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THE STATE OF ELECTRIC VEHICLE CHARGING FOR MULTIFAMILY HOUSING

Assessing the Public EV Charging Gap in U.S. Cities

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ELECTRIC VEHICLE (EV) CHARGING INFRASTRUCTURE TERMINOLOGY

- *There are three main categories of EV charging infrastructure: Level 1, Level 2, and Level 3 chargers.*
- ***Level 1 (L1)** provides charging through a standard 120-volt outlet and can deliver approximately three to seven miles of range per hour of charging. L1 is best suited for residential applications, including multifamily housing, and some workplaces. L1 works well for overnight and longer charge times, given the slow charging rate. Most EVs come with a portable L1 plug, enabling charging anywhere with available grounded three-prong outlets.*
- ***Level 2 (L2)** provides charging through 240-volt electrical service and is common for residential, workplace, and public charging. L2 can deliver approximately 14 to 35 miles of range per hour of charging. Typically, L2 chargers require electrical upgrades unless a property is pre-wired for EVs (or EV ready).*
- ***Level 3 (L3) or direct current fast chargers (DCFC)** use higher voltages and direct current (as opposed to alternating current used with L1 and L2 charging) to deliver faster charging. L3 is more common in commercial applications than residential, due to electric power and infrastructure requirements. L3 charging stations can provide from 50 to 350 kilowatts of power and fully charge an EV in minutes, depending on the size of the vehicle's battery. Most L3 chargers have more than one charging port per station. They are well suited for corridor charging, long-distance driving, fleet charging, and higher-mileage drivers.*
- ***Bring-your-own-cable (BYOC)** charging posts offer 240-volt plugs and can be installed on a sidewalk or a building, but the EV driver must have their own compatible cord to plug into the charger. This report does not cover BYOC, as it is not yet common in the United States, though some cities are beginning to offer this type of public charging.*

EXECUTIVE SUMMARY

A renter living in a large apartment building commutes 30 minutes daily to work in her gas-fueled vehicle because no public transit is available. Rising gas prices are costing her hundreds each month. She knows EVs cost less to drive and have lower cost of ownership compared to internal combustion engine (ICE) vehicles[1,2] and she wants to take advantage of the new used-EV tax credit in the Inflation Reduction Act (IRA). She also wants to reduce her transportation pollution footprint. But one thing stands in her way from switching to an EV: she would be solely reliant on public chargers because she has no on-site EV charging at her apartment, nor at her workplace. The nearest public charger (L2) is three miles from where she lives and would require hours to get the full charge necessary for her commute. Although she'd love to drive an EV and contribute to cleaner air and a stable climate, her need for a reliable mode of transportation deters her. Instead, she continues to drive her gas car, hoping her EV charging situation will one day improve.

Nearly a third of households in the United States lack an equal opportunity to drive and benefit from an electric vehicle (EV) simply because they live in multifamily housing (MFH).[3] Without access to the same reliable, convenient, and affordable EV charging available to residents of single-family homes, many MFH residents may continue to choose fossil-fueled internal combustion engine (ICE) vehicles over EVs, exacerbating climate change and contributing to local air pollution. This is not only a climate and public health issue, but also an equity issue.

Today, most EV drivers in the U.S. are white, higher-income homeowners.[4] Between 84 and 94 percent of U.S. EV drivers living in detached single-family homes have access to home charging, while less than half of those living in apartments have access to home charging.[5] Renters make up more than a third of all U.S. households, with nearly two-thirds of renters living in MFH.[6,7] And renters are more likely than homeowners to be single, to be households of color, or to have lower incomes.[8]

Black, Latino, and Asian drivers have the same interest in owning EVs as white drivers, but equitable access to EV charging remains a critical barrier.[9] Similarly, a growing number of apartment renters see EV chargers as an important amenity and would even pay more to have access to chargers. But the split incentive between landlords and tenants often prevents action.[10]

Bridging these equity divides requires more attention. But who holds the keys? States, local government, private businesses, regulated utilities, and MFH stakeholders all have a role to play in tackling the EV infrastructure challenge.

Although the U.S. has made great strides in growing its EV market and expanding charging infrastructure to serve existing and future EV drivers, accelerating progress in the transition to clean transportation will require more action from all stakeholders.

State and local policymakers should proactively expand EV charging options to ensure a smooth road ahead for all EV drivers.

Shifting to cleaner vehicles will clean the air and reduce harmful climate emissions, but a sizable vehicle stock turnover problem looms large for the foreseeable future across the U.S. In 2022, there were more than 278 million registered private and commercial vehicles in the U.S., and just over 91 percent of U.S. households had at least one automobile.[11] Nearly 140 million people in the U.S. routinely commute by car to work,[12] and many MFH residents rely on personal vehicles for commuting to work and for daily life.

More drivers need to opt for EVs to reduce transportation emissions, but they also need confidence in the available charging infrastructure. Research consistently shows that access to reliable, affordable, and convenient charging is a leading factor in the decision to buy or lease an EV.[13]

This report offers a unique contribution to this nascent area of research, focusing on cities because of their sizable influence over where EV infrastructure is deployed. We analyze cities of all sizes with high volumes of MFH to assess how much public EV charging is available to serve EV drivers living in MFH.[i]

As shown on the map (Figure ES-1), we ranked 69 cities based on the number of MFH units to the number of public EV chargers (level 2 and 3), applying a scale ranging from *best in class* to *worst*. Figure ES-2 provides a snapshot of our full city list, featuring the top 10 and bottom 10 cities, with the full list available in the report.

Our analysis finds a charging access gap across the U.S. Whether large or small, and whether growing their MFH or with an established MFH stock (or both), all cities have room for improvement.

Most cities (44 out of 69) had *fair* to *worst* rankings, and only 23 were designated as *better* or *good* (with none designated as *best in class*). Even the cities with *better* or *good* rankings still have relatively high ratios of MFH units to public chargers (all with more than 40 units per charger), suggesting that local and state policies should continue to prioritize more strategic and equitable public EV charging infrastructure to serve MFH.

To fill the identified charging gap, we recommend state and local policymakers pursue a combination of EV-ready building codes, incentives for EV charging infrastructure, EV-ready parking and zoning ordinances, streamlined EV charging interconnection rules, curbside public charging, right-to-charge laws, and policies to support competitive charging markets. Policy actions should increase access to public charging and support on-site MFH charging options (in new and existing buildings).

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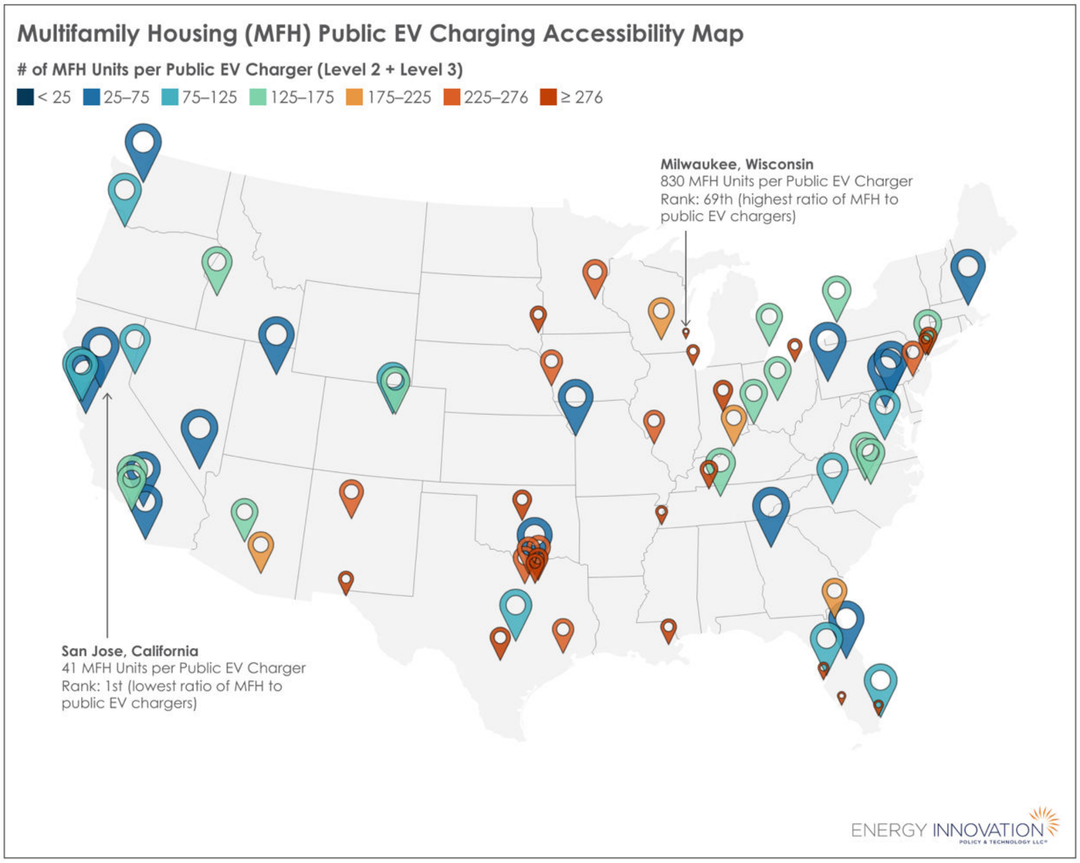
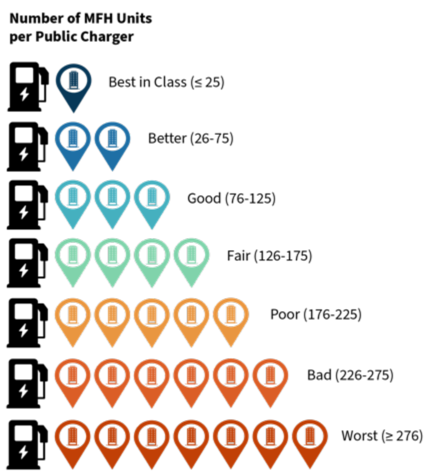
[i] We focus on public EV charging because there is limited public data on the amount of dedicated on-site or workplace EV charging available to serve MFH. We assume people living in MFH without access to on-site charging are disproportionately reliant on public EV charging.

Figure ES-1.



To view the interactive map online and see more city statistics, please visit:
https://energyinnovation.org/publication/the-state-of-charge-for-multifamily-housing-assessing-the-public-ev-charging-gap-in-u-s-cities/

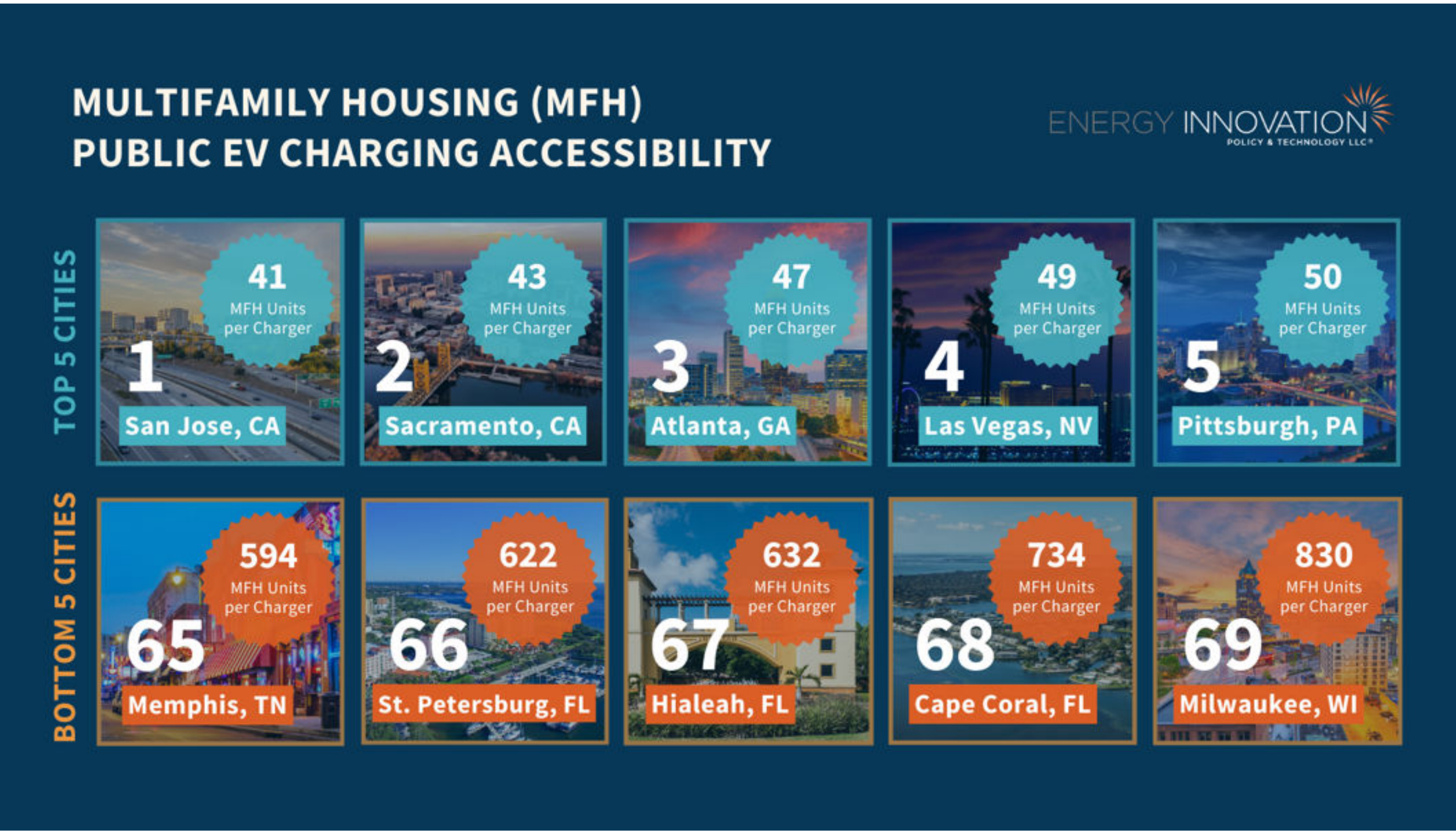
Source: U.S. Census Bureau, U.S. Department of Energy



Ranking Scale for Figures ES-1 and ES-2

Figure ES-2. U.S. cities ranked (out of 69) according to number of MFH units per public charger; the top 10 and bottom 10 cities are shown here (see full report for all cities)

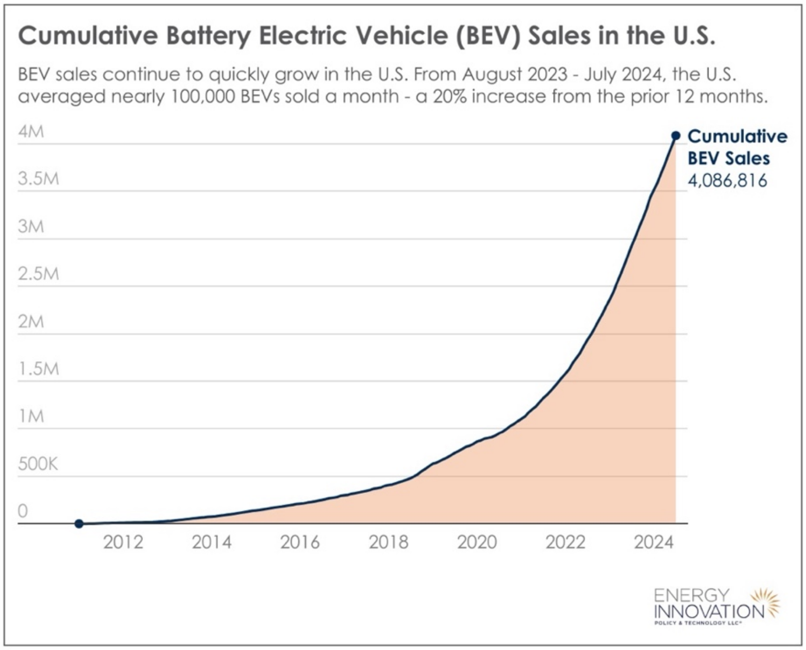
Rank (Top 10)	City	State	# of MFH units per public charger (L2+ L3)	Rank (Bottom 10)	City	State	# of MFH units per public charger (L2+ L3)
1	San Jose	CA	41	60	New Orleans	LA	438
2	Sacramento	CA	43	61	El Paso	TX	444
3	Atlanta	GA	47	62	Cleveland	OH	456
4	Las Vegas	NV	49	63	Newark	NJ	483
5	Pittsburgh	PA	50	64	Chicago	IL	486
6	Seattle	WA	51	65	Memphis	TN	594
7	Washington	DC	57	66	St. Petersburg	FL	622
8	Salt Lake City	UT	57	67	Hialeah	FL	632
9	Orlando	FL	58	68	Cape Coral	FL	734
10	Frisco	TX	60	69	Milwaukee	WI	830



THE U.S. NEEDS MORE ELECTRIC VEHICLE CHARGING TO SERVE MULTIFAMILY HOUSING

The U.S. has made steady progress over the past two decades in facilitating EV market growth. New EV sales represented just over 9 percent of all new light-duty sales in 2023, with 1.2 million new vehicles sold, marking a tipping point for the U.S. EV market.[14] Automotive research firms forecast that light-duty EV sales will make up to 11 percent of the U.S. auto market in 2024, as shown in Figure 1.[15] Looking ahead, the combination of IRA incentives for new EVs,[16] updated passenger vehicle standards (adopted by the EPA in April 2023),[17] and increased state adoption of Advanced Clean Cars II regulations could result in EVs constituting upwards of 67 percent of new vehicle sales in the light-duty sector by 2032.[18]

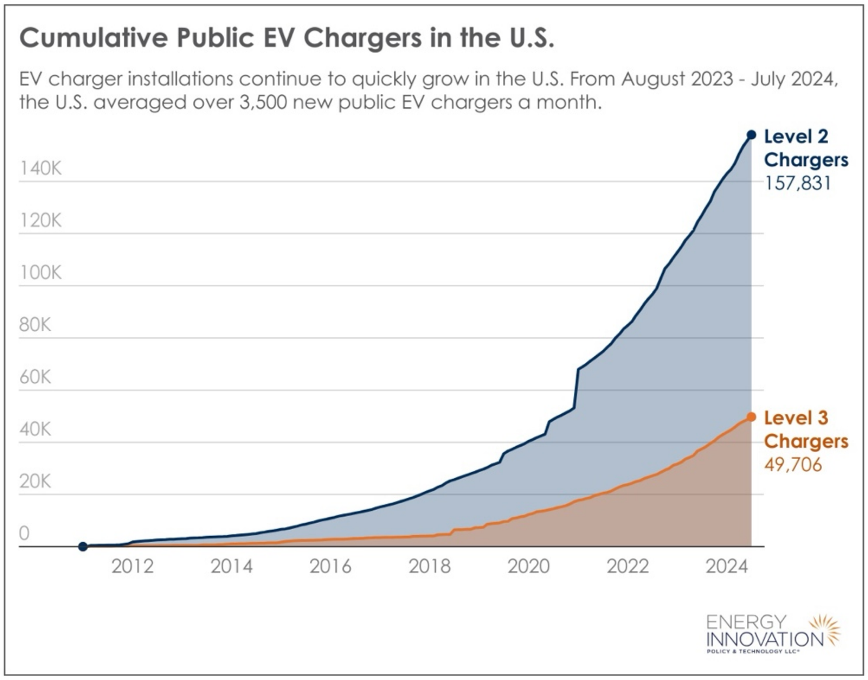
Figure 1.



Source: Argonne National Laboratory

EV infrastructure is growing commensurately to meet increased demand for convenient and reliable charging. According to Atlas Public Policy, publicly accessible EV charging infrastructure grew from fewer than 500 ports in 2010 to more than 131,000 ports at 50,000-plus locations as of February 2023 (see Figure 2).[19] Incentives and grant programs for EV charging will further support this growth, such as new federal tax incentives for individual and commercial EV charging in the IRA, the $7.5 billion in the Infrastructure Investment and Jobs Act for states to expand the EV charging network, and myriad state and utility incentives and programs.[20]

Figure 2.



Source: U.S. Department of Energy

However, the National Renewable Energy Laboratory estimates that the U.S. will need at least 28 million EV charging ports to support the roughly 33 million EVs expected to be on the road by 2030.[21] Of those 28 million chargers, nearly 8 percent (or just over 2 million) will need to be public and private L2 chargers at MFH, workplaces, and other public locations. And approximately 182,000 will be DCFC ports located at public charging stations, primarily to support those with inconsistent access to off-street parking and to support long-distance travel.[22] Atlas Public Policy estimates that achieving 100 percent passenger vehicle electrification by 2035 will require more than $87 billion in investments in charging infrastructure over the next decade, including $39 billion for public charging.[23]

Compared to the 131,000 public charging ports currently available for EV drivers, there are 435,000 to 1.74 million gas pumps in the U.S. today.[ii,24] Today's public gas station network originated in the early 1900s, whereas the U.S. EV charging network has been under development for just over a decade.[25]

As they were during the rise of the personal automobile, states and cities are once again at the forefront of a transportation transformation. State and local policymakers can ensure these sizable investments in new public infrastructure are both equitable and

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[ii] There are approximately 145,000 gasoline fueling stations across the U.S., these figures assume the average station has between three and 12 pumps.

strategic to meet charging needs for new and prospective EV drivers, including those living in MFH. With this analysis in hand, decision-makers can assess gaps and take action to improve EV charging access for their residents.

This report offers state and local policymakers a more granular analysis of their public EV charging network to help them better understand how it stacks up. We offer recommendations to help them prioritize actions to support a robust EV charging network capable of serving all EV drivers, including the nearly one-third of U.S. households living in MFH.

Building more EV charging infrastructure to serve all people, regardless of where they live, will help put the U.S. on the fast track to a cleaner, climate-stable, and more equitable transportation future. But policymakers should act now to avoid forestalling progress.

Background Context

According to the National Association of Home Builders' analysis based on U.S. Census Bureau data, nearly 44 million residences in the U.S. today are multifamily (including apartment buildings, condominiums, townhouses, and mixed-use developments).[26] Today, nearly one in three households live in MFH (structures with two or more units).[27]

Credit: yahtzeen

New construction of MFH has been steadily increasing since 2010, reaching historic highs from 2022 to 2024,[28] which suggests more people across the U.S. will be living in MFH in the years ahead. The top 10 states for new construction of MFH apartments[iii] in 2023 were Texas, Florida, California, New York, North Carolina, Arizona, Colorado, Georgia, New Jersey, and Washington.[29] In addition, cities of varying sizes across the U.S. are seeing increasing volumes of multifamily building permits and new construction.[iv]

[iii] Of course, not all MFH units are apartments. This data is representative of overall market trends. An apartment is defined as a unit occupied by renters, a vacant unit, or a rented unit not yet occupied, all located in a structure with five or more units.

[iv] Some cities have a well-established MFH stock but aren't necessarily seeing high volumes of new MFH development, while others have historically lower volumes of high-density housing but are seeing recent

Strategic MFH development in tandem with sustainable urban planning and zoning practices can bring myriad benefits to cities of all sizes, such as minimizing environmental impacts from land use, encouraging transportation modes that reduce reliance on personal vehicles, limiting vehicle miles traveled and congestion, and mitigating harmful air pollution and climate emissions. Providing more diverse housing options to people of all ages also helps reduce housing costs.[30,31]

Yet while higher-density housing options are on the rise across the U.S., one thing remains true: America is still a car-reliant country. In 2022, there were more than 278 million registered private and commercial vehicles in the U.S., and just over 91 percent of U.S. households had at least one automobile.[32] Almost 140 million people in the U.S. routinely commuted to work in 2022, and nearly 69 percent of workers drove alone to work in 2022 (with an average one-way travel time of 26 minutes).[33] For 7.3 million people nationwide, personal vehicles are a means for earning a living (e.g., app-based workers like rideshare and delivery drivers).[34]

While efforts continue to get people out of their cars and utilizing alternative modes of transportation, such as public transit, bikes, scooters, and walking, not all cities have prioritized these investments equally. Older, more established cities tend to have more robust transit systems, whereas growing cities may lack sufficient transit options.[35] Reliance on personal vehicles is likely to remain the norm in the U.S. for the foreseeable future.

This is highly problematic considering the outsized impact vehicles have on climate, public health, and equity. The U.S. transportation sector is the nation's largest source of greenhouse gas (GHG) emissions, representing 29 percent of total GHGs, and light-duty passenger vehicles are the largest contributor, at 58 percent of all transportation sources.[36] Vehicle pollution causes unhealthy air in cities across the country, regardless of size, with lower-income and frontline communities[v] experiencing disproportionate public health impacts from tailpipe emissions.[37]

Barriers to Equitable EV Adoption

While EVs are a proven solution to tackle both climate and vehicle pollution, not all people have equitable access to EVs or EV charging.

According to research from *MIT Science Policy Review*, most EV drivers are white, have higher incomes, and are homeowners with access to at-home charging.[38] Research

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increases to their MFH housing stock in response to rising populations and the need for more diverse, affordable housing options. Meanwhile, some cities have an MFH stock that is both established *and* growing. See Methodology in Appendix B for a full list of cities analyzed in this report, characterized as established MFH plus growing MFH; not established MFH plus growing MFH; or those that fall into both categories.

[v] The term "frontline communities" refers to communities of color, Indigenous peoples, and people with lower incomes who are impacted first and worst by environmental hazards and climate change and who are more likely to be at high risk for poor health outcomes in response to environmental harms due to socioeconomic, demographic, work, and health sensitivity factors.

from the Union of Concerned Scientists found that Black, Latino, and Asian drivers are just as interested in EVs as white drivers, but access to EV charging remains a critical barrier to adoption, because the clean electricity transformation is reaching communities of color far more slowly than white communities.[39]

In addition, approximately 64 percent of U.S. renters live in MFH,[40] and are much more likely than homeowners to be single, to be households of color, or to have lower incomes.[41] As of 2019, a higher percentage of non-white households were renters: 58 percent of Black households, 52 percent of Hispanic households, 43 percent of American Indian or Alaskan Native households, 39 percent of Asian households, and 28 percent of white households.[42]

Emerging research suggests a notable discrepancy in EV charging access and use patterns between people living in single-family homes and those living in MFH:

Credit: Andersen EV

- According to a 2023 Boston Consulting Group analysis of EV drivers in the U.S. (as well as Europe and China), 60 percent of drivers have access to both home and workplace charging, but most drivers prefer to charge at home when the option exists. The same study shows that less than 5 percent of EV drivers rely solely on public charging.[43]
- A 2019 International Council on Clean Transportation analysis found that 84 to 94 percent of U.S. EV drivers living in detached single-family homes had access to home charging, while less than half (from 18 to 48 percent) of those living in apartments had access to home charging.[44]
- A 2015 U.S. Department of Energy (DOE) analysis showed that at-home overnight charging accounted for 80 to 90 percent of all EV charging.[45]

While more research is needed to fully understand the disparity in EV charging access, consumer surveys reveal the importance of access to reliable, affordable, and convenient charging as a leading factor in the decision to buy or lease an EV.[46]

Put another way, many MFH residents may be dissuaded from choosing an EV over an ICE vehicle until they have access to sufficiently convenient and reliable charging options.

Although electrified transportation is on the rise in the U.S., a lag in EV charging build-out could impede progress. The “chicken-and-egg scenario” of EV adoption rates and EV charging build-out remains a challenge for both drivers and EV charging stakeholders.[47]

Research Questions and Methodology

The following questions guided this research and analysis:

1. For MFH residents without on-site charging available (i.e., those who rely solely on public charging to meet their charging needs), how do different U.S. cities compare in terms of public charging access?

2. Based on a city-level analysis, how well does the current public EV charging network serve MFH residents?

3. What policies and approaches can help increase public EV charging options, as well as on-site options, to better serve MFH residents?

This report provides a snapshot of the state of public EV charging available to serve MFH in cities with the highest established and growing MFH markets (or both). The EV charging experience for MFH residents varies considerably across the country, and there is limited public data on the amount of dedicated on-site or workplace EV charging available to serve MFH.

With our research questions guiding our approach to this analysis, we developed a new methodology, which we summarize below and describe fully in Appendix B (which also includes results from our sensitivity analyses).

We started with a list of 100 U.S. cities, selecting the top 50 cities with the highest rates of existing MFH as a share of total occupied housing, and the top 50 cities with the highest growth rates for new MFH construction in 2023 (based on building permits filed in 2023 for two or more housing units).[vi] We combined duplicates (i.e., cities that appeared on both top 50 lists are counted as one city in the final list), leaving 69 unique cities out of the original 100. We categorized the 69 cities based on their MFH housing stock characteristics:

- **Established MFH + Growing MFH *(31 results)*:** These cities have substantial existing MFH and are experiencing high rates of new MFH construction.
- **Established MFH + Not Growing MFH *(19 results)*:** These cities have substantial existing MFH but are not experiencing much new MFH construction.
- **Not Established MFH + Growing MFH *(19 results)*:** These cities have not historically had substantial MFH, relative to other housing types, but are experiencing high volumes of new MFH construction.

For each of the 69 cities, we calculated the access to public EV charging for people living in MFH, based on a formula that accounts for the number of existing MFH units in the city, the total volume of public EV chargers available within the city's boundaries, and the percentage of the city's population that drives to work. While we note that the

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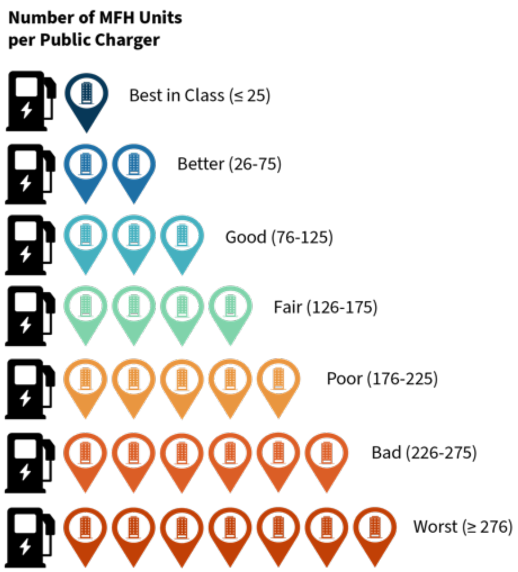
[vi] We relied solely on 2023 data and did not evaluate longer-term growth trends in new construction of MFH. However, as noted above, the U.S. has seen a major uptick in MFH construction from 2022 to 2024. Future analyses could examine longer-term growth patterns to derive more insight on MFH growth trends.

percentage of work commuters cannot be applied evenly to single-family housing and MFH units, we used this percentage as a proxy absent other data (and to account for people not reliant on a personal vehicle for primary travel needs).

Applying our formula, we ranked each of the 69 cities based on the number of MFH units per number of publicly available EV chargers (L2 and L3). Higher ranks indicate more MFH units per public charger, and thus more competition for charging for those without access to at-home charging.

We then developed a scale to assess how the cities compare with each other, based on the range of MFH units per public charger, from *best in class* to *worst* (see Figure 3).

Figure 3. Public EV charging access scale based on the number of MFH units per public charger



The rationale for this scale is somewhat subjective but intuitive. If a city has fewer MFH units per public charger, then presumably an EV driver who lives in MFH and relies solely on public charging would have less competition for that charger, which might provide greater assurance that they would be able to charge their vehicle when needed and have more options to choose from near where they live. The lower the ratio of MFH units per public charger, the more convenient and reliable public charging will be for all EV drivers. Alternatively, more MFH units per public charger will result in greater competition for charging access and less convenience, resulting in lower driver confidence as to meeting charging needs with public charging alone (and therefore, prospective EV drivers living in MFH may be deterred from swapping out their ICE vehicle for an EV).

Using our scale to gauge relative performance, cities with 25 or fewer MFH units per public charger would be considered *best in class*, whereas those with 275 or more MFH units per charger are defined as *worst*.

Although the cities are ranked against each other, they are not ranked against an established baseline number representing the optimal number of public chargers needed to support MFH EV charging needs. This was outside the scope of this research, and we did not find external research to determine what this ideal ratio might be.

The number 25 is not a magic number, but it represents a lower ratio than any of the cities evaluated. While a one-to-one MFH unit-to-public charger ratio would be ideal, that is likely unrealistic. On the other hand, a 40-to-one ratio is arguably still suboptimal for EV drivers who rely mostly or entirely on public EV charging.[vii] Thus, we selected a more modest ratio for *best in class* on the scale, with the hope it encourages all cities to continue efforts to expand a variety of public charging options.

Credit: Ivan Radic

Given that this is one of the first studies of its kind, the authors acknowledge its limitations in providing a comprehensive picture of EV charging to serve MFH, but we consider this an important starting point for discussion to inform policy actions and future research in this space. We lacked sufficient data to perform a more comprehensive EV charging gap analysis and would have preferred to incorporate into our analysis the volume of dedicated on-site charging options available to MFH buildings across the U.S.[viii]

Anecdotally, we know most existing MFH buildings lack on-site or dedicated EV charging. New buildings are more likely to have on-site EV charging, though not necessarily in numbers that match the number of MFH units in a building. As such, even if a building has a few chargers on site, residents may still need to rely on public charging. Consider a 400-unit MFH building with two or even 10 dedicated EV chargers on site. If every resident had an EV, most would still have to rely on off-site or public charging. We also note the differences in adopting EV charging for existing buildings

[vii] San Jose, the top-ranked city in this analysis, has 41 MFH units per public EV charger.

[viii] Most MFH buildings are privately owned by individuals or businesses, and there is no publicly available data source that tracks the number of EV charging installations by building (whether in existing or new-construction MFH). Similarly, third-party EV charging companies that partner with MFH properties to provide dedicated charging do not publish locations if the stations are for private resident use only or if restricted from doing so by property owners.

(many of which would require costly electric upgrades, new wiring, and possibly a distribution system upgrade from the local utility) compared with new-construction MFH (which would need to plan for EVs with make-ready wiring, panels, and spacing, adding some costs for developers). Both types of MFH housing face unique challenges not easily overcome without dedicated incentives and other supportive policies.

Regardless of whether a building is new or existing, more should be done to increase the availability of on-site or dedicated EV charging options in MFH (as noted in our policy recommendations) to optimize for reliability, affordability, and convenience. Nonetheless, public charging will remain important for EV owners residing in MFH buildings for decades to come, and policymakers should prioritize efforts to increase public charging to serve more MFH.

Results and Key Findings

Table 1 shows the 69 cities, ranked and categorized according to our scale, along with the corresponding number of MFH units per public EV charger. The map in Figure 4 shows the geographic distribution of the cities, with colors indicating where they fall on the scale and with the size of their marker indicating their rank. Note this is a screenshot of an interactive version of the map available at https://energyinnovation.org/publication/the-state-of-charge-for-multifamily-housing-assessing-the-public-ev-charging-gap-in-u-s-cities/. The complete version of Table 1 with additional city data is also available at this link.

Although an incomplete picture of the realities facing EV drivers, this snapshot provides more insight into public charging networks across diverse cities of varying sizes.

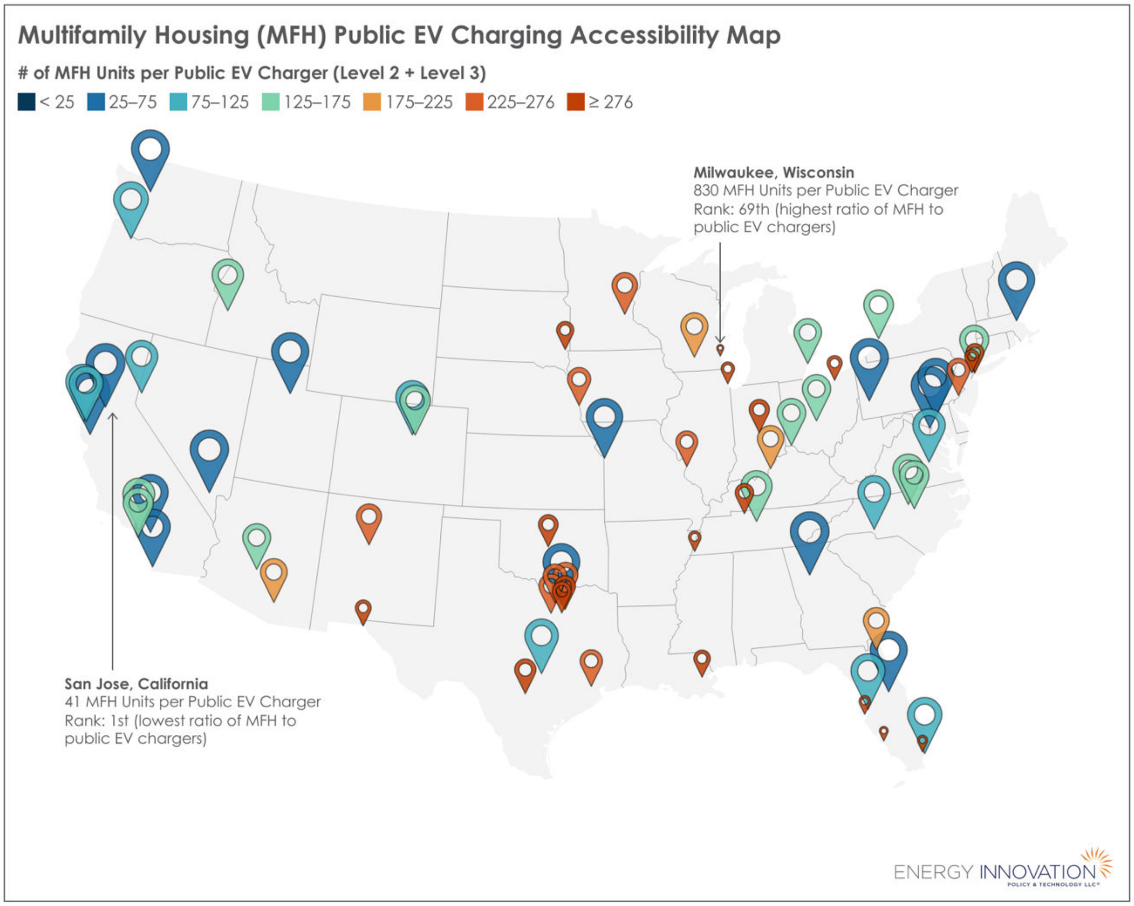
Our analysis finds that every city has room for improvement when it comes to public EV charging to serve MFH, suggesting that local and state policies should continue to prioritize more public charging infrastructure to serve MFH. Of the 69 cities in our analysis, no city ranked *best in class*. In other words, all cities—even the top performing cities—have work to do in expanding public charging options to serve all EV drivers, especially those living in MFH.

Table 1. Cities ranked according to number of MFH units per public charger

Rank	City	State	# of MFH units per public charger (L2 + L3)		Rank	City	State	# of MFH units per public charger (L2 + L3)
1	San Jose	CA	41		36	Columbus	OH	162
2	Sacramento	CA	43		37	Phoenix	AZ	166
3	Atlanta	GA	47		38	Detroit	MI	167
4	Las Vegas	NV	49		39	Madison	WI	177

5	Pittsburgh	PA	**50**		**40**	Tucson	AZ	**197**
6	Seattle	WA	**51**		**41**	Louisville	KY	**206**
7	Washington	DC	**57**		**42**	Jacksonville	FL	**211**
8	Salt Lake City	UT	**57**		**43**	Minneapolis	MN	**232**
9	Orlando	FL	**58**		**44**	Albuquerque	NM	**232**
10	Frisco	TX	**60**		**45**	McKinney	TX	**233**
11	Kansas City	MO	**62**		**46**	Fort Worth	TX	**237**
12	Boston	MA	**65**		**47**	Denton	TX	**247**
13	Baltimore	MD	**69**		**48**	Omaha	NE	**253**
14	Ontario	CA	**70**		**49**	Philadelphia	PA	**262**
15	San Diego	CA	**73**		**50**	Houston	TX	**264**
16	San Francisco	CA	**75**		**51**	St. Louis	MO	**265**
17	Portland	OR	**78**		**52**	San Antonio	TX	**286**
18	Miami	FL	**83**		**53**	Garland	TX	**324**
19	Tampa	FL	**86**		**54**	Indianapolis	IN	**327**
20	Oakland	CA	**89**		**55**	Oklahoma City	OK	**341**
21	Austin	TX	**92**		**56**	Dallas	TX	**348**
22	Denver	CO	**98**		**57**	Clarksville	TN	**389**
23	Charlotte	NC	**103**		**58**	New York	NY	**402**
24	Richmond	VA	**105**		**59**	Sioux Falls	SD	**410**
25	Reno	NV	**123**		**60**	New Orleans	LA	**438**
26	Los Angeles	CA	**126**		**61**	El Paso	TX	**444**
27	Boise	ID	**132**		**62**	Cleveland	OH	**456**
28	Nashville	TN	**133**		**63**	Newark	NJ	**483**
29	Durham	NC	**139**		**64**	Chicago	IL	**486**
30	Aurora	CO	**140**		**65**	Memphis	TN	**594**
31	Long Beach	CA	**144**		**66**	St. Petersburg	FL	**622**
32	Buffalo	NY	**146**		**67**	Hialeah	FL	**632**
33	Raleigh	NC	**146**		**68**	Cape Coral	FL	**734**
34	Jersey City	NJ	**152**		**69**	Milwaukee	WI	**830**
35	Cincinnati	OH	**152**					

Figure 4.



To view the interactive map online and see more city statistics, please visit: https://energyinnovation.org/publication/the-state-of-charge-for-multifamily-housing-assessing-the-public-ev-charging-gap-in-u-s-cities/

Source: U.S. Census Bureau, U.S. Department of Energy

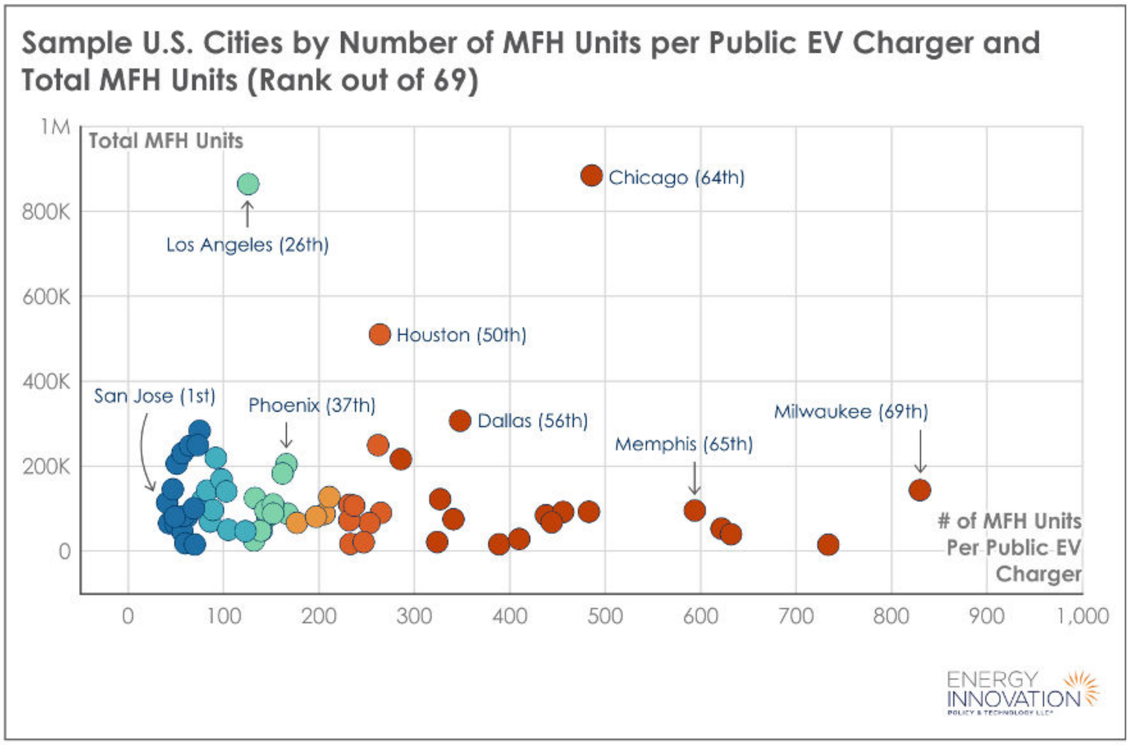
We find a higher concentration of *better* and *good* ranks in cities on the West Coast and in the Mountain West region (with San Jose earning the top rank among the cities analyzed), as well as in Northeastern and Southeastern states. The Upper Midwest and Texas have the highest concentrations of cities with *bad* and *worst* rankings.

Cities ranked *bad* and *worst* should be doing much more to expand equitable EV charging options. In some cases, however, there may be a perceived or actual chicken-and-egg scenario in which EV adoption rates lag, thus not attracting public or private investments in charging infrastructure, or there may be other market barriers to installing public EV charging.[ix]

[ix] We did not evaluate each city to determine all factors relevant to influencing its rank, and each city is unique in terms of its building stock and EV infrastructure, as well applicable state policies influencing the EV market.

Figure 5 shows the distribution of the 69 cities by number of MFH units per public EV charger (x-axis) and total number of existing MFH units (y-axis), with sample cities provided for reference. There does not appear to be a strong correlation between the size of a city's MFH stock and the ratio of public charging available to serve MFH, suggesting that state and local policies have an outsized influence on the prioritization and deployment of equitable EV charging infrastructure.

Figure 5.



New York City does not appear on this chart because it is off the scale with over 3 million MFH units. The city ranks 58th out of 69, with 402 MFH units per public EV charger. Visit https://energyinnovation.org/publication/the-state-of-charge-for-multifamily-housing-assessing-the-public-ev-charging-gap-in-u-s-cities/ for the interactive version of this graph.

Regardless of a city's size[x] or whether it has an established or growing MFH market, the common theme is that most currently lack sufficient public EV infrastructure to support MFH residents.

Some additional insights emerged from our analysis:

Insights from the top 25 cities

- Of the top 25 cities, six (San Jose, Sacramento, Ontario, San Diego, San Francisco, and Oakland) are in California—a leading state for EV adoption and proactive EV

[x]Of the cities ranked in our analysis, the smallest according to population was Denton, Texas, at just over 150,000 people, and the largest was New York City, with just over 8.3 million people.

and charging policies. California also had the highest number of light-duty EV registrations by state in Q4 2023 (at just over 1.17 million EVs[xi]).[48]

  - San Jose is the top city for public charging available to serve MFH residents, according to our analysis. Perhaps not coincidentally, San Jose also was the top city for low-carbon transport, according to the 2024 US Transportation Climate Impact Index by Streetlight Data, based on vehicle miles traveled, EV penetration, fuel economy, and truck mileage.[49]

- Florida is a leading state for MFH growth and had the second-highest number of light-duty EV registrations by state in Q4 2023 (231,518).[50] But Florida also has an equal number of cities ranked *better* or *good* (Orlando, Miami, and Tampa) and *worst* (Cape Coral, Hialeah, and St. Petersburg), suggesting that local government policies likely have an outsized impact on equitable public charging deployment in the state.
- Seattle ranks sixth and has a high volume of existing MFH and considerable new MFH, as well as a relatively high volume of new EV registrations (141,055 in Q4 2023).[51] The city's efforts to accommodate more EV drivers with more public charging are starting to pay off. Seattle City Light recently rolled out 25 curbside L2 EV charging stations across the metro area, with the capacity to charge 58 cars simultaneously.[52]
- Salt Lake City (ranked eighth overall) has a lower population (just over 204,000) relative to the largest cities in the analysis, but it is experiencing rapid growth and high MFH growth to meet housing needs. To support MFH access to charging, the city has adopted parking ordinances requiring a minimum of 20 percent EV-ready parking spaces installed on site at new or remodeled MFH structures.[53] More may be needed, however, to ensure public EV charging expands as the MFH stock grows apace.
- Seven of the top 25 cities have a majority white population, and 18 are majority non-white.
- Seventeen have poverty rates higher than the U.S. average (which is 11.5 percent, according to 2022 U.S. Census data), ranging from around 12 percent (Reno, Nevada) to nearly 22 percent (Richmond).

Insights from the bottom 25 cities

- The worst cities for public charging access for those living in MFH (Milwaukee, Cape Coral, Hialeah, St. Petersburg, and Memphis) have more than 500 units of MFH for every public charger available. As noted above, Florida has the second-strongest EV market in the country, whereas Wisconsin and Tennessee have relatively low EV penetration, with EVs making up only 0.5 percent of all registered vehicles in 2022.[54]

[xi] California also has the highest number of vehicles nationwide, with approximately 36 percent of registered light-duty vehicles.

- Texas is a leading state for MFH growth and had the third-highest EV registrations in Q4 2023 (210,433),[55] but the state has eight cities in the bottom 25, suggesting that both local and state policies should evolve to support EV drivers and those living in MFH.
- Chicago and New York City have high volumes of established MFH and are seeing new MFH growth as well. While these large metro areas have robust public transportation options, they still have relatively high rates of commuting by car: 22 percent of people in New York City and 45 percent of people in Chicago still drive to work. Even though New York City has almost 1,600 public chargers, there is only one public charger available for every 402 units of MFH, while Chicago has one public charger available for every 486 units of MFH. Both cities would benefit from efforts to build more curbside public EV charging and require new MFH to build sufficient EV charging infrastructure to meet future demand.
- Nine have a majority white population, and 16 have a majority non-white (or people of color) population.
- Twenty-two have higher-than-average poverty rates, ranging from 12 percent (Fort Worth, Texas) to nearly 32 percent (Cleveland).

Air pollution and GHG emissions

- Among the 69 cities analyzed, nearly half (33) are located within designated national non-attainment areas for 8-hour ozone or PM2.5—meaning their air pollution levels exceed scientifically based standards for public health, according to the EPA.
    - Twelve cities that were ranked *better* or *good* and 15 that were ranked *bad* or *worst* for public EV charging were in designated non-attainment areas. Although other non-transportation sources of emissions contribute to air pollution, the ICE vehicle's predominance across American cities of all sizes remains a leading contributor to air pollution.[56]
- St. Louis had the highest per-person transportation-related GHG emissions (at 6,469 kg CO_2/km^2/year), followed by Louisville, Kentucky (at 6,352), Nashville, Tennessee (at 6,300), Memphis, Tennessee (at 6,118), and Richmond, Virginia (at 6,059). These emissions are nearly double that of the cities with the lowest per-person transportation-related GHG emissions (New York City, Newark, Jersey City, and San Jose), which all had less than 3,100 kg CO_2/km^2/year (likely due to higher usage rates of non-vehicle modes of transportation, such as public transit, biking, and walking).
- Notably, 10 Texas cities had average transportation GHG emissions per person of around 5,700 kg CO_2/km^2/year, indicating that Texas has an outsized climate emissions problem from the transportation sector relative to other states.

POLICY RECOMMENDATIONS AND EXAMPLES

The following recommendations are actions state and local policymakers can take to ensure equitable EV charging does not remain an afterthought in the context of other decisions relating to housing, affordability, transportation, zoning and planning, infrastructure, air quality, and climate.

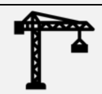
Local governments and states have near- and long-term opportunities and obligations to expand EV charging access for all EV drivers, including those living in MFH. Cities with a lot of new MFH growth should prioritize policies targeting new construction to ensure new buildings can accommodate future EV demand. Cities with established MFH should explore creative approaches to expand curbside, streetlight, and other public charging located in parking areas near where people live. For cities with a mix of new and established MFH, prioritizing expanded EV charging alongside smart growth policies will ensure all MFH residents can benefit from more EV charging options.

Fortunately, there are more incentives and resources available than ever before to help cities, states, and multifamily building stakeholders install more EV charging to serve people living in MFH.[xii]

The characteristics of MFH make charging solutions inherently more complex than for single-family housing. For example, there are multiple stakeholders and potential decision-makers (such as residents, property owners and managers, homeowners' associations, and other tenants); financial considerations (such as who pays, who benefits, and how costs are allocated); and owner/tenant dynamics that can limit options. Existing buildings face higher obstacles compared to installing charging in new buildings at the time of construction. Contributing factors include the age of the building, the applicable building codes and requirements for upgrades, and the state of the internal

POLICY KEY

For each recommendation, we provide the following icons to indicate the type of charging and type of MFH building the action would apply to:

	Public charging
	On-site charging
	Existing MFH
	New MFH construction

[xii] See the DOE's list of relevant EV charging incentives and funding opportunities: https://afdc.energy.gov/laws

electric infrastructure and grid infrastructure. State and local policymakers should involve all interested stakeholders and community leaders in the development of solutions that overcome real-world barriers and rely on available data to deploy strategic charging where gaps exist.

The following policy recommendations and examples, though not exhaustive, offer leading solutions to support more EV charging to serve MFH. The icons indicate which recommendations apply to local or state governments, new construction or existing housing, and on-site charging or public charging.

- **States and local governments should adopt and enforce EV-ready building codes.** New construction and major renovations are subject to building codes, which vary by state and by city (though most places have adopted some version of the International Code Council's codes). Building codes set minimum standards, making them an important tool to ensure EV charging access is integrated into design and infrastructure (such as the capacity of the electrical panel, conduit, circuitry, and trenching to and from parking areas).[57] Codes are especially important given recent growth trends in new MFH construction. States and local governments can adopt building codes for MFH that require buildings to be EV capable or EV ready, or to have EV charging installed.[58]

  Examples:

  - The Illinois Electric Vehicle Charging Act requires all new properties (and major renovations) to be EV capable beginning in 2024, and multiunit buildings must have at least one EV-capable parking space for each residential unit that has dedicated parking.[59]
  - The city of Indianapolis requires two EV charging stations for developments that provide 500 or more off-street parking spaces.[60]
  - Four cities in the U.S. have adopted building codes that provide for EV charging capability at 100 percent of parking spaces in new MFH developments. All of these cities—San Jose, San Francisco, Oakland, and Denver—rank within the top 25 cities in our analysis. Each city varies in its breakdown of requirements for EV-capable buildings, EV-ready buildings, and number of EV charging installations.[61]

- **States, local governments, and utilities should leverage federal funding and incentivize EV charging infrastructure for MFH and other underserved areas.** Direct incentives for charging infrastructure can help MFH stakeholders overcome the costs of electric retrofits or the incremental cost of EV-ready requirements in new buildings. In addition to adopting state and utility-funded incentives, states and local governments should take advantage of available federal funding from the U.S. Department of Transportation's Community

Charging and Alternative Fueling Grants (part of the Infrastructure Investment and Jobs Act) to help fill EV charging gaps in underserved communities, rural areas, low- and moderate-income neighborhoods, and places with high volumes of MFH.

Examples:

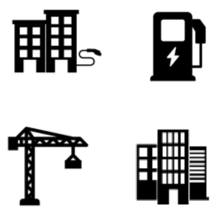
- The Massachusetts Department of Environmental Protection's MassEVIP Multi-Unit Dwelling & Educational Campus Charging is one of several rolling grant programs aimed at making EV charging stations more widely available across Massachusetts. The program provides an incentive (60 percent of the hardware and installation costs to a maximum of $50,000 per street address) for property owners or managers to acquire and install L1 and L2 EV charging stations for MFH with five or more residential units.[62]
- The first round of Community Charging awards distributed nearly $623 million across 22 states, and the second round distributed $521 million to 29 states, eight tribal governments, and the District of Columbia (including numerous cities covered in this analysis). The latest round of funding will facilitate the installation of more than 9,200 EV charging ports to fill charging gaps. Notable examples include:
    - New York City ($15 million) aims to create the largest curbside L2 charging program in the country with 700 plugs, located in disadvantaged areas throughout the city.
    - The City of Chicago ($15 million) will install EV charging across city-owned locations that serve disadvantaged communities, have a high percentage of MFH, and lack public EV charging within a mile.
    - The City of Milwaukee ($15 million) will install EV chargers at 53 sites citywide, prioritizing areas that lack existing EV infrastructure, low- to moderate-income communities, and places with high ratios of MFH.[63]

- **Local governments should adopt EV-ready parking and zoning ordinances.** Parking ordinances can facilitate EV charging accessibility through design, location, capacity, and parking times. Zoning ordinances can also require EV charging stations within certain zones or incentivize EV readiness.[64] Ordinances may also stipulate EV charging stations as a permitted land use, designate required standards, establish signage requirements, and institute other protections.[65] Local governments should encourage coordination among the numerous entities that may be tasked with enforcing parking ordinances, including transportation, law enforcement, permitting, and parking lot owners and managers.

Examples:

- In 2023, Salt Lake City adopted an EV-readiness update to its parking ordinance to better serve MFH residents by requiring a minimum of 20 percent EV-ready parking spaces on-site.[66]
- A study from StreetLight and Siemens identified five zones outside of San Jose where vehicle trips under 30 miles on average would benefit from more EV chargers, using metrics including the percentage of work- and home-based car trips, the number of public chargers available, and the population of the metro area.[67]

- **States and utilities should adopt clear, streamlined EV charging interconnection rules that account for charging management technologies and programs.** Efficiently deploying EV charging infrastructure will require improvements to the policies and practices that determine how charging equipment is connected to the electric grid. These processes are governed by interconnection rules, which are typically adopted by electric utilities, with oversight and direction from state legislators and utility regulators (depending on the state and the type of utility). According to the Interstate Renewable Energy Council (IREC), a national interconnection expert, delays at different stages of the process currently create uncertainty for project developers and slow down the transition to electrified transportation.[68] States and local governments seeking to expand EV charging infrastructure should engage with their electric utilities and regulators to determine whether current processes are sufficiently clear, transparent, and efficient to accommodate increasing volumes of EV charging interconnection requests. In developing interconnection rules, stakeholders should account for the availability of software-based energy management systems, managed charging, time-of-use rates, and demand-side management that can address potential grid impacts of EV charging and reduce the overall cost to interconnect to the grid.



Examples:

- The California Public Utilities Commission adopted a resolution to establish clearer timeframes for the EV charging infrastructure interconnection process, requiring utilities to propose the average number of business days it should reasonably take them to process an EV charger application (from initial service request to site energization) and to recommend internal suggestions to improve energization timelines, based on stakeholder input.[69]
- A real estate property developer in Los Angeles, the Onni Group, has partnered with EV charging technology solutions providers CapEV and SWTCH to install 200 chargers across 35 multitenant residential and commercial properties. The charging solutions ensure on-site charging operates within any capacity constraints of the existing grid infrastructure,

while also optimizing charging to align with time-of-use utility rates that offer lower electricity rates during off-peak periods. [70]

Tools:

- IREC's guide informs emerging best practices for EV charging interconnection.[71]
- Electric Power Research Institute's eRoadMAP is a publicly accessible, online tool for understanding where, when, and how much EV charging load is likely to materialize on the U.S. electric grid.[72]
- NREL's EVI-X Toolbox estimates the charging infrastructure necessary to support daily travel in each state or city and determines how EV charging will impact electricity demand.[73]

- **States and local governments should encourage curbside and streetlight-mounted EV chargers for MFH residents who lack home charging and use on-street parking.** Stand-alone curbside chargers can be installed on the side of a road or sidewalk, while streetlight-mounted chargers are attached to an existing streetlight or other type of pole. Other private-venture pilots are introducing newer technologies, such as larger charging "trees," capable of providing curbside DCFCs in large cities to expedite charging in public parking spaces.[74] Meanwhile, BYOC charging stations can obviate the need for more expensive and intrusive infrastructure by instead relying on drivers to provide their own cables to charge at strategic curbside parking locations.[75] Relatively novel, several of these charging pilot projects are supported by the DOE's Vehicle Technologies Office,[76] but policymakers could consider leveraging funding from the $27 billion Greenhouse Gas Reduction Fund, created under the IRA, to support dedicated MFH charging infrastructure, especially in underserved communities.[77]

Examples:

- Kansas City, Missouri, began a pilot program in 2021 to install L2 chargers mounted on city streetlights, partnering with the local utility company in a 10-year agreement to provide power to these chargers. [78]
- The City of Melrose, Massachusetts, partnered with the electric utility National Grid to install 16 chargers on utility distribution poles to provide public EV charging in a community that has many EV drivers without access to home charging.[79] The chargers are owned by the city, leveraging electricity on the poles, and reduce installation costs by up to 70 percent. This installation by National Grid is the first deployment of elevated, pole-mounted EV chargers by an investor-owned utility in the U.S.

- **States should enact right-to-charge laws.** These policies prevent building owners, landlords, or homeowners' associations from restricting EV charging access in MFH buildings (whether new or existing). In these policies' strongest form, property managers are required to install dedicated EV charging if requested by residents, though in some cases tenants must pay for any costs associated with installing EV. Currently, 12 states have variations of right-to-charge laws that require property managers to install dedicated EV charging if requested by residents: California, Colorado, Connecticut, Florida, Hawaii, Illinois, New Jersey, New York, Oregon, Utah, Virginia, and Washington.[80]

  Examples:

  - California's law ensures that renters or owners who lack a designated parking spot to add EV charging will have access to shared parking spaces to install EV charging stations.[81]
  - Colorado requires common interest communities to allow EV charging, rather than create artificial restrictions, and offers an EV grant fund to help fund the installation of charging stations on common property as an amenity for residents and guests.[82]

- **States should allow and support competitive markets for third-party charging providers and third-party financing.** States should increase access to EV charging, while also promoting competition in the market, by explicitly allowing third-party EV charging providers and financiers, while also ensuring appropriate consumer protections and affordability for EV drivers.[83] Most states have exempted privately owned or third-party charging providers from being defined as public utilities, ensuring greater competition in the market and allowing private-sector providers to set electricity prices. State legislators or utility regulators should proactively define who can participate in the EV charging market, under what conditions.[84] States should also encourage third-party financing, whether through a bank or other private entity, to support charging infrastructure, including for underserved communities.

  Examples:

  - Wisconsin's Act 121 (2023) provided needed clarity to the EV industry in Wisconsin, which will also help the state capture nearly $80 million in federal funding to deploy EV charging infrastructure, by clarifying which entities can sell electricity through EV chargers while avoiding classification as a public utility. Act 121 creates a new exemption from regulation as a public utility for persons or entities that provide electricity through any level of EV charging station, provided that the charging station requires a fee based on the amount of kilowatt-hours the user consumes. Act 121 also requires that all electricity supplied at the EV charging station be supplied by the local electric utility or cooperative.[85]

   - Amperage Capital's model offers a novel third-party financing approach for MFH building owners and tenants by leasing dedicated parking spots from MFH properties, fronting the cost of the EV charging infrastructure and leasing spots to EV-driving tenants for a monthly fee.[86]

EQUITABLE ACCESS TO EV CHARGING AND ALTERNATIVE TRANSPORTATION

The World Resources Institute has identified the following recommendations to increase EV charging for underserved communities and support more equitable access to EV charging:

- Engage communities to inform transportation needs and identify optimal charger locations
- Prioritize public charging infrastructure in charging deserts near MFH
- Expand curbside charging in areas where people rely heavily on street parking
- Increase clarity and transparency around pricing and costs
- Provide incentives and charging for other forms of e-mobility, such as electric bikes, scooters, and electric buses, as well as dedicated charging for electric rideshare drivers, to encourage alternatives to personal vehicles

Alongside efforts to expand public EV charging and enable more on-site charging in MFH buildings, state and local policymakers should promote equitable transportation options that increase mobility, reduce vehicle usage, and reduce overall emissions, such as:

- Public transportation systems
- Dedicated safe and convenient walking and biking paths
- E-bikes and e-scooters with safe and convenient pickup and drop-off stations throughout metro areas, including near public transit
- Incentives for affordable carpooling and ridesharing

The Greenlining Institute's Mobility Equity Framework guide offers a framework to help decision-makers adopt transportation systems and enhance economic opportunity in low-income communities of color. Start by identifying mobility needs, conducting a mobility analysis (based on 12 equity indicators), and giving decision-making to the local community.

- Equity indicators: affordability, accessibility, efficiency, reliability, safety, clean air, positive health benefits, reduction in GHGs and in vehicle miles traveled, and connectivity to places of employment, education, services, and recreation.

For more information, visit

- https://www.wri.org/insights/electric-vehicle-charging-station-access
- https://greenlining.org/publications/mobility-equity-framework-how-to-make-transportation-work-for-people/

CONCLUSION

While favorable policies and improving economics are enabling the transportation electrification transformation, sustained EV growth depends on a commensurate increase in reliable, affordable, and convenient EV charging to serve all people, regardless of where they live.

The findings from this research indicate that cities of all sizes (and states) should do more to address the existing charging gap for MFH residents. Charging infrastructure limitations and inequitable access are likely preventing drivers living in MFH from switching to clean, electric vehicles, which has implications for equity, air quality, and climate. EV charging stakeholders, whether private or public, should engage MFH residents, building owners and managers, and other community members to develop comprehensive EV charging plans to fill identified gaps and needs.

Policymakers should maintain a laser focus on deploying equitable public charging infrastructure, while also adopting proactive policies to ensure that new MFH construction includes ample on-site charging. State and local governments should evaluate how existing codes, ordinances, and requirements may be supporting or hindering equitable EV charging infrastructure and adopt more favorable policies. Utilities and regulators should prioritize the adoption and enforcement of streamlined EV charging interconnection processes that minimize costs. While the policy recommendations in this report offer a starting point, they are not exhaustive. The EV charging space is ripe for more innovation and creative solutions that target real-world barriers.

Future research could explore whether there is an optimal ratio of MFH units to available chargers (on-site, off-site, or public charging), and what more is needed to reduce the time and expense of EV charging. Additional efforts to develop a publicly available database on private and on-site MFH charging networks would contribute to more informed discussions on EV infrastructure needs. And the field would benefit from more engagement with MFH stakeholders to inform additional policies and incentives to move the dial.

As we approach the midpoint of this defining decade for climate action, and as the EV market moves beyond the early-adopter stage into the mainstream, the U.S. needs to double down on the infrastructure needed to scale clean, reliable, and affordable transportation options. Further, as more cities and states take the initiative to expand consumer choice and develop convenient charging options, they will reap the benefits of cleaner air, improved public health, and reduced climate emissions. But realizing such a future requires both hands on the wheel and eyes on the road ahead.

Appendix A - Considerations for Multifamily Building Stakeholders

While policy plays an important role in expanding EV charging infrastructure, the people who own, manage, and live in MFH are key decision-makers who should be engaged and involved in implementing the solutions. We offer the following recommendations and considerations for building owners, managers, and residents navigating efforts to increase EV charging access.

Building owners and managers

For those wanting to provide EV charging at their properties, there are several factors to consider before deciding the best approach. For example:

- Evaluate the demand for EV chargers based on current and projected EV driver occupancy in the building. Conducting a survey of residents at the outset can gauge residents' demand for EV chargers and assess their willingness/ability to pay for potential building upgrades that may be required.
- Contact an electrical contractor and the local utility to understand the various charging options; determine electric requirements, wiring needs, and trenching requirements; and identify optimal locations.
- Understand how EV charging fits within existing or planned parking arrangements (e.g., assigned parking, common area parking, or deeded parking) and how that may impact cost allocation.
- Evaluate the type of charger that can be installed to support residential charging needs, including charging access for electric bicycles.
- Consider contracting with third-party companies to either install and operate EV charging on the property or to provide dedicated off-site EV charging near the property. For example, ChargePoint provides EV charging for assigned or common area parking spaces in multifamily buildings. Under this arrangement, the owners and managers pay the fee (and potentially divide that among the residents), and ChargePoint handles the installation and electricity charges.[87]
- Explore funding and incentives, as well as financing options, to cover the cost of the charging infrastructure. Leverage multiple sources of funding, such as government grants, utility investments, third-party funding or financing, and resident fees.

Multifamily residents

For MFH residents, whether you are a renter or an owner, consider the following as you explore EV charging options:

- If you hope to have an EV charger installed at your building, research the costs of installing an EV charger on site and present the information to the building manager or owner.

- Conduct a survey in your building to determine how many chargers and what types would be necessary to serve current and future residents.
- If on-site charging is not an option, consider developing a shared map of nearby charging locations. Explore third-party partnerships, including having your multifamily property selected as a public charging station site.
- If your state does not have legislation to support EV charger installation, educate your elected officials on the importance of MFH EV charging access and right-to-charge laws. Contact local nonprofit organizations to determine what efforts might already be underway.
- For a more specific step-by-step process, refer to existing guides:
    - Drive Electric Chicago: https://www.chicago.gov/content/dam/city/progs/env/CACCEVResident.pdf
    - California Plug-in Electric Vehicle Collaborative: https://www.veloz.org/wp-content/uploads/2017/08/MUD_Guidelines4web.pdf

Multifamily housing data by U.S. city

We derived the list of cities for this analysis from two datasets:

1. We used the U.S. Census 2022 American Community Survey (ACS) 5-Year Estimates to determine the top 50 U.S. cities with the highest volume of existing MFH units, aka *Established MFH* markets. We eliminated single-family (detached), single-family (attached), mobile homes, and boat/RV/van from the total occupied housing dataset. See Table B-1.
2. We used the U.S. Census Building Permits Survey to determine the top 50 U.S. cities for new MFH (i.e., buildings permitted for construction), aka *Growing MFH* markets. We relied on the number of annual building permits pulled in 2023 for MFH (two units or more) in each U.S. Census core-based statistical area. See Table B-2.

Table B-1. Top 50 U.S. cities for existing MFH, total MFH (established MFH market)

Rank	City	State	# of 2-Unit+ MFH Units	Rank	City	State	# of 2-Unit+ MFH Units
1	New York	NY	3,022,008	**26**	Jersey City	NJ	110,672
2	Chicago	IL	884,545	**27**	Minneapolis	MN	109,584
3	Los Angeles	CA	864,429	**28**	Fort Worth	TX	107,717
4	Houston	TX	510,471	**29**	Baltimore	MD	101,390
5	Dallas	TX	307,413	**30**	Oakland	CA	97,495
6	San Francisco	CA	283,696	**31**	Long Beach	CA	96,959
7	San Diego	CA	250,002	**32**	Memphis	TN	96,191
8	Philadelphia	PA	249,895	**33**	Newark	NJ	93,377
9	Boston	MA	248,266	**34**	Cleveland	OH	92,846
10	Washington	DC	231,251	**35**	St. Louis	MO	90,658
11	Austin	TX	220,087	**36**	Cincinnati	OH	89,173
12	San Antonio	TX	216,970	**37**	Detroit	MI	88,984
13	Seattle	WA	206,243	**38**	Louisville	KY	88,138
14	Phoenix	AZ	205,155	**39**	Raleigh	NC	85,717
15	Columbus	OH	183,328	**40**	New Orleans	LA	84,993
16	Denver	CO	169,288	**41**	Orlando	FL	83,098

17	Atlanta	GA	146,290	**42**	Kansas City	MO	82,014
18	Milwaukee	WI	144,223	**43**	Las Vegas	NV	81,651
19	Miami	FL	143,239	**44**	Tucson	AZ	81,590
20	Charlotte	NC	141,267	**45**	Buffalo	NY	81,468
21	Jacksonville	FL	127,872	**46**	Oklahoma City	OK	75,724
22	Nashville	TN	125,496	**47**	Albuquerque	NM	73,069
23	Indianapolis	IN	122,858	**48**	Tampa	FL	70,201
24	Portland	OR	120,960	**49**	El Paso	TX	68,525
25	San Jose	CA	114,615	**50**	Madison	WI	67,082

Source: U.S. Census 2022 American Community Survey

Table B-2. Top 50 U.S. cities for new MFH (growing MFH market)

Rank	City	State	# of 2-Unit+ Building Permits (2023)	Rank	City	State	# of 2-Unit+ Building Permits (2023)
1	New York	NY	31,733	**26**	Frisco	TX	2,364
2	Austin	TX	11,885	**27**	Madison	WI	2,288
3	Phoenix	AZ	10,268	**28**	Pittsburgh	PA	2,283
4	Los Angeles	CA	10,236	**29**	Aurora	CO	2,213
5	Houston	TX	9,821	**30**	Portland	OR	2,212
6	Nashville	TN	8,052	**31**	Ontario	CA	2,195
7	Charlotte	NC	7,529	**32**	Jersey City	NJ	2,188
8	Atlanta	GA	6,482	**33**	Reno	NV	2,176
9	Jacksonville	FL	5,485	**34**	San Jose	CA	2,069
10	Miami	FL	5,307	**35**	Sioux Falls	SD	1,986
11	San Diego	CA	5,249	**36**	Denton	TX	1,981
12	San Antonio	TX	4,860	**37**	Cape Coral	FL	1,972
13	Seattle	WA	4,826	**38**	Boston	MA	1,943
14	Raleigh	NC	4,626	**39**	Richmond	VA	1,896
15	Denver	CO	4,551	**40**	Sacramento	CA	1,864
16	Dallas	TX	4,429	**41**	St. Petersburg	FL	1,781
17	Columbus	OH	4,340	**42**	Omaha	NE	1,756

18	Philadelphia	PA	3,458	**43**	Baltimore	MD	1,751
19	Fort Worth	TX	3,429	**44**	Indianapolis	IN	1,517
20	Chicago	IL	3,326	**45**	Orlando	FL	1,514
21	Salt Lake City	UT	2,929	**46**	Garland	TX	1,491
22	Washington	DC	2,854	**47**	Minneapolis	MN	1,458
23	Durham	NC	2,678	**48**	Clarksville	TN	1,455
24	McKinney	TX	2,552	**49**	Boise	ID	1,450
25	Tampa	FL	2,415	**50**	Hialeah	FL	1,439

Source: U.S. Census Building Permits Survey

We combined the two top 50 lists and removed duplicates (i.e., cities that were on both top 50 lists), which left 69 unique cities. We then categorized the 69 cities into three groups, as shown in Table B-3 (listed alphabetically by city):

- **Established MFH + Growing MFH *(31 results)*:** These cities were in both top 50 lists. They have a large established MFH market and are experiencing substantial new MFH construction.
- **Established MFH + Not Growing MFH *(19 results)*:** These cities were in the top 50 established MFH list, but not in the top 50 growing MFH list. These cities have substantial existing MFH but are not experiencing substantial new MFH construction.
- **Not Established MFH + Growing MFH *(19 results)*:** These cities were in the top 50 growing MFH list, but not in the top 50 established MFH list. These cities have not historically had a large volume of MFH but are experiencing high volumes of new MFH construction.

Table B-3. U.S. cities categorized according to type of MFH market (listed alphabetically by city)

Established MFH + Growing MFH	Established MFH + Not Growing MFH	Not Established MFH + Growing MFH
Atlanta, GA	Albuquerque, NM	Aurora, CO
Austin, TX	Buffalo, NY	Boise, ID
Baltimore, MD	Cincinnati, OH	Cape Coral, FL
Boston, MA	Cleveland, OH	Clarksville, TN
Charlotte, NC	Detroit, MI	Denton, TX
Chicago, IL	El Paso, TX	Durham, NC
Columbus, OH	Kansas City, MO	Frisco, TX
Dallas, TX	Las Vegas, NV	Garland, TX

Denver, CO	Long Beach, CA	Hialeah, FL
Fort Worth, TX	Louisville, KY	McKinney, TX
Houston, TX	Memphis, TN	Omaha, NE
Indianapolis, IN	Milwaukee, WI	Ontario, CA
Jacksonville, FL	New Orleans, LA	Pittsburgh, PA
Jersey City, NJ	Newark, NJ	Reno, NV
Los Angeles, CA	Oakland, CA	Richmond, VA
Madison, WI	Oklahoma City, OK	Sacramento, CA
Miami, FL	San Francisco, CA	Salt Lake City, UT
Minneapolis, MN	St. Louis, MO	Sioux Falls, SD
Nashville, TN	Tucson, AZ	St. Petersburg, FL
New York, NY		
Orlando, FL		
Philadelphia, PA		
Phoenix, AZ		
Portland, OR		
Raleigh, NC		
San Antonio, TX		
San Diego, CA		
San Jose, CA		
Seattle, WA		
Tampa, FL		
Washington, DC		

Public EV charging data

We relied on the DOE's Alternative Fuels Data Center for public EV charging data, which was pulled on May 24, 2024, and for each city in the list above we summed the publicly available L2 and L3 chargers. We assumed that people living in MFH would rely more on public chargers for their EV charging needs than people living in single-family housing, who may be more able to access at-home charging. We did not consider workplace chargers in this analysis, due to the lack of data and uncertainties around correlating workplace and housing. The boundaries for EV locations are defined by the DOE, and they encompass only the area within city limits (i.e., no suburbs or surrounding metropolitan areas).

In addition, we counted both L2 and L3 chargers because we assume that people driving an EV will take advantage of both types of chargers. We assumed people living in MFH who drive EVs would not be completely reliant on L3 charging, even though it offers a faster charge compared to L2. Charging needs vary by use case.

Travel trends and multifamily housing EV charging access

The U.S. Census Bureau's ACS 1-Year data tracks the travel trends for U.S. Census tract populations, including their mode of travel to work. For each city, we used the reported "Drove to Work" data to determine the percentage of a city's population that would likely rely on a personal vehicle to travel to work daily ("Car-to-Work"). We apply this Car-to-Work percentage in the multi-family housing public EV charging accessibility formula (see below). Of note, we did not use data from the "Carpooled" category in the U.S. Census data, due to the higher margin of error when attempting to attribute it to individual or household travel trends.

We acknowledge that people choosing to live in MFH, regardless of which city they live in, may not own a car for myriad reasons. Even if they own a car, they may opt to take public transit, walk, bike, or carpool to work or to run errands. However, in this analysis we do not account for these considerations.

For MFH residents, the option to own or drive an EV is far more limited than for single-family housing residents due to the increased reliance on public or workplace charging. For those reliant on or choosing to travel using a personal vehicle, the opportunity to adopt a cleaner, electrified vehicle in the future will likely depend on their access to EV charging, which we calculate below.

Multifamily housing public EV charging accessibility formula

We applied the following formula to assess the relative access to public EV charging for people living in a multifamily unit for each of the 69 unique cities. The number derived from the formula is a ratio of the number of MFH units per public charger:

Multifamily Housing Access to Public EV Charging =

*(Car-to-Work % * Total Existing MFH Units in Each City) /*

(Level 2 Chargers + Level 3 Chargers)

For each city, we multiply the percentage of Car-to-Work population by the Total Existing MFH units to determine the approximate number of MFH units with residents who are likely to drive a vehicle to work. While we note that the Car-to-Work percentage cannot be applied evenly to single-family housing and MFH units, we relied on this as a proxy based on available data.

We then divide that number of units by the total number of publicly available L2 and L3 EV chargers to arrive at the number of MFH housing units per charger. (See sensitivity analysis section below for different charging assumptions.)

We ranked the list of 69 cities (1 through 69) based on the ratio of MFH units per public EV charger. The lower rankings signify that people living in MFH would have more public chargers available to use (meaning less competition for charging access and more readily available public charging in the city). The higher rankings reflect places where MFH residents would have a much harder time relying on publicly available EV chargers for their charging needs, which could be a deterrent to their purchasing an EV in the future.

From the rankings, we then applied a color-coded scale to designate all the cities according to their public charging access, designating the top cities as better and best, and the bottom cities as bad and worst. Cities in the middle are designated as fair or poor. Of note, we did not account for the number of new MFH building permits in the calculations above to determine the ratio for each city. Although most permits will translate into new buildings and MFH units, we opted to compare the number of existing MFH units with the number of existing public EV chargers to provide more of an apples-to-apples comparison.

However, we did run a sensitivity analysis to determine if the addition of new MFH permits would impact the ranking of the cities. Using the formula listed above, we added the number of MFH permits per city to the number of existing MFH units in that city and divided that total by the total number of L2 and L3 public chargers. Across all 69 cities, the new calculation resulted in a nominal (+/- 5) adjustment to the number of MFH units per charger in each city, and no notable changes in rank.

In addition, we acknowledge that many public chargers and MFH buildings are slated for construction, which could modify the ratios reflected herein within a few years.

Sensitivity analysis: the impact on rank of different public charging assumptions

As described above, our calculation to determine each city's rank included all L2 and L3 public chargers available in a city, giving both equal weight. We also ran the following sensitivity analyses for a select group of the cities to evaluate how changing these assumptions might impact each city's rank. We do not provide the full results here (but can make them available upon request). We used the formula noted above and swapped out the denominator for two additional scenarios—only L2, and only L3. For example:

Multifamily Housing Access to Public EV Charging =

*(Car-to-Work % * Total Existing MFH Units in Each City) /*

(# of Level 3 Chargers Only)

We found for all cities that including only L3 chargers resulted in substantially higher MFH unit-to-public-charger ratios (due to the smaller number of L3 chargers currently available), which indicates that more L3 chargers are needed to expand fast-charging options to all EV drivers, including those living in MFH. Nonetheless, with all cities seeing higher ratios, just including L3 chargers had little to no impact on most cities' overall rank. For others (namely those cities without many L3 chargers), however, this adjustment resulted in a considerable shift in rank (for example, Kansas City would go from rank 11 to rank 57 if only L3 chargers were included in the calculation). We did the same calculation for only L2 chargers, though that had nominal impact on the results. We provide a sample of the results below for comparison.

Table B-4. Sensitivity analysis results, showing change in city rank for the top 10 cities when accounting for L2-only or L3-only, compared with original analysis

City	Original Analysis: L2 + L3 Rank (# MFH units per public charger)	Sensitivity Analysis 1: L2-Only Rank (# MFH units per public charger)	Sensitivity Analysis 2: L2-Only Rank (# MFH units per public charger)
San Jose, CA	1 (41)	1 (49)	4 (264)
Sacramento, CA	2 (43)	3 (54)	2 (220)
Atlanta, GA	3 (47)	2 (51)	17 (637)
Las Vegas, NV	4 (49)	12 (72)	1 (157)
Pittsburgh, PA	5 (50)	5 (57)	5 (401)
Seattle, WA	6 (51)	4 (55)	26 (779)
Washington, DC	7 (57)	6 (62)	20 (684)
Salt Lake City, UT	8 (57)	8 (64)	10 (512)
Orlando, FL	9 (58)	10 (67)	7 (451)
Frisco, TX	10 (60)	9 (65)	30 (819)
The cities below are *not* in the top 10 ranking for L2 + L3 but would be in the top 10 if the ranking only accounted for volume of L2 *or* L3 charging.			
Kansas City, MO	11 (62)	7 (64)	57 (2,734)
Ontario, CA	14 (70)	18 (99)	3 (239)
San Diego, CA	15 (73)	15 (89)	6 (410)
San Francisco, CA	16 (75)	14 (89)	8 (480)
Baltimore, MD	13 (69)	13 (80)	9 (488)

Table B-5. Sensitivity analysis results, showing change in city rank for the bottom 10 cities when accounting for L2-only or L3-only, compared with original analysis

City	Original Analysis: L2 + L3 Rank (# MFH units per public charger)	Sensitivity Analysis 1: L2-Only Rank (# MFH units per public charger)	Sensitivity Analysis 2: L2-Only Rank (# MFH units per public charger)
Milwaukee, WI	69 (830)	68 (927)	66 (7,956)

Cape Coral, FL	68 (734)	65 (734)	69 (No Level 3 chargers)
Hialeah, FL	67 (632)	69 (993)	51 (1,738)
St. Petersburg, FL	66 (622)	63 (669)	67 (8,894)
Memphis, TN	65 (594)	66 (779)	55 (2,504)
Chicago, IL	64 (486)	60 (575)	59 (3,141)
Newark, NJ	63 (483)	61 (579)	58 (2,930)
Cleveland, OH	62 (456)	58 (525)	63 (3,457)
El Paso, TX	61 (444)	64 (693)	46 (1,237)
New Orleans, LA	60 (438)	56 (490)	64 (4,106)
The cities below are **not** in the bottom 10 for L2 + L3, but would be in the bottom 10 if the ranking only accounted for volume of L2 *or* L3 charging.			
Oklahoma City, OK	55 (341)	67 (799)	15 (593)
Sioux Falls, SD	59 (410)	62 (600)	48 (1,299)
Garland, TX	53 (324)	48 (331)	68 (15,897)
Buffalo, NY	32 (146)	26 (149)	65 (6,059)
St. Louis, MO	51 (265)	43 (288)	62 (3,386)
New York, NY	58 (402)	55 (458)	61 (3,308)
Minneapolis, MN	43 (232)	42 (251)	60 (3,155)

We also modified the calculation to provide greater weight to L3 (80 percent) than L2 (20 percent), using the following formula:

Multifamily Housing Access to Public EV Charging =

*(Car-to-Work % * Total Existing MFH Units in Each City) /*

((# of Level 2 Chargers x 20%) + (# of Level 3 Chargers x 80%))

From these results, we find no notable changes to the rankings, but a substantially higher ratio of MFH units per charger.

Table B-6. Sensitivity analysis results, showing change in city rank for top 10 cities when weighting L3 chargers higher, compared with original analysis

City	Current Rank (Result)	Weighted Rank (Result)
San Jose, CA	1 (41)	3 (140)
Sacramento, CA	2 (43)	2 (136)
Atlanta, GA	3 (47)	6 (194)

Las Vegas, NV	4 (49)	1 (127)
Pittsburgh, PA	5 (50)	4 (182)
Seattle, WA	6 (51)	9 (215)
Washington, DC	7 (57)	10 (227)
Salt Lake City, UT	8 (57)	8 (214)
Orlando, FL	9 (58)	7 (209)
Frisco, TX	10 (60)	13 (247)
The city below is *not* in the top 10 for the original L2 + L3 formula but is in the top 10 for the weighted formula.		
Ontario, CA	14 (70)	5 (186)

Table B-7. Sensitivity analysis results, showing change in city rank for bottom 10 cities when weighting L3 chargers higher, compared with original analysis

City	Original Analysis: L2 + L3 Rank (# MFH units per public charger)	Sensitivity Analysis 3: L3 Weighted Rank (# MFH units per public charger)
Milwaukee, WI	69 (830)	68 (3,161)
Cape Coral, FL	68 (734)	69 (No L3 Chargers)
Hialeah, FL	67 (632)	60 (1,512)
St. Petersburg, FL	66 (622)	67 (2,569)
Memphis, TN	65 (594)	66 (1,736)
Chicago, IL	64 (486)	65 (1,659)
Newark, NJ	63 (483)	62 (1,616)
Cleveland, OH	62 (456)	63 (1,633)
El Paso, TX	61 (444)	55 (1,069)
New Orleans, LA	60 (438)	64 (1,658)
The city below is *not* in the bottom 10 for the original L2 + L3 formula but is in the bottom 10 of the weighted formula.		
Garland, TX	53 (324)	61 (1,529)

Transportation sector GHG emissions data

To determine the GHG emissions associated with passenger vehicle transportation for each city in this analysis, we used the Oak Ridge National Laboratory's Database of Road Transportation Emissions (DARTE) Annual On-Road CO_2 Emissions. DARTE provides a 38-year, 1-km resolution inventory of annual on-road CO_2 emissions for the conterminous U.S. based on roadway-level vehicle traffic data and state-specific emissions factors for multiple vehicle types on urban and rural roads at a metro level.

Of note, the most recent data is from 2017, so it does not account for recent changes, such as work-from-home policies, increased adoption of passenger EVs, or shifts in utilization rates of alternative modes of personal transportation.

For our analysis, we used DARTE metro-level data to city-level data by dividing each city's population by the corresponding metro area population, which yielded a percentage of the city population relative to that of the metro area. We multiplied that percentage by the total metro area on-road GHG emissions to provide city-level transportation GHG emissions estimates. We then divided that number by city population size to approximate transportation emissions per person for each city.

In addition, we relied on EPA data to determine which of the cities were in metro areas designated as in non-compliance for either ozone or PM2.5, both of which indicate poor air quality and negative impacts to public health. This is used to inform which cities in the analysis might benefit most from the adoption of EVs.

A spreadsheet with the full city dataset is available online at https://energyinnovation.org/publication/the-state-of-charge-for-multifamily-housing-assessing-the-public-ev-charging-gap-in-u-s-cities/.

Additional notes for the methodology

- Unincorporated areas were removed from building permit data. That includes Travis County, Hillsborough County, Harris County, Miami-Dade County, Louisville-Jefferson County, El Paso County, Orange County, Osceola County, Fairfax County, Polk County, Montgomery County, Iredell County, Manatee County, and New Hanover County. The U.S. Census differentiates unincorporated and incorporated areas in such a way that including these unincorporated areas would complicate the analysis. Both MFH and EV charging data are only available for incorporated areas, so including the unincorporated area data would have made city comparisons less accurate.
- For building permit data, New York is a combination of Brooklyn, Queens, Bronx, Manhattan, and Staten Island boroughs.
- From the U.S. Census Bureau: "Estimates will be shown for consolidated cities and the consolidated city 'balance,' which is the consolidated city minus the semi-independent incorporated places located within the consolidated city. Consolidated cities include: Athens-Clark County, GA; Augusta-Richmond County, GA; Butte-Silver Bow, MT; Greeley County, KS; Indianapolis, IN; Louisville/Jefferson County, KY; Milford, CT; and Nashville-Davidson, TN. Estimates also are produced for the semi-independent places which together with the 'balance record,' sum to the entire territory of the consolidated city."[88]
- Charlotte, North Carolina (Mecklenburg County): MFH permitting data does not count Charlotte but counts Mecklenburg County (the county Charlotte resides in). Charlotte's population is 897,720, while Mecklenburg County's population is

1,145,392. It is assumed most MFH units are being built within Charlotte, so all MFH units counted toward Mecklenburg County are attributed to Charlotte. All other data is for Charlotte.

- Jacksonville, Florida (Duval County): MFH permitting data does not count Jacksonville, but counts Jacksonville-Duval County (the county Jacksonville resides in). Jacksonville's population is 971,315, while Duval County's population is 1,016,536. It is assumed most MFH units are being built within Jacksonville, so all MFH units counted toward Duval County are attributed to Jacksonville. All other data is for Jacksonville.
- Using U.S. Census Bureau data, we included the following demographic and socioeconomic data for each of the 69 cities:
    - Percentage of the population that is white or non-white (Black, Indigenous, Asian, Hispanic)
    - Income levels at, above, or below U.S. average poverty levels

Endnotes

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