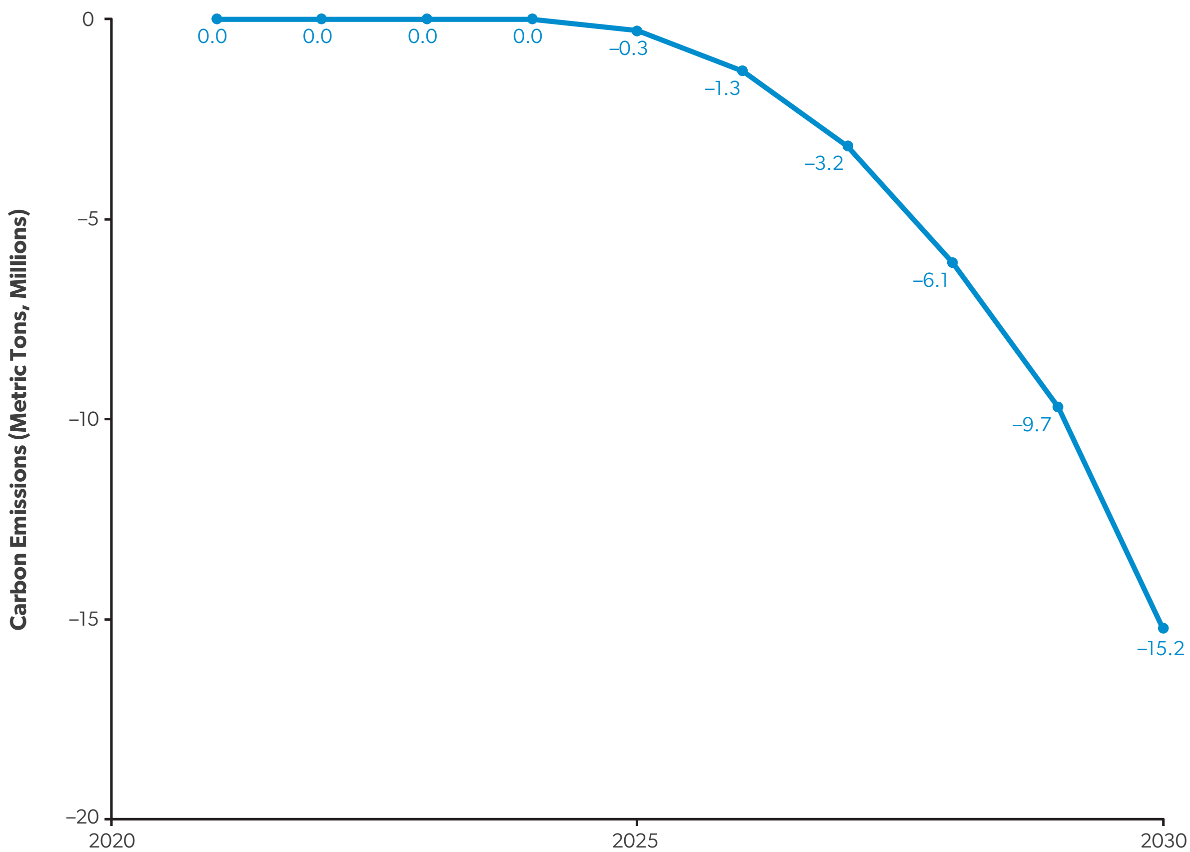
As the EV market matures and low to middle-income households increasingly purchase used EVs, these price-sensitive buyers are less likely to pay a monthly subscription to find chargers—a potential obstacle to used-EV sales. Thinking ahead and planning for a healthy used-EV market is essential to creating a healthy new EV market today.

We consider three approaches to achieving universal real-time data sharing.

Pure Market Approach

A pure market approach has clearly been unsuccessful, given that the two largest CPOs do not have open real-time data. While it could improve in time—especially if big-budget new entrants shared data and created competitive pressure for large incumbents to do so—waiting to see whether that happens risks stalling EV adoption. Automaker consortium IONNA and BP Pulse already share real-time data. However, the large market shares of Tesla and EA, combined with their importance on remote highway corridors, reduces the odds that they will be quickly pressed to

Figure 7. Carbon Emissions with Full Real-Time Data and Driver Confidence in Those Data vs. a Baseline Without



Source: Authors' calculations.

share real-time data or that drivers will have adequate real-time data anytime soon.

A Federal Requirement and Centralized API

While the federal government could require universal real-time data by law, that is unlikely to happen under the Trump administration given its aim to withdraw federal support for EV adoption, its cutbacks to federal data provision,[60] and its broader efforts to reduce regulation.

While improbable, a federal requirement would be advantageous because it would use a single entity to monitor and enforce compliance, versus individual states needing to separately enforce it, including developing their own capabilities to do so. Enforcement could be easier if CPOs had to provide their data to a centralized federal API, which would then provide open data to EV drivers.

State Requirements

Currently, state requirements may be the most likely way to achieve universal real-time data sharing. However, multiple state legislatures must act to achieve a tipping point that may induce CPOs to share real-time data nationally. States have less power and are less efficient in achieving compliance.

The biggest costs of any real-time data requirement would be monitoring and enforcement. States could reduce costs by cooperating to monitor and enforce compliance, possibly by enlisting a multistate organization like the National Association of State Energy Officials or the American Association of State Highway and Transportation Officials, which could in turn contract a third party.

Achieving Higher EV Adoption Through State Real-Time Data Requirements

State action offers the best path to drive the EV market to the information-sharing equilibrium of universal, centralized real-time charger data and faster EV adoption. How would this work?

States should follow the IIJA's example and require real-time data—ideally for all publicly available chargers in their state, but at minimum for new DCFCs the state and ratepayers fund. As we noted earlier, three states are already moving to address this. Massachusetts recently legislated a real-time data requirement for all new chargers receiving federal, state, or ratepayer funding.[61] The proposed California regulations would compel all new state- and ratepayer-funded chargers to post real-time data.[62] Maryland considered requiring real-time data for all chargers in the state and has legislated the creation of a committee to further evaluate the proposal.[63] While the Massachusetts and California laws affect only publicly funded chargers, they could induce CPOs to disclose real-time data for all their chargers to give customers in those states a consistent experience across that CPO's chargers.

Model legislation, presented in Appendix A, can push states to adopt common real-time data disclosure standards that are consistent with the IIJA standards. Common standards would be easier for charging providers (CPOs) and therefore reduce resistance to data sharing. To curb any resistance, states could include technical minimums, such as enforcing the standards on all DCFC plus Level 2 chargers installed after a certain date only, to ensure that the affected chargers are capable of sharing real-time data.

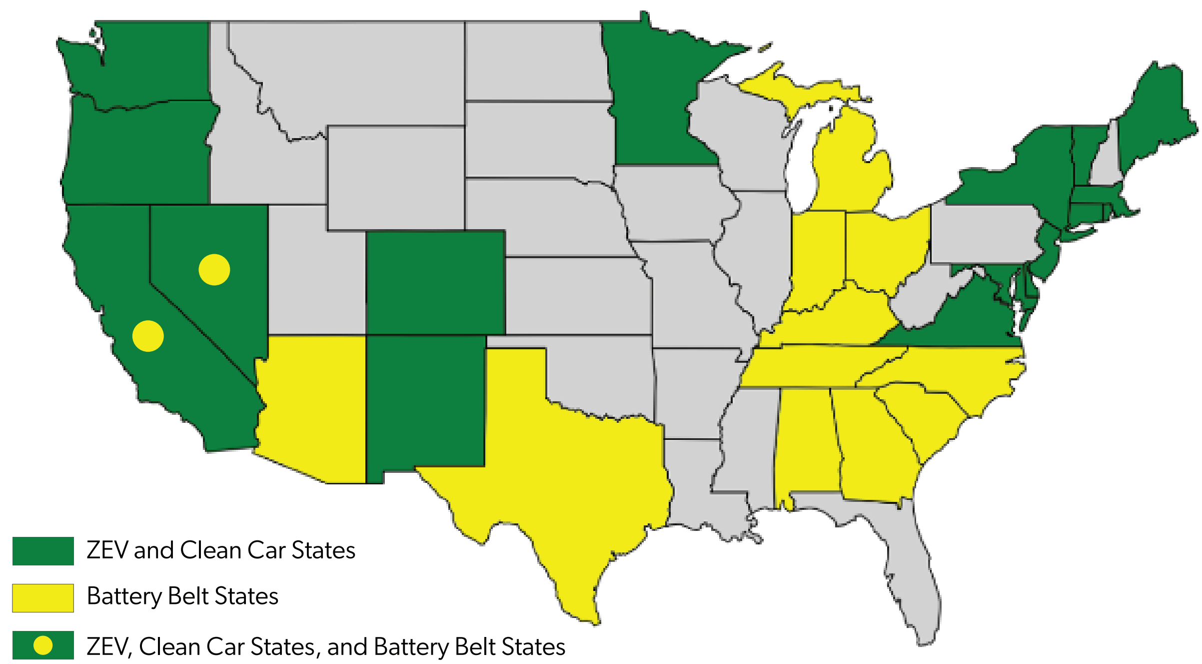
Real-time data sharing could further a state's environmental and economic goals, as the model legislation reflects. Benefits include protecting consumers, promoting EV deployment, easing travel for EV drivers, and improving public safety by making it easier for EV drivers to locate a working and free charger while driving. Price transparency would create a more competitive market. Another economic benefit is attracting EV-driving tourists, who might choose not to visit the state if it's hard to reliably find a charger there.

While some CPOs may nonetheless object to data sharing—particularly those sharing only via proprietary apps today—if they publish their real-time data in certain apps or websites, it would undermine a potential legal claim that the state is unconstitutionally "taking" a trade secret or other company property. Applying the disclosure requirement to only new chargers could further insulate the policy from a takings lawsuit because companies considering investment decisions would be on notice that they would have to share real-time data. Limiting the requirement to new chargers also avoids any burden of retrofitting existing chargers.

To further mitigate the potential for lawsuits, states should allow CPOs to attach reasonable data-use conditions, as CPOs do in their own apps, even when the data are obtained through third-party software developers, such as Google. The model legislation includes such language. States could also offer regulatory benefits in exchange for disclosure, such as exemptions from public utility commission regulation. Moreover, the model legislation *does not* call for sharing other potentially valuable data such as the length of individual charging sessions, initial and final charge states, and patterns by charger location, EV model, or specific vehicles.

Finally, because the model legislation is narrowly tailored to accelerate EV adoption and would help a state achieve its environmental and economic policy goals, the data-sharing provision would not be an unconstitutional compulsion of commercial speech. When states demonstrate a reasonable relationship between their legitimate policy goals and the required disclosure of accurate and factual commercial information, courts tend to reject First Amendment challenges. Only a few states may need to require disclosure to tip the market outcome to the information-sharing equilibrium. The broader the

Figure 8. Battery Belt and ZEV State Real-Time Data Requirements Would Ease EV Navigation Across Large Regions of the US



Source: California Air Resources Board, "States That Have Adopted California's Vehicle Regulations," https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/states-have-adopted-californias-vehicle-regulations; and Big Green Machine, website, https://www.the-big-green-machine.com/.
Note: For further analysis, see Table B3.

requirement in any state, and the more states that adopt real-time data requirements, the more rapidly the equilibrium may tip to universal real-time data sharing.

If CPOs provide centralized real-time data for chargers only in states where it is explicitly required, they would risk offering customers an inconsistent and confusing experience—especially in metro areas that span two or more states. CPOs may quickly decide that it is easier and more customer friendly to meet the real-time data sharing requirements across the board, rather than do it only in the states that require it, and on any NEVI chargers they operate. Large, new CPO-market entrants may provide real-time data on all their chargers in the face of these requirements, putting pressure on large incumbents to do so as well.

In exchange for voluntarily posting their real-time data to an API where any software developer can access it, the CPOs would enjoy the benefits of a faster growing market. A 13 percent larger US fleet of EVs in 2030, as our modeling indicates, would enable charging providers to amortize their investments more rapidly.

Even before real-time data sharing becomes standard practice, the regional nature of the Battery Belt, ZEV, and Clean Car states also means that long, multistate stretches of major highways could be transformed by state action, alleviating range anxiety for many road trips. If all 17 ZEV and Clean Car states plus Washington, DC, set universal real-time data disclosure requirements, then large regions of the country would become EV travel friendly: all highways in the mid-Atlantic and New England (excluding

New Hampshire), the West Coast (plus Nevada), and Colorado and Minnesota. (See Figure 8.) The ZEV and Clean Car states represent 40.2 percent of US registered vehicles.[64]

If the 11 additional Battery Belt states (which have at least $10 billion in EV or battery plant investment and 9,500 jobs announced)[65] also set real-time data disclosure requirements, it would cover the highways in 28 states, plus Washington, DC. (See Table B3.) EV drivers could go from Alabama to Maine or Michigan's Upper Peninsula, from New York to Chicago's Indiana suburbs, from Seattle to Tucson, and throughout Texas. Those 28 states have 67 percent of the nation's registered vehicles.[66] Yet other states might decide to follow so as not to be at a disadvantage in attracting tourism—such as Western states, where tourism may center on people driving to national parks.

Once multiple states adopt real-time data requirements, those states could reduce their implementation costs by cooperating with each other to monitor and notify CPOs and enforce the requirements. Standardizing states' requirements would facilitate joint monitoring and enforcement.

Conclusion

States' most powerful lever for accelerating EV adoption is essentially free from a state budget perspective: Follow the example of the IIJA and require real-time data for chargers in their state. We estimate that making real-time data universal for highway DCFCs would raise the 2030 EV share of new vehicle sales by 6.4 percentage points. As a result, there would be 3.5 million more EVs on the road by 2030, a 9.2 percent increase versus the baseline forecast. The fiscal cost is near zero.

Massachusetts has moved forward already, requiring any new charger receiving state, federal, or ratepayer funding to post real-time data. The California Energy Commission has issued draft regulations that would require posting real-time data for all new chargers funded by the state and electricity ratepayers. Maryland has created a commission to study requiring real-time data for chargers in the state.

Model legislation, which can be found in Appendix A, can facilitate states adopting common real-time data disclosure standards that are consistent with the IIJA's. Common requirements would be easier for CPOs and therefore reduce their resistance to data sharing.

Only a few states may need to require disclosure to motivate the EV market to comply as a whole. Even if the majority of states don't require CPOs to share their EV chargers' real-time data, the regional nature of the Battery Belt, ZEV, and Clean Car states could mean that long, multistate stretches of major highways could be quickly transformed by state action, alleviating range anxiety for many road trips just through state action.

Appendix A. Model Legislation Requiring Real-Time Data Reporting from Electric Vehicle Chargers

Section 1. Legislative Findings

a. The legislature finds that it is in the best interests of the state to encourage private-sector investment in infrastructure, including public electric vehicle (EV) charging stations.

b. The legislature finds that transparency into the real-time pricing and availability of public charging stations is essential for protecting consumers, promoting EV deployment, and fostering the rapid installation and widespread use of public charging stations.

c. The legislature finds that a robust network of privately owned public charging stations that provide consumers with transparent information about real-time pricing and availability will ease travel along the state's roadways, improve public safety by simplifying how drivers locate available chargers, and reduce the time drivers spend searching for a charger or waiting to charge.

Section 2. Definitions

"Charger," a device having at least 1 charging port and connector for charging EVs.

"Charging station," a charger or group of chargers and the area in the immediate vicinity of such charger or group of chargers, which may include, at the discretion of the regulating entity, supporting equipment, parking areas adjacent to the chargers and lanes for vehicle ingress and egress; provided, however, that a charging station may compose only part of the property on which it is located.

"Charging network provider," an entity that operates the digital communication network that remotely manages the chargers at a charging station; this may include charge point operators.

"Charging station operator," an entity that owns or provides the chargers and the supporting equipment and facilities at charging stations and is responsible for operating and maintaining chargers, supporting equipment, and facilities; they may delegate responsibility for certain aspects of the charging station operation and maintenance to subcontractors.

"Connector,": a device that attaches an EV to a charging port to transfer electricity; provided, however, that the term "connector" may also be referred to as a plug.

"Direct current fast charger," or "DCFC," a charger that enables rapid charging by delivering direct current electricity to an EV's battery.

"Electric vehicle," or "EV," a motor vehicle that is either partially or fully powered on electric power received from an external power source. For the purposes of this regulation, this definition does not include golf carts, electric bicycles, or other micromobility devices.

"Level 2 charger," a charging system with a single-phase input voltage range from 208 to 240 volts of alternating current (AC) and maximum output current less than or equal to 80 amperes AC.

"NEVI Standards," the minimum standards and requirements for projects funded under the National Electric Vehicle Infrastructure (NEVI) Formula Program that were published in the *Federal Register* on February 28, 2023, beginning on page 12752 of volume 88.

"Port," a system or connecting outlet on a charger that provides power to charge an EV, provided, that a port may be equipped with multiple connectors but uses only one connector at a time to provide such power.

"Public charging station," a charging station that is a Level 2 charger or a DCFC and is located at a publicly available parking space.

"Publicly available parking space," a parking space that has been designated by a property owner or lessee to be available to and accessible by the public and may include on-street parking spaces and parking spaces in surface lots or parking garages; provided, however, that a "publicly available parking space" shall not include a parking space that is part of or associated with a private residence or that is reserved for the exclusive use of an individual driver or vehicle or for a group of drivers or vehicles including employees, tenants, visitors, residents of a common interest development, or residents of an adjacent building.

Section 3. Availability of Real-Time Data and Regulation of Charging Network Providers and Charging Station Operators

a. Consistent with regulations pursuant to section (b), any charging network provider or charging station operator of a public charging station in the State shall make available to third-party software developers, free of charge, data necessary to provide real-time information on availability, power delivery rating, and pricing of each public charging station.

b. Within 12 months of the effective date of this Act, the [DEPARTMENT] shall promulgate regulations to implement subsection (a), including but not limited to:
   i. data requirements, provided further, that the [DEPARTMENT] shall ensure that availability, power delivery rating, and pricing information are accurate and reflect the real-time conditions of each public charging station port;
   ii. definitions of key terms, including but not limited to "availability" and "real time";
   iii. requirements that the data include geographic information sufficient to support third-party mapping software;
   iv. requirements that the data format comply with EV charging industry best practices and standards, such as the NEVI Standards, and other best practices and standards identified by the [DEPARTMENT];
   v. provisions allowing charging station operators to attach reasonable conditions to data use designed to protect confidential business information, provided that such conditions shall not prevent third-party software developers from accessing real-time information on the availability, power delivery rating, and pricing of each public charging station port; and
   vi. applicability of the regulations, provided that the regulations shall apply to all public charging stations that commence operations no sooner than 12 months following the enactment of this Act.

c. Notwithstanding any other law, the [PUBLIC UTILITY COMMISSION] shall not have any jurisdiction to regulate the prices, terms, or conditions of any public charging station that complies with all regulations promulgated pursuant to this chapter and that is owned or operated by a charging network provider or charging station operator, provided the charging network provider or charging station operator does not otherwise distribute or sell electric power to the public.

Appendix B. A Breakdown of Real-Time Data Across Six Interstates and Battery Belt State Jobs and Investment

Table B1. Real-Time Data Provision on November 19, 2024, vs. August 18, 2024

Interstate	I-5	I-10	I-75	I-80	I-90	I-95	Total
Total Stations	349	185	150	213	187	335	1,419
Real-Time Data	43.8%	33.0%	35.3%	31.0%	24.6%	30.2%	33.8%
Difference in Real-Time Data Compared with Data from August 18, 2024	−1.6%	+1.4%	+1.8%	+1.0%	+1.3%	+1.6%	+0.6%
Non-Tesla Stations	248	114	91	132	109	187	881
Real-Time Data	61.7%	53.5%	58.2%	50.0%	42.2%	54.0%	54.5%
Difference in Real-Time Data Compared with Data from August 18, 2024	−2.4%	+2.6%	+8.7%	−3.4%	+2.6%	+2.9%	+1.1%
Excluding Tesla and EA Stations	197	80	70	88	79	149	663
Real-Time Data	77.7%	76.3%	75.7%	75.0%	58.2%	67.8%	72.4%
Difference in Real-Time Data Compared with Data from August 18, 2024	−3.0%	+4.3%	+11.4%	−4.8%	+3.9%	+3.8%	+1.5%

Source: Authors' analysis of PlugShare data.
Note: Unless specified, data are from November 19, 2024.

Table B2. Data Deserts of at Least 145 Miles (Including Auto Dealerships)

Interstate	Start Location	End Location	Length (Miles)	Number of Stations	Tesla Chargers	Electrify America Chargers	Other Charge Point Operators
1-10	Tuscon, AZ	Deming, NM	209	4	2	2	0
	El Paso, NM	Kerrville, TX	481	11	6	5	0
	Beumont, TX	Gulfport, MS	315	18	9	4	5
	Pensacola, FL	Tallahassee, FL	201	12	5	4	3
I-80	Truckee, CA	Lovelock, NV	148	7	4	3	0
	Lovelock, NV	Carlin, NV	153	3	1	2	0
	Coalville, UT	Laramie, WY	353	7	4	3	0
	Cheyenne, WY	Kearney, NE	318	9	4	3	2
	Bettendorf, IA	Lansing, IL	168	4	2	2	0
	Emlenton, PA	Bloomsburg, PA	195	6	4	2	0
1-90	Cour D'Alene, ID	Missoula, MT	164	8	5	0	3
	Missoula, MT	Bozeman, MT	207	4	2	2	0
	Bozeman, MT	Sheridan, WY	271	7	4	1	2
	Sheridan, WY	Spearfish, SD	199	5	3	1	1
	Spearfish, SD	Mitchell, SD	322	10	4	3	3
1-95	Lynchburg, SC	Savannah, GA	145	8	7	1	0

Source: Authors' analysis of PlugShare data.

Table B3. Battery Belt States Based on EV and Battery Investment

State	Capital Investment (US Dollars, Billions)	Announced Jobs
Georgia	37.8	46,300
Michigan	31.1	31,000
Tennessee	24.1	21,700
North Carolina	22.6	18,800
Indiana	21.8	18,700
California	16.7	27,600
Nevada	15.4	16,200
South Carolina	15.3	20,400
Ohio	14.3	22,500
Arizona	12.4	17,000
Texas	11.5	72,100
Kentucky	10.8	9,600
Alabama	10.6	13,300

Source: Authors' calculations; and Big Green Machine, website, https://www.the-big-green-machine.com.
Note: Data are from a December 16, 2024, dataset. States are ranked by capital investment. The table excludes canceled investments. California and Nevada are also ZEV states.

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Notes

1. Omar Isaac Asensio et al., "Charging Uncertainty: Real-Time Charging Data and Electric Vehicle Adoption" (working paper, National Bureau of Economic Research, January 13, 2025), https://www.nber.org/papers/w33342. Chargeway, a newer app with a free option, indicates the charger status for Tesla and EA chargers, yet it has not achieved widespread use to date. On April 18, 2025, Chargeway had 2,000 reviews on Apple's App Store, versus 122,000 for PlugShare. CPO proprietary apps from EA (26,000 reviews), ChargePoint (18,000), Blink Charging (15,000), EVgo (9,500), EV Connect (5,200), and FLO (2,900) all had more reviews in Apple's App Store. Similarly, on April 21, 2025, Chargeway had only 381 reviews on the Google Play store, versus 40,000 for PlugShare. CPO proprietary apps had more reviews than Chargeway, and occasionally more even than PlugShare, on the Google Play store: EA (15,000 reviews), ChargePoint (50,000), Blink Charging (3,000), EVgo (6,000), EV Connect (1,000), and FLO (3,000).

2. For our purposes, a data desert is a stretch of highway where there are no DCFCs within two miles of the highway in rural areas or 0.5 miles in metro areas.

3. Asensio et al., "Charging Uncertainty."

4. DCFCs, which are sometimes known as Level 3 chargers, produce at least 50 kilowatts per hour.

5. Range anxiety is a fear among EV drivers that their vehicle will run out of charge before reaching a charging station or their destination. This includes anxiety about charger reliability, search time, and congestion—not just the absolute number of chargers on the road.

6. US Department of Transportation, Federal Highway Administration, "National Electric Vehicle Infrastructure Standards and Requirements," *Federal Register* 88, no. 39 (February 28, 2023): 12752, https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements#page-12752.

7. See, for example, James Bikales, "Trump Administration Moves to Suspend National EV Charger Rollout," Politico, February 6, 2025, https://www.politico.com/news/2025/02/06/trump-administration-ev-charger-program-00203011; White House, "Unleashing American Energy," January 20, 2025, https://www.whitehouse.gov/presidential-actions/2025/01/unleashing-american-energy/; US Department of Transportation, Office of the Secretary of Transportation, "Memorandum on Fixing the CAFE Program," January 28, 2025, https://www.transportation.gov/sites/dot.gov/files/2025-01/Signed%20Secretarial%20Memo%20re%20Fixing%20the%20CAFE%20Program.pdf; US Environmental Protection Agency, "EPA Launches Biggest Deregulatory Action in U.S. History," press release, March 12, 2025, https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history; and US Environmental Protection Agency, "EPA Announces Action to Implement POTUS's Termination of Biden-Harris Electric Vehicle Mandate," press release, March 12, 2025, https://www.epa.gov/newsreleases/epa-announces-action-implement-potuss-termination-biden-harris-electric-vehicle.

8. One Big Beautiful Bill Act, Pub. L. No. 119-21, § 70504; David Ferris, "Trump Budges on Freezing Funds for EV Charging," *E&E News*, July 3, 2025, https://www.eenews.net/articles/trump-budges-on-freezing-funds-for-ev-charging/; and US Department of Transportation, Federal Highway Administration, "President Trump's Transportation Secretary Sean P. Duffy Unveils Revised NEVI Guidance to Allow States to Actually Build EV Chargers," August 11, 2025, https://highways.dot.gov/newsroom/president-trumps-transportation-secretary-sean-p-duffy-unveils-revised-nevi-guidance.

9. Cassandra Cole et al., "Policies for Electrifying the Light-Duty Vehicle Fleet in the United States," *American Economic Association Papers and Proceedings* 113 (May 2023): 316–22, https://www.aeaweb.org/articles?id=10.1257/pandp.20231063.

10. One Big Beautiful Bill Act Pub. L. No. 119-21, §§ 70501–03.

11. US Environmental Protection Agency, "EPA Releases Proposal to Rescind Obama-Era Endangerment Finding, Regulations That Paved the Way for Electric Vehicle Mandates," press release, July 29, 2025, https://www.epa.gov/newsreleases/epa-releases-proposal-rescind-obama-era-endangerment-finding-regulations-paved-way.

12. Tony Briscoe, "Trump Signs Laws to Kill California Auto Emissions Standards. California AG Sues," *Los Angeles Times,* June 12, 2025, https://www.latimes.com/environment/story/2025-06-12/trump-signs-laws-undoing-california-auto-emission-standards.

13. These 17 states followed California's waiver before Congress revoked California's right to set stricter standards.

14. Elaine Buckberg and Cassandra Cole, *Trump EV Policy Overhaul: What Will Happen to EV Adoption, Emissions, and the Fiscal Balance?*, Salata Institute for Climate and Sustainability, March 18, 2025, https://salatainstitute.harvard.edu/quantifying-trumps-impacts-on-ev-adoption/.

15. This figure includes battery EVs and plug-in hybrid EVs. Rho Motion, "Over 17 Million EVs Sold in 2024—Record Year," press release, January 14, 2025, https://rhomotion.com/news/over-17-million-evs-sold-in-2024-record-year/.

16. Kelley Blue Book, *Electric Vehicle Sales Report Q4 2024*, January 13, 2025, https://www.coxautoinc.com/wp-content/uploads/2025/01/Q4-2024-Kelley-Blue-Book-EV-Sales-Report.pdf.

17. We obtain these estimates using a two-sided model that combines a discrete choice model of consumers' vehicle purchase decisions—including whether to buy an EV or ICE vehicle, a decision that would likely be influenced by public charging availability—and a model of charging station deployment and exit decisions, which depends on the number of EVs on the road.

18. Because of the litigation challenging the law eliminating California's waiver, and because California state actions could potentially circumvent the waiver's withdrawal, we do not incorporate its removal in our baseline projection.

19. Asensio et al., "Charging Uncertainty."

20. Seventeen states have adopted California's Advanced Clean Cars II or ZEV Light-Duty Vehicle Standards. Of those 17 states, 12 also adopted the Clean Cars regulations: California, Colorado, Delaware, Maryland, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, and Washington. Five states plus Washington, DC, that adopted California's ZEV Light-Duty Vehicle Standards did not adopt the Clean Cars regulations: Connecticut, Maine, Minnesota, Nevada, and Virginia, plus Washington, DC. California Air Resources Board, "States That Have Adopted California's Vehicle Regulations," https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/states-have-adopted-californias-vehicle-regulations.

21. The 13 Battery Belt states, ranked by total announced investment amount, are Georgia, Michigan, Tennessee, North Carolina, Indiana, California, Nevada, South Carolina, Ohio, Arizona, Texas, Kentucky, and Alabama. Of those, only California and Nevada are ZEV or Clean Car states. Calculations use data from the Big Green Machine database as of December 16, 2024. Big Green Machine, website, https://www.the-big-green-machine.com/. See Table B4.

22. In 2022, these 27 states and the District of Columbia had a combined 190,842,258 registered cars (out of the 283,400,987 vehicles registered in the US). These figures are calculated from US Department of Transportation data via Mathilde Carlier, "Automobile Registrations in the United States in 2023, by State," Statista, March 11, 2025, https://www.statista.com/statistics/196505/total-number-of-registered-motor-vehicles-in-the-us-by-state/.

23. Washington, DC, follows the Clean Car standards. See California Air Resources Board, "States That Have Adopted California's Vehicle Regulations."

24. Asensio et al., "Charging Uncertainty."

25. See, for example, Katalin Springel, "Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives," *American Economic Journal: Economic Policy* 13, no. 4 (2021): 393–432, https://www.aeaweb.org/articles?id=10.1257/pol.20190131; Stephan Sommer and Colin Vance, "Do More Chargers Mean More Electric Cars?," *Environmental Research Letters* 16 (June 2021): 064092, https://iopscience.iop.org/article/10.1088/1748-9326/ac05f0; Shanjun Li et al., "The Market for Electric Vehicles: Indirect Network Effects and Policy Design," *Journal of the Association of Environmental and Resource Economists* 4, no. 1 (2017), https://www.journals.uchicago.edu/doi/10.1086/689702; Yiyi Zhou and Shanjun Li, "Technology Adoption and Critical Mass: The Case of the U.S. Electric Vehicle Market," *The Journal of Industrial Economics* 66, no. 2 (2018): 423–80, https://doi.org/10.1111/joie.12176; and Jianwei Xing et al., "What Does an Electric Vehicle Replace?," *Journal of Environmental Economics and Management* 107 (May 2021): 102432, https://www.sciencedirect.com/science/article/abs/pii/S0095069621000152.

26. Alec Tyson and Emma Kikuchi, "About 3 in 10 Americans Would Seriously Consider Buying an Electric Vehicle," Pew Research Center, July 27, 2024, https://www.pewresearch.org/short-reads/2024/06/27/about-3-in-10-americans-would-seriously-consider-buying-an-electric-vehicle/.

27. Searching for a charger is costly even when charge attempts do not fail. Jackson Dorsey, Ashley Langer, and Shaun McRae estimate that under the current distribution of charging infrastructure, EV drivers without access to public charging would spend the equivalent of $7,763 per driver annually in time lost to searching for or waiting to use a charger. Jackson Dorsey et al., "Fueling

Alternatives: Gas Station Choice and the Implications for Electric Charging" (working paper, National Bureau of Economic Research, March 2022), https://www.nber.org/papers/w29831.

28. Joanna Stern, "I Visited Over 120 EV Chargers: Three Reasons Why So Many Were Broken," *The Wall Street Journal*, November 15, 2023, https://www.wsj.com/tech/i-visited-over-120-ev-chargers-three-reasons-why-so-many-were-broken-7a5d3e45.

29. Jeff Youngs, "Lack of Public Chargers Draining EV Owner Satisfaction," J.D. Power, February 29, 2024, https://www.jdpower.com/cars/shopping-guides/lack-of-public-chargers-draining-ev-owner-satisfaction.

30. J.D. Power, *J.D. Power 2025 EV Consideration (EVC) Study*, https://www.jdpower.com/business/electric-vehicle-consideration.

31. Omar Isaac Asensio et al., "Real-Time Data from Mobile Platforms to Evaluate Sustainable Transportation Infrastructure," *Nature Sustainability* 3 (2020): 463–71, https://doi.org/10.1038/s41893-020-0533-6.

32. David Rempel et al., "Reliability of Open Public Electric Vehicle Direct Current Fast Chargers," *Human Factors* 66, no. 11 (2023), https://doi.org/10.1177/00187208231215242.

33. Multifamily housing represents 40 percent of units in cities, versus 18 percent in suburbs. Caitlin Walter, "Blurring the Line Between Cities and Suburbs," *Multi-Housing News*, May 2, 2018, https://www.multihousingnews.com/blurring-the-line-between-cities-and-suburbs/.

34. Over half of urban housing was rented in 2021, versus 30 percent in suburbs and 28 percent in rural areas. Joint Center for Housing Studies of Harvard University, *America's Rental Housing 2024*, 2024, https://www.jchs.harvard.edu/sites/default/files/reports/files/Harvard_JCHS_Americas_Rental_Housing_2024.pdf.

35. US Department of Energy, Vehicle Technologies Office, Fact of the Week, "FOTW #1336, April 1, 2024: 60% of EVs Are Expected to Be in Suburban Areas in 2030," April 1, 2024, https://www.energy.gov/eere/vehicles/articles/fotw-1336-april-1-2024-60-evs-are-expected-be-suburban-areas-2030.

36. The 2022 National Household Travel Survey data reveal that 97 percent of households do not take a road trip longer than 100 miles (one way) each year. In other words, they should never need to charge away from home; they can charge using either their home charger or familiar public chargers. Fewer than 1 percent do a trip longer than 200 miles each way. In an EV with a 300-mile range, drivers starting with a full battery could drive a 200-mile round trip without charging on the way or a 400-mile round trip with a single charge at the destination, even in cold temperatures. In our study, the model year (2024) median range was 283 miles. See US Department of Energy, Vehicle Technology Office, Fact of the Week, "FOTW #1375, December 30, 2024: Median EV Range in Model Year 2024 Reached a Record 283 Miles per Charge," December 30, 2024, https://www.energy.gov/eere/vehicles/articles/fotw-1375-december-30-2024-median-ev-range-model-year-2024-reached-record.

37. Most non-Tesla EVs use J1772 plugs for Level 2 charging and CCS1 for fast charging, but some US EVs, like the Nissan LEAF, use CHAdeMO plugs. While many DCFCs include CCS1 and CHAdeMO plugs, some only include one or the other.

38. Laura Veldkamp, "Valuing Data as an Asset," *Review of Finance* 27, no. 5 (2023): 1545–62, https://doi.org/10.1093/rof/rfac073.

39. The NEVI interim guidance issued on August 11, 2025, retains, without changes, the NEVI regulations issued on February 28, 2023. See US Department of Transportation, Federal Highway Administration, *National Electric Vehicle Formula Program Interim Final Guidance*, August 11, 2025, 6, https://www.fhwa.dot.gov/environment/nevi/resources/NEVI-Interim-Final-Program-Guidance-8-11-2025.pdf.

40. US Department of Transportation, Federal Highway Administration, "National Electric Vehicle Infrastructure Standards and Requirements," *Federal Register* 88, no. 39 (February 28, 2023): 12756, https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements#page-12752.

41. In February 2025, the US Department of Transportation withdrew NEVI guidelines and instructed states to pause disbursements. In May 2025, the Government Accountability Office determined that these funds were illegally impounded; however, the Office of Management and Budget instructed the Department of Transportation to continue withholding the funds. In June 2025, a district judge required the Department of Transportation to restore funding to 14 states. See Emily Biondi, "Suspending Approval of State Electric Vehicle Infrastructure Deployment Plans," US Department of Transportation, Federal Highway Administration, February 6, 2025, https://www.fhwa.dot.gov/environment/nevi/resources/state-plan-approval-suspension.pdf; Edda Emmanuelli Perez, *U.S. Department of Transportation, Federal Highway Administration—Application of the Impoundment Control Act to Memorandum*

Suspending Approval of State Electric Vehicle Infrastructure Deployment Plans, US Government Accountability Office, May 22, 2025, https://www.gao.gov/products/b-337137; Chris Marquette, "White House Directs DOT to Ignore GAO Ruling on EV Funding Pause," *Politico*, June 4, 2025, https://www.politico.com/news/2025/06/04/white-house-dot-gao-ev-funding-00384230; and Ferris, "Trump Budges on Freezing Funds for EV Charging."

42. National Renewable Energy Laboratory, *The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure*, June 2023, https://www.nrel.gov/docs/fy23osti/85654.pdf.

43. For more details about our survey methodology, see Asensio et al., "Charging Uncertainty."

44. Our EV driver sample comprised members of the Electric Vehicle Association, a North American nonprofit working to accelerate the adoption of EVs. For the potential-EV-driver sample, we acquired an age- and gender-balanced panel of US-based non-EV drivers likely to buy a new car in the next one to two years through the survey firm Dynata. We asked respondents to imagine that the chargers we asked about were all within 200 miles of their home, within two miles of a US interstate, and compatible with their vehicle. We received 1,006 completed survey responses from prospective car buyers and 814 from current EV drivers via the Electric Vehicle Association.

45. Asensio et al., "Charging Uncertainty."

46. ChargerHelp, "ChargerHelp Annual Reliability Report: The State of EV Charging and the Driver Experience," June 2024, https://www.chargerhelp.com/2024-annual-reliability-report.

47. For statistics on real-time data provision by app, see Asensio et al., "Charging Uncertainty."

48. Our methodology is described in detail in Asensio et al., "Charging Uncertainty."

49. US Department of Energy, Vehicles Technologies Office, Fact of the Week, "FOTW #1375, December 30, 2024."

50. Table B2 presents data deserts on 1-5, 1-10, 1-75, I-80, I-90, and I-95, including chargers at auto dealerships. Except for I-95, the overall picture of data deserts improves significantly in this context; the 13 data deserts documented in Table 2 are broken into 16 shorter data deserts.

51. The revised interim guidance eliminates the 50-miles requirement and instead instructs states to "consider the appropriate distance between stations to allow for reasonable travel and certainty that charging will be available to corridor travelers when needed." US Department of Transportation, Federal Highway Administration, *National Electric Vehicle Formula Program Interim Final Guidance*, 6.

52. Joint Office of Energy and Transportation, "Q4 2024 NEVI Quarterly Update," November 26, 2024, https://driveelectric.gov/news/q4-2024-nevi-quarterly-update.

53. The model also incorporates charging firms' entry and exit decisions.

54. Estimates in this paper also incorporate several key modeling changes: updating the parameterization of vehicle prices and segmenting the national population of EVs into ZEV and non-ZEV states. Buckberg and Cole, *Trump EV Policy Overhaul*; and Asensio et al., "Charging Uncertainty."

55. Asensio et al., "Charging Uncertainty," 33, Figure 17.

56. Buckberg and Cole, *Trump EV Policy Overhaul*.

57. Based on the projection from Cole et al., "Policies for Electrifying the Light-Duty Vehicle Fleet in the United States."

58. Cole et al., "Policies for Electrifying the Light-Duty Vehicle Fleet in the United States."

59. Authors' review of Ford, GM, Honda, Hyundai, Jeep, and Tesla website information on EV route-planning apps.

60. Austyn Gaffney, "Government Science Data May Soon Be Hidden. They're Racing to Copy It," *The New York Times*, March 21, 2025, https://www.nytimes.com/2025/03/21/climate/government-websites-climate-environment-data.html.

61. The requirement applies to any "publicly-funded and available charging station," defined as "a public electric vehicle charging station that has received, or expects to receive, a grant, loan or other incentive from a federal or state government source or by a charge on ratepayers and is located at a publicly available parking space." An Act Promoting a Clean Energy Grid, Advancing Equity and Protecting Ratepayers, ch. 239, § 31(a), 2024 Mass. Acts.

62. California Energy Commission, *Second Draft Staff Report*.

63. An Act Concerning Electric Vehicle Supply Equipment Workgroup, ch. 453, 2024 Md. Laws.

64. California Air Resources Board, "States That Have Adopted California's Vehicle Regulations."

65. Authors' calculations using Big Green Machine, "Summary Data Tables and Dataset Access," accessed December 16, 2024, https://www.the-big-green-machine.com/access-database.

66. Of the 283,400,987 vehicles registered in the US as of 2022, 190,842,258 were registered in these 28 states. Calculated from US Department of Transportation data via Statista, website, https://www.statista.com/statistics/196505/total-number-of-registered-motor-vehicles-in-the-us-by-state/.