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Dane County Electric Vehicle Charging Infrastructure Plan

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March 2024

Prepared by staff of Greater Madison MPO with assistance from staff of other agencies.

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GREATER MADISON METROPOLITAN PLANNING ORGANIZATION

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Executive Summary

With the number of electric vehicles on the road growing each year and the passage of the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA), which provided new sources of funding for electric vehicle infrastructure, the Greater Madison MPO identified the need for a plan to help local governments prepare for the shift towards electric vehicles (EVs) and take advantage of these new sources of federal funding.

To help define the purpose and scope of the plan and better understand the current state of EV charging infrastructure in our region, the MPO convened a steering committee made up of representatives from state and local government, energy utilities, and nonprofit organizations.

This plan aims to help communities in Dane County prepare for the ongoing shift toward electric vehicles and to provide them with the foundational information needed to secure grant funding for needed infrastructure. To meet these goals, this plan provides an overview of:

- Trends in EV ownership and charging.
- Best practices, including planning, zoning, regulatory, and statutory changes to ensure sufficient charging infrastructure for the increasing number of EVs in the County.
- Charging needs and priority locations for different types of public charging infrastructure.
- Available grant funding opportunities.

This plan does not set targets for the quantity, type, or locations of charging infrastructure in the County due to the early stage of large-scale EV deployment and uncertainty regarding the rate of EV adoption, charging behaviors, and rapidly evolving vehicle and charging technologies.

Trends in EV Ownership and Charging

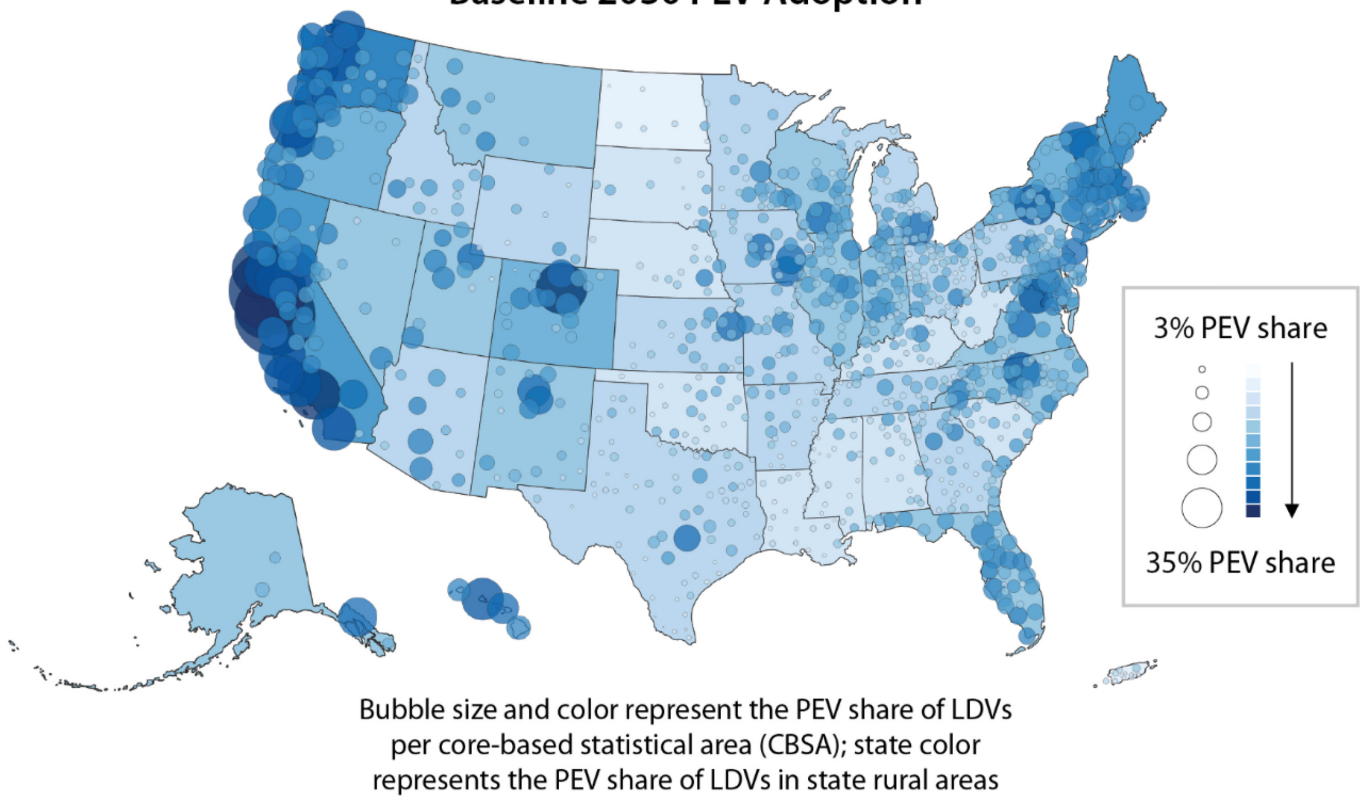
In January 2023, there were 3,397 EVs registered in Dane County, representing 0.7% of all vehicles registered in the County, and there were 13,893 EVs registered in Wisconsin, representing 0.2% of all vehicles registered in the state. Although EVs account for just a fraction of the vehicles on the road today, the number of EVs in Dane County and Wisconsin overall grew by about 50% during 2022.

This tremendous growth is in keeping with the Wisconsin Electric Vehicle Infrastructure (WEVI) Plan's projection that the number of EVs in the state will grow to nearly 1.9 million, 31% of all vehicles in the state, by 2050.

Depending on whether Dane County EV adoption tracks with the rest of the state or continues on its current, more rapid trajectory, we can expect 45,000-85,000 EVs (13%-16% of all vehicles) by 2030 and 185,000-470,000 EVs (32%-81% of all vehicles) by 2050.

These projections align with recent estimates from the National Renewable Energy Laboratory. As shown in Figure 1, the Madison area is projected to have one of the highest shares of EVs—shown in the figure as PEVs, plug-in electric vehicles—in the Midwest in 2030.

Figure 1: Plug-In Electric Vehicle (PEV) Adoption in 2030



Source: 2030 National Charging Network: Estimating U.S. Light Duty Demand for Electric Vehicle Charging Infrastructure

The growing number of EVs in the County is consistent with the goals outlined in the Dane County Climate Action Plan, highlighting the need to rapidly transition from conventional fossil-fueled vehicles to EVs as a top priority. The plan sets a goal of EVs accounting for 40% of new vehicles sold in the County by 2030 and 57% by 2040. As the number of EVs in the County grows, demand for charging infrastructure will grow along with it.

Unlike vehicles that run on gasoline or diesel fuel and need to visit a gas station to refill their tanks, EVs can charge their batteries in many locations, from residential wall outlets to large scale purpose-built charging stations.

There are three levels of EV charging infrastructure. Level 1, which provides 1.3-2.4 kW of power, uses a standard residential wall outlet and often requires 20 to 50 hours to fully charge an EV. Level 2, which provides 3-19.2 kW of power, requires 240v service and can charge an EV in 4-10 hours. Level 3, also known as direct-current fast charging (DCFC), which provides 50-400 kW of power, requires 480v service and can charge an EV in less than 1 hour. Charging times vary based on the power output of the charger, the size of the vehicle's battery, and the vehicle's maximum charge rate.

Because charging an EV takes longer than filling a gas tank and EVs can be charged while they are parked at residences, workplaces, and other destinations, charging normally takes place while vehicles are parked and drivers engage in their regular day-to-day activities. Privately owned vehicles are parked about 95% of the time, so even slow charging speeds are normally sufficient.

Currently, about 90% of EV charging consists of level 1 and level 2 charging in residential settings. Much of the remaining 10% of charging is at level 2 chargers located in parking facilities at workplaces and shopping and entertainment destinations. Level 3 charging accounts for a small portion of the total and is normally only used by long-distance travelers or workers who need to recharge quickly and get back on the road.

Most charging infrastructure needs can be met by individuals installing level 2 infrastructure or using standard wall outlets at their homes, apartment buildings installing level 2 chargers for residents, and by businesses installing level 2 and level 3 chargers in locations that will attract customers, appeal to employees, and generate revenue.

The primary role of the public sector is to facilitate these types of EV infrastructure investments and address remaining infrastructure gaps.

Charging Needs in Dane County

The expected surge in EV ownership over the next few decades will require a major expansion in charging infrastructure. Since the vast majority of EV owners who have residential charging access charge their vehicles at home and do not regularly charge their vehicles at other locations, much of the required infrastructure will be installed in private homes and parking facilities without the need for outside incentives or intervention. However, a lack of access to charging facilities is significant barrier to EV adoption for renters and people without off-street parking.

The most pressing needs are for infrastructure serving people who cannot charge their vehicles at home, or whose travel patterns make it make it necessary for them to charge their vehicles away from home:

- People without residential access to charging.
- Long-distance travelers.
- Ride-hailing and delivery drivers.

To make the ownership and use of EVs more convenient and to provide redundancy in the system, charging infrastructure should also be made available to serve:

- Worksites where employees leave their vehicles parked during their shifts.
- Destinations where drivers park their vehicles while attending to day-to-day activities—shopping, socializing, dining, or running errands.
- Multimodal hubs where drivers can leave their EVs charging as they travel to work or elsewhere by alternate modes.
- Rural communities where there are few nearby charging locations.

Priority Charging Locations

Dane County will need new EV charging infrastructure to support the growing number of EVs. Level 2 charging infrastructure is well-suited to use in public or shared-use settings in employment and residential areas. Faster level 3 charging infrastructure will also be needed over the coming years to serve drivers on the go. Because of its slow charging speeds, level 1 charging is not normally used in shared or public charging installations.

Level 2

Level 2 charging infrastructure is relatively low cost and can be useful wherever people are stopped for more than 30 minutes or so. Newer more powerful level 2 chargers, delivering up to 19.2 kWh, can charge a vehicle about twice as fast as a standard level 2 charger. These faster level 2 chargers, which are still only a fraction of the cost of a level 3 charger, will make level 2 charging more attractive to people making short stops.

The highest priority locations for level 2 charging infrastructure are:

- Residential areas, where residents cannot charge their vehicles while at home.
- Employment areas, where employees park for the length of their workday.

Level 2 charging is also sufficient for destination charging in many locations, allowing drivers to top off their charge while away from home. However, the time required to charge using level 2 infrastructure, and the fact that most people charge their vehicles at home, make level 2 chargers unlikely to be a significant draw for customers to most businesses. Hotels are the exception, with level 2 chargers attracting customers wanting to charge their vehicles overnight.

Level 3

Level 3 charging allows drivers to charge quickly and get back on the road. This is particularly critical for ride-hail and delivery drivers and people on long-distance trips. A network of level 3 chargers spread throughout the County in business districts along key travel routes can serve these groups and provide rural residents with an additional charging option away from home.

An initial screening level analysis identified a set of priority zones for new level 3 charging infrastructure to meet the needs of EVs in Dane County over the coming years. The key considerations in identifying the 13 zones shown in Figure 2, were the total number of vehicles stopping in each zone on a daily basis, the amount of traffic passing nearby, the percentage of vehicles stopping for less than 30 minutes, the percentage of trips over 50 miles originating and terminating in each zone, and the proximity of each zone to existing charging infrastructure.

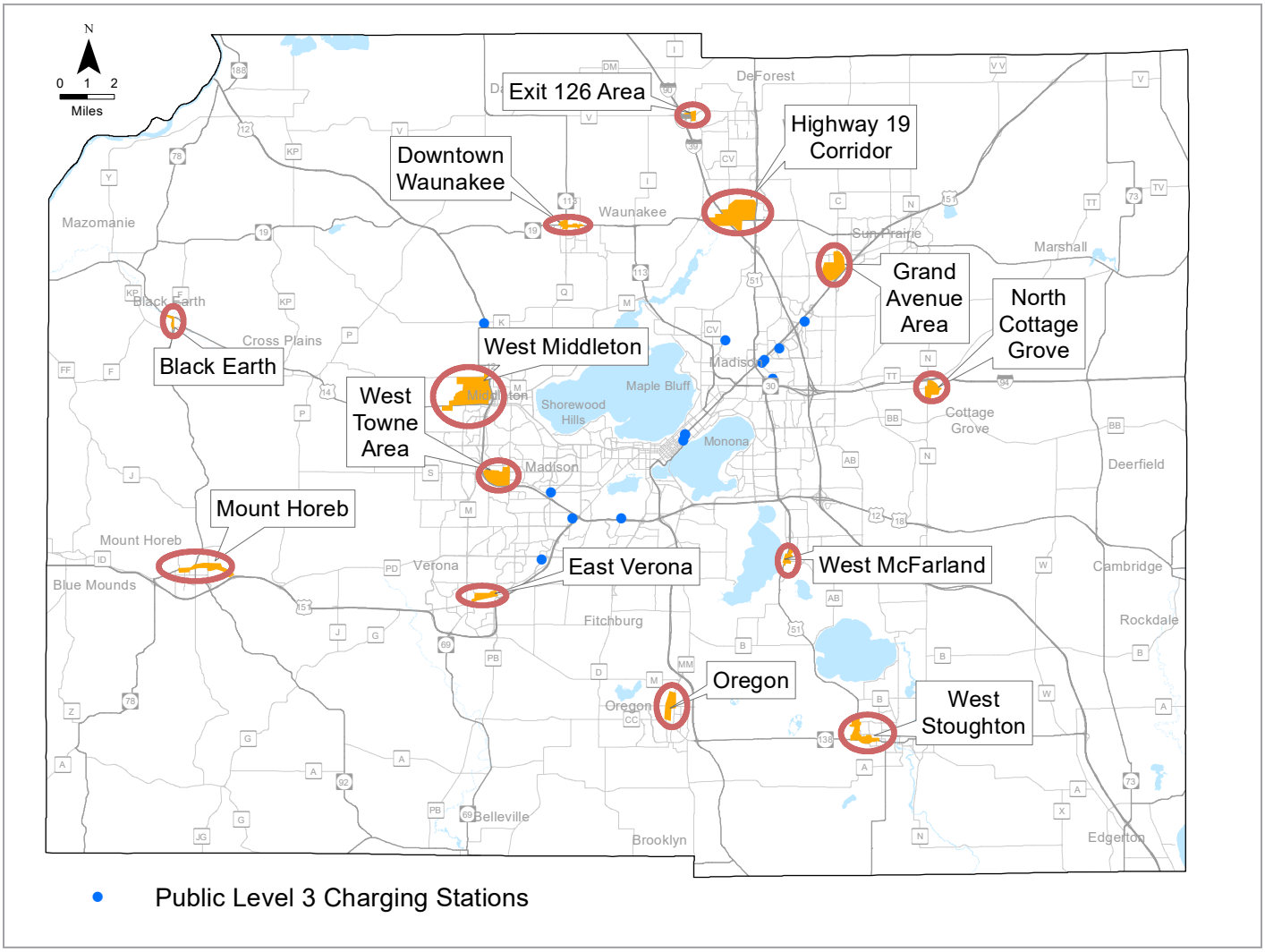
Recommendations

Providing the charging infrastructure needed to support the continued growth of EVs in Dane County will require coordinated actions from agencies and jurisdictions throughout the Greater Madison region: the County, the MPO, the City of Madison, and other area communities, as well as utilities, nonprofit groups and employers. The State of Wisconsin also has an important role to play in modifying rules governing electricity sales. In addition, the State can help to facilitate EV adoption by repealing its ban on direct sales of vehicles by manufacturers.

Monitor Trends in EV Ownership and Charging Needs, with a Focus on Equity

The number of EVs in the County is growing rapidly but currently accounts for less than 1% of the County's registered vehicles. While EVs are certain to make up a significant portion of vehicles on the road in the years to come, there is still a great deal of uncertainty as to just how rapid the transition will be. Forecasts of EV penetration in Dane County in 2050 range from about one-third to more than three-quarters of all registered vehicles.

Figure 2: Priority Level 3 Charging Zones



As EVs continue to grow in popularity and the used EV market matures, they will become more accessible to lower income drivers who are less likely to have access to charging infrastructure at their residences. Nonprofit community organizations may be able to help communities understand the EV charging needs of their economically disadvantaged residents.

Discussing EV charging infrastructure access during public engagement activities for local planning efforts is one way to gauge your community's interest and need for additional charging infrastructure. Utilities are highly involved in EV charging and have a great deal of information about local charging trends and issues. They can assist communities in better understanding charging behavior and identifying emerging needs.

Communities should keep track of EV growth trends and public charging infrastructure utilization and engage EV drivers, community organizations, utilities, charging station operators, and others to better understand potential issues as they arise.

To facilitate this, the Greater Madison MPO will issue annual updates on charging stations, EV registrations, and other relevant information.

Increase Residential Access to Charging

About 90% of charging is currently done at home, but the 37% of Dane County residents living in multifamily homes and others living in homes without off-street parking, who also tend to have lower incomes, often lack this option.

Policies that require the installation of charging infrastructure or EV-ready parking spaces in newly constructed parking lots, such as those enacted by the City of Madison and the City of Verona, are one way to increase charging access for residents of new apartment buildings. Residents of existing apartments and of homes lacking off-street parking can be afforded access with the installation of new charging stations nearby and potentially through on-street charging infrastructure. Nearby businesses, houses of worship, and community organizations may be willing to host charging infrastructure to allow residents to charge vehicles in their parking lots overnight.

Communities should assess their residential charging needs and, if necessary, explore ways to provide residents the means to charge their vehicles at home.

Update Plans and Regulations to Support EV Infrastructure Installation

Soft costs associated with site selection and permitting can significantly increase the total cost of EV charging installations. Community plans, zoning codes, and parking ordinances can play an important role in reducing these costs and increasing charging infrastructure access.

Identifying EVs as a part of local transportation strategy in comprehensive planning documents provides a foundation for zoning and other local ordinances to be similarly tailored to promote the use of EVs and the installation of charging infrastructure.

Zoning codes that explicitly address EV charging infrastructure reduce confusion for installers and government officials, making installation faster and more efficient. Zoning codes should, at a minimum, identify where charging stations are permitted by right and conditionally. Communities should also consider including requirements and incentives for the installation of charging infrastructure in parking lots, and site design guidelines.

EV-supportive parking ordinances that clarify restrictions and penalties for non-EVs parked in EV-designated spaces promote the expansion and use of EV charging infrastructure by reducing the likelihood that it will be blocked by fossil-fueled vehicles.

Communities should work to identify and correct gaps and ambiguities in their local plans and regulations that may inhibit the expansion of EV charging infrastructure. They should also consider amending their zoning codes to include incentives or requirements for the installation of EV charging infrastructure in new parking facilities.

See the Policy and Planning Tools section for additional discussion.

Encourage and Facilitate Private Sector Charging Infrastructure Investments

Most public charging infrastructure is owned and operated by private businesses. As the number of EVs and demand for new charging infrastructure grows, most new charging installations will be developed by the private sector.

Providing information and assistance to private sector partners considering new charging infrastructure investments can lower their cost and risk while giving local governments an opportunity to help direct new charging infrastructure to areas where it is most needed.

Local governments should work with private sector charging infrastructure developers to share information, help them navigate required approval processes, and highlight areas with a need for additional charging infrastructure.

Revise Wisconsin State Statutes to Enable Charging Fees Based on Energy Use

The federal requirement that charging infrastructure receiving federal funding must base charging fees on kilowatt-hours of energy will prevent businesses and communities in Wisconsin from accessing NEVI and CFI grant funding included in the BIL due to current state law that regulates entities selling electricity as public utilities. EV charging station operators are averse to classification as a public utility because it would place them under the oversight of the state's Public Service Commission (PSC) and impose burdensome requirements that they share data with the PSC.

Failure to amend this statute will jeopardize the NEVI funding allocated to the state for the expansion of charging infrastructure along the state's network of Alternate Fuel Corridors as well as the joint CFI grant application submitted by Dane County communities.

The State Senate passed a bill to make this change in January 2024.[1] A similar bill is currently circulating in the State Assembly, as of February 2024.[2] Legislation to enable non-utilities to base charging fees on energy use is expected to be signed into law by the governor later in 2024.

The state legislature should amend its definition of a public utility to include an exemption for EV charging stations so that they are not subject to regulation as public utilities.

See Pricing (page 26) for more on this issue.

Repeal Wisconsin's Statewide Prohibition on Vehicle Sales by Manufacturers

Wisconsin's ban on "factory stores," auto dealerships owned by manufacturers, effectively blocks the sale of several EV models in the state, including those made by Tesla. Although buyers are free to purchase these vehicles from dealerships in other states, repealing this ban would increase competition among manufacturers in Wisconsin and reduce the time, effort, and expense required to purchase some popular EV models.

The state legislature should remove the statutory ban on "factory stores" to provide greater choice to EV purchasers in Wisconsin and keep vehicle purchase-related taxes and fees in Wisconsin.

Remove State Restrictions on the Use of Federal Funding for EVs and EV Infrastructure

The purpose of the federal Carbon Reduction Program (CRP) is to provide funding for a wide variety of project types that reduce transportation-related CO_2 emissions from on-road sources. The Wisconsin Legislature's Joint Finance Committee, however, has made EVs and EV infrastructure ineligible for funding under the program. Removing these restrictions would provide a valuable source of funding for EV infrastructure projects, particularly projects serving low-income residential areas and other locations that are less likely to generate sufficient revenue to attract private investment.

The Wisconsin Legislature's Joint Finance Committee should remove the restrictions on the use of federal funding for EVs and EV charging infrastructure to provide local decision makers with greater flexibility and help prepare the state for the transition to EVs.

[1] SB 791.

[2] AB 846.

Introduction

With the number of electric vehicles on the road growing each year and passage of the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA), which provided new sources of funding for electric vehicle infrastructure, the Greater Madison MPO identified the need for a plan to help local governments prepare for the shift towards electric vehicles (EVs) and take advantage of these new sources of federal funding.

To help define the purpose and scope of the plan and to better understand the current state of EV charging infrastructure in our region, the MPO convened a steering committee made up of representatives from state and local government, energy utilities, and nonprofit organizations, shown in Table 1.

Table 1: Steering Committee Members

Organization	Representative
Alliant Energy	Michelle Yun, Senior Manager, Strategy and Electrification
Alliant Energy	Lucy Sanchez, Electrification Program Specialist
City of Madison Department of Transportation	Tom Lynch, Director of Transportation
City of Madison Fleet Service	Mahanth Joishy, Superintendent
City of Madison Mayor's Office	Jessica Price, Sustainability & Resilience Manager
City of Madison Traffic Engineering	Yang Tao, City Traffic Engineer
Dane County Office of Energy & Climate Change	Kathy Kuntz, Director
Electrification Coalition	Emma Heins, Policy Manager
Madison Gas and Electric (MGE)	Guy Gryphan, Product Manager
Madison Gas and Electric (MGE)	Erinn Monroe-Nye, Energy Services and Policy Manager
Madison Region Economic Partnership (MadREP)	Gene Dalhoff, Vice President of Talent and Education
Renew Wisconsin	Francisco Sayu, Director, Emerging Technology
University of Wisconsin-Madison	Dar Ward, Commuter Solutions Manager
Wisconsin Clean Cities	Lorrie Lisek, Executive Director
WisDOT Division of Budget and Strategic Initiatives	Kaleb Vander Weile, Transportation Electrification Project Manager
WPPI Energy	Clint Cry, Energy Services Manager

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- Trends in EV ownership and charging.
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This plan does not set targets for the quantity, type, or locations of charging infrastructure in the County due to the early stage of large-scale EV deployment and uncertainty regarding the rate of EV adoption, charging behaviors, and rapidly evolving vehicle and charging technologies.

What are EVs?

There are three types of vehicles powered by electric motors: battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs).

BEVs, or fully electric vehicles, have an electric motor powered by a battery that is plugged in to charge.

PHEVs have an electric motor powered by a battery that can be plugged in to charge as well as an internal combustion engine (ICE) that runs on gasoline. Most PHEVs can travel 20-40 miles on electricity alone, after which they operate on gasoline, like HEVs.

Like PHEVs, HEVs have both an ICE and a battery-powered electric motor. However, unlike PHEVs, HEV batteries are charged during driving and braking and cannot be plugged in to charge. Both hybrid vehicle types are typically more fuel efficient than comparable ICE vehicles.

Only vehicles that can be plugged in to charge (BEVs and PHEVs) are classified as EVs.

Benefits of EVs

While EVs offer numerous benefits in terms of performance and convenience, the most important benefits of EVs from a societal perspective are in the areas of public health, environmental sustainability, and the economy.

Public Health and Environmental Sustainability

The most obvious environmental impacts of motor vehicles are on air quality and climate—both direct emissions of criteria pollutants and greenhouse gases (GHG) generated by the vehicle during operation and upstream emissions generated during fuel production and processing.

Along with carbon dioxide (CO_2) emissions, which contribute to climate change, the burning of gasoline in fossil-fueled vehicles releases nitrogen oxides (NOx)[3], carbon monoxide (CO), and volatile organic compounds (VOCs). These pollutants have direct health impacts, with NO_2 associated with asthma exacerbation; CO associated with nausea and even death by limiting the blood's ability to carry oxygen; and many VOCs characterized as air toxics affecting cancer risk and other adverse outcomes.[4]

The most significant air quality and health benefits of eliminating internal combustion engines, however, come from reductions in secondary (chemically formed) pollutants associated with these direct emissions.[5] Ground-level ozone is a major summertime air pollutant caused by emissions of NOx and VOCs. In urban environments, on-road vehicles are the largest source of NOx emissions and a major source of VOC emissions. EV expansion is expected to reduce population exposure to ground-level ozone.[6]

Fine particulate matter ($PM_{2.5}$) is another major health and air quality issue that benefits from the transition to EVs. While some older vehicles, especially diesel-burning engines, emit $PM_{2.5}$ directly from their tailpipes, the largest sources of $PM_{2.5}$ in the U.S. are chemically formed in the atmosphere, including nitrate particles (formed from NOx, especially in wintertime) and secondary organic aerosols (formed from VOCs, especially in the summer). The ongoing transition to EVs will reduce these precursor emissions to $PM_{2.5}$, benefitting air quality and health.

Emissions from plug-in hybrid electric vehicles (PHEVs), which have internal combustion engines along with electric motors, vary depending on whether they are operating using electricity or gasoline; however, even when relying on gasoline, they normally produce fewer direct emissions than conventional ICE vehicles.

While EVs do not produce tailpipe emissions, generating the electricity powering the vehicles emits a range of pollutants depending on the source of electricity, with coal emitting NO_x and CO_2, as well as sulfur dioxide (SO_2) and $PM_{2.5}$. While there is some trade-off between the reduction of tailpipe emissions and the increase in emissions due to higher electricity demand for EV charging, the U.S. Department of Energy estimates that conventional vehicles produce more than three times the greenhouse gas (GHG) emissions of EVs on a per-mile basis.[7] Furthermore, the energy mix for electricity generation is becoming cleaner, with commitments from Madison Gas & Electric and other regional suppli-

[3] NOx includes NO_2 and NO.

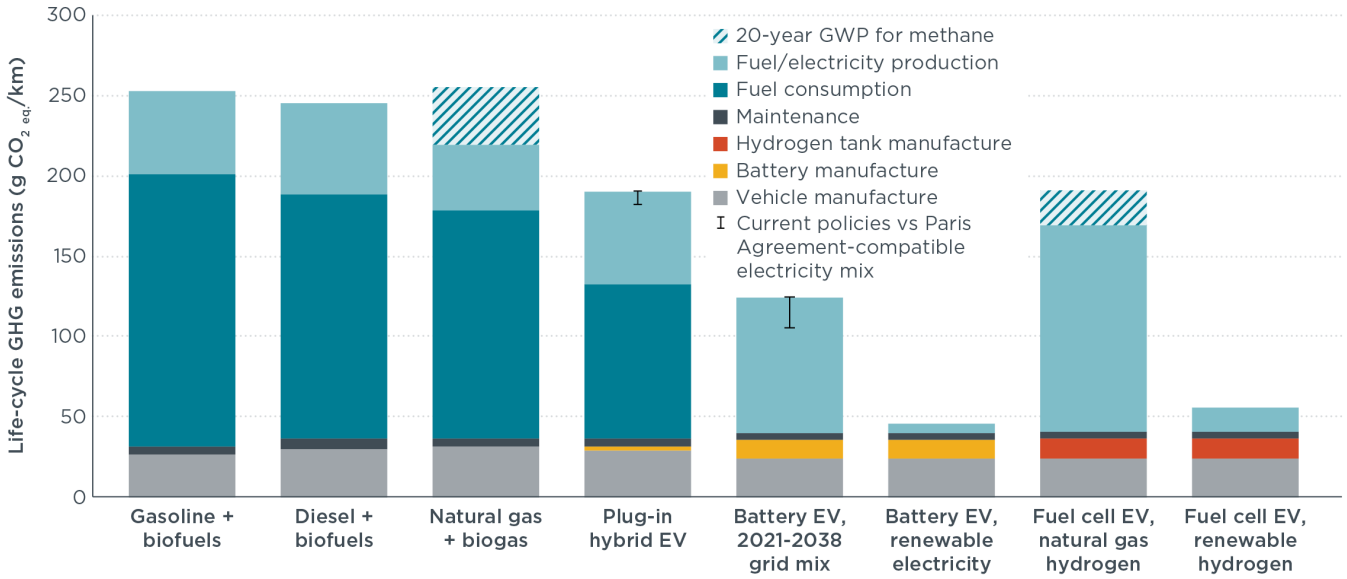
[4] Manisalidis, I., et al. Environmental and Health Impacts of Air Pollution: A Review. Front Public Health. 2020 Feb 20;8:14. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7044178/.

[5] Gallagher, C.L. & Holloway, T. Integrating Air Quality and Public Health Benefits in U.S. Decarbonization Strategies. Front. Public Health, 19 November 2020 Sec. Environmental health and Exposome. https://www.frontiersin.org/articles/10.3389/fpubh.2020.563358/full.

[6] Schnell, J.L., et al. Air quality impacts from the electrification of light-duty passenger vehicles in the United States. Atmospheric Environment, Vol. 208, 1 July 2019, Pages 95-102. https://doi.org/10.1016/j.atmosenv.2019.04.003.

[7] "Emissions from Electric Vehicles." Alternate Fuels Data Center, U.S. Department of Energy, https://afdc.energy.gov/vehicles/electric_emissions.html.

Figure 3: Life-Cycle GHG Emissions for Global Typical Medium-Size Passenger Cars Registered in 2021



Source: International Council on Clean Transportation
GWP = global warming potential

ers to increase the role of renewables and other clean energy options in coming years. As shown in Figure 3, EVs fueled using renewable electricity have lower life-cycle GHG emissions than any other available vehicle technologies.

Motor vehicle emissions are not limited to those produced during internal combustion and electricity generation. Dust particles from brake pads and tires are a growing share of on-road $PM_{2.5}$ emissions. Unlike tailpipe emissions, this dust is unregulated and, in some locations, may represent a larger public health hazard than tailpipe emissions.[8] All motor vehicles produce tire dust during normal operation, but because all commercially available EVs use regenerative braking, they tend to produce less brake dust than ICE vehicles. Larger and longer-range EVs equipped with heavy battery packs have a greater impact on roadway $PM_{2.5}$ levels compared to smaller EVs due to their weight, which increases tire wear and stirs up more roadway dust that has settled on the pavement.[9]

Evidence indicates that transitioning from ICE vehicles to EVs will yield major public health benefits. However, shifting trips from personal vehicles to transit, biking, and walking should continue to be a priority.

Economy

Fuel costs for EVs are generally less than half that of similar fossil-fueled vehicles.[10] In addition, without the need for oil changes and engine maintenance, EVs are cheaper to maintain. One analysis of vehicle ownership costs conducted by AAA found that among 2021 model vehicles, the average cost of fuel for an EV was just 3.66 cents per mile compared to 10.72 cents per mile for the average conventional vehicle. Per-mile maintenance costs show a similar pattern, 7.70 cents per mile for an EV compared to 9.55 cents per mile for the average conventional vehicle.

The transportation network companies (TNCs) Uber and Lyft have recognized the economic benefits of EVs. Both plan to have 100% of their drivers using EVs by 2030, but TNC drivers have already been shifting to EVs as a way to reduce their fuel and maintenance costs.

[8] Patel, Kasha. "Why tires — not tailpipes — are spewing more pollution from your cars." Washington Post (7/9/2023). https://www.washingtonpost.com/climate-environment/2023/07/09/tire-brake-tailpipes-emissions-pollution-cars/.

[9] Sensiba, Jennifer. "European Regulators Don't Really Think EVs Make More Brake Dust, But They're Still Being Foolish." Clean Technica (May 30, 2022). https://cleantechnica.com/2022/05/30/european-regulators-dont-really-think-evs-make-more-brake-dust-but-theyre-still-being-foolish/.

[10] Relative costs vary by energy market and with gasoline prices.

According to Uber, its drivers in the U.S. were using EVs at eight times the rate of the general public, as of the third quarter of 2022.[11]

Due to their high fuel expenses, rural drivers, who tend to drive longer distances than those in urban areas and often drive pickup trucks and other large vehicles, stand to reap particularly large benefits from the shift to EVs. As more large EVs come to market, particularly electric pickup trucks, increasing numbers of rural drivers will be able to cut their spending on fossil fuels by transitioning to EVs.

The public health benefits of EVs will also resonate in the economy. The growing share of EVs on the road in Dane County and the resulting air quality improvements will reduce cardiovascular and respiratory illnesses such as asthma and heart attacks. These improvements in community health will reduce healthcare expenses, visits to the doctor's office and ER, and the number of school and work days lost to illness, all of which save money for families and improve quality of life.

An additional economic benefit of shifting from conventional vehicles to EVs is that reducing our dependency on oil reduces our exposure to oil price fluctuations and their associated economic impacts. While most gasoline used in the U.S. is made with oil produced and refined domestically, and most of our imports come from Canada and Mexico; the price is set on the global market and is influenced by global events and subject to manipulation by Saudi Arabia and other countries that can easily adjust their production levels.

[11] Zukowski, Dan. "Uber and bp to provide fast EV chargers to the ride-hailing company's drivers." Smart Cities Dive (3/31/2023). https://www.smartcitiesdive.com/news/uber-bp-fast-ev-electric-vehicle-chargers-ride-hailing-drivers/646527/.

Barriers to EV Uptake

A national survey conducted in 2022 found that the top three issues stopping Americans from purchasing EVs were the cost of the vehicles, concerns about limited driving range (i.e., "range anxiety"), and a lack of charging locations.[12]

Cost of Vehicles

One of the largest barriers impeding the growth of the EV market share is the higher purchase cost of EVs relative to conventional vehicles. According to Kelley Blue Book's analysis of transaction prices for new vehicles, the average EV sold for $67,000 in June 2022 compared to $48,000 for the industry average vehicle. However, the scale of this disparity is likely due to both a temporary increase in demand resulting from a surge in gasoline prices as well as differences in features between available EVs and conventional vehicles.

Comparing electric and conventional vehicles of the same type may provide a more reliable measure of the true EV price premium. The difference in the base price of the 2023 Mini Cooper Electric, $30,895, and the conventional Mini Cooper Hardtop, $24,395, suggests that the current price premium for an electric vehicle may be close to 25%.[13]

The cost of EV batteries is dropping quickly, which is expected to make EVs increasingly cost-competitive, in terms of total cost of ownership, with ICE vehicles over the next few years.[14] Ford CEO Jim Farley has said that he does not expect the purchase price of new EVs to drop to the level of new ICE vehicles until after 2030, when automakers will roll out their second and third generations of EVs.[15]

Ban on Direct Sales by Automobile Manufacturers

In Wisconsin, state law prohibits manufacturers from selling vehicles directly to consumers. Automobile sales to consumers must go through auto dealerships. This prohibition prevents some EV manufacturers, such as Tesla and Rivian, from selling their vehicles in the state. While buyers are free to purchase vehicles in other states, such as Illinois, that lack this prohibition, the law increases the time, effort, and expense required to purchase some popular EV models. This also results in neighboring states collecting the revenues from sales taxes and other fees.

Range Anxiety and Concerns about Charging Infrastructure Availability and Speed

Concern about EV driving range has always been one of the primary obstacles to EV adoption, despite the average American driving fewer than 40 miles per day[16]—far less than the range of any EV on the market. A 2021 survey found that EV range was the most important factor for buyers in choosing an EV and that driving range is correlated with driver satisfaction with their vehicles.[17]

Concerns about the availability of charging infrastructure and the time required to charge vehicles are a major component of range anxiety. Much of this concern is driven by a lack of familiarity with EVs and existing charging stations, but there is a legitimate need for additional charging infrastructure.

[12] "Survey: Price and Range, Not Gas Prices, Dominate Worries about EVs." Autolist.com (7/20/2022). https://www.autolist.com/news-and-analysis/2022-survey-electric-vehicles.

[13] Blanco, Sebastian. "The Real Cost of Owning an Electric Car." Car and Driver (8/17/2022). https://www.caranddriver.com/research/a31544842/how-much-is-an-electric-car/.

[14] Fortuna, Carolyn. "Have Electric Vehicles Reached Parity With Their ICE Counterparts." Clean Technica (7/7/2022). https://cleantechnica.com/2022/07/07/have-electric-vehicles-reached-parity-with-their-ice-counterparts/.

[15] Dnistran, Iulian. "EV Price Parity With Gas-Powered Cars May Not Come Until After 2030: Ford CEO." InsideEVs (6/1/2023). https://insideevs.com/news/670052/ev-price-parity-after-2030-ford-ceo-jim-farley/.

[16] "Average Annual Miles per Driver by Age Group." FHWA (5/23/2022). https://www.fhwa.dot.gov/ohim/onh00/bar8.htm.

[17] Voelcker, John. "Range Anxiety Is Very Real, New J.D. Power EVs Survey Finds." Forbes (1/20/2021). https://www.forbes.com/wheels/news/range-anxiety-very-real-jd-power-evs-survey/.

According to the U.S. Department of Energy's Alternative Fuels Data Center, most EV owners charge their vehicles at their homes overnight.[18] Similarly, most EV fleets have charging infrastructure at their primary parking location. However, for EV owners who live in multifamily residences or lack off-street parking at home and for drivers on longer trips away from home, finding suitable charging locations can be a challenge.

While additional charging locations are needed to support the increasing number of EVs, public charging infrastructure alone does not drive EV uptake. Research has shown that EV charging infrastructure often goes unnoticed by people who are not already interested in EVs.[19]

[18] "Charging Electric Vehicles at Home." https://afdc.energy.gov/fuels/electricity_charging_home.html.

[19] Hoogland, K., et al. Understanding the Impact of Charging Infrastructure on the Consideration to Purchase an Electric Vehicle in California. UC Office of the President: University of California Institute of Transportation Studies (2022). http://dx.doi.org/10.7922/G21G0JKP.

EV Charging Infrastructure and Charging Levels

EV Charging Infrastructure

Unlike vehicles that run on gasoline or diesel fuel that need to visit a gas station to refill their tanks, EVs can charge their batteries in a wide variety of locations, from residential wall outlets to large-scale purpose-built charging stations.

EV charging infrastructure, also known as electric vehicle supply equipment (EVSE), consists of at least one port and one connector, or plug. As shown in Figure 4, a single port may have multiple connectors to accommodate different vehicle types, but each port can serve only one vehicle at a time. Ports can be mounted on the side of a building or on a freestanding post.

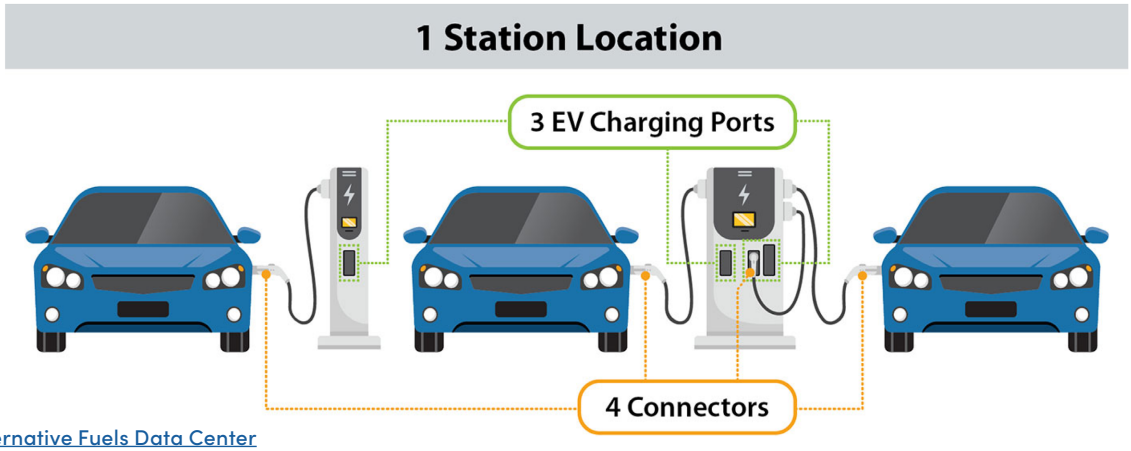
Figure 5 shows the plug types used to connect EVs to charging infrastructure. Tesla vehicles come with an adaptor that allows them to connect to J-1772 plugs for level 1 and 2 charging, but non-Tesla vehicles are currently unable to connect to Tesla plugs.

Three types of plugs are used for level 3 charging, also known as direct current fast charging (DCFC). About 50% of EVs are compatible with CCS plugs, 42.5% with Tesla plugs, and just 7.5% with CHAdeMO connectors.[20] One of the reasons that CCS has become more popular compared to CHAdeMO is because the top portion of the CCS vehicle charging port accommodates a J-1772 connector, allowing charging at all levels through a single vehicle charging port.

In late 2022, Tesla renamed its plug type the North American Charging Standard (NACS) and began encouraging other carmakers and charging networks to use it in their vehicles and charging stations. Since then, most major automakers have announced plans to incorporate the NACS plug in their vehicles during the

Figure 4: EV Charging Infrastructure

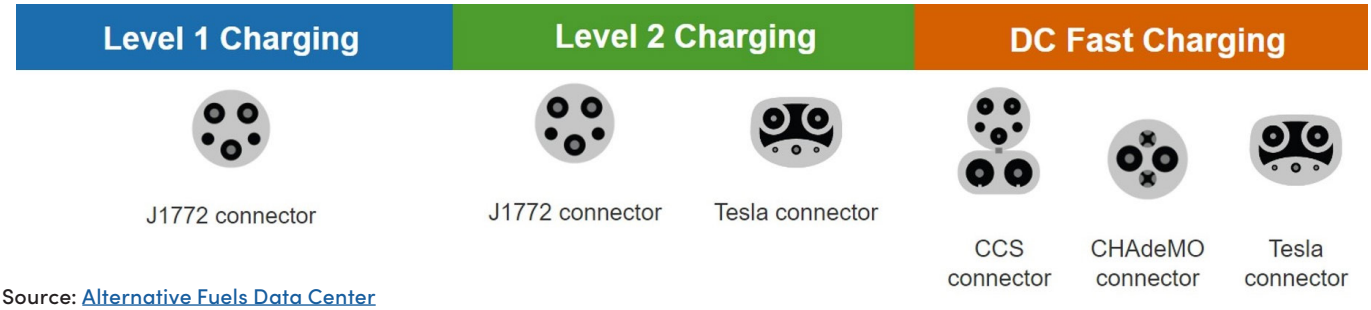
- **Station Location:** A station location is a site with one or more EV charging ports at the same address. Examples include a parking garage or a mall parking lot.
- **EV Charging Port:** An EV charging port provides power to charge only one vehicle at a time even though it may have multiple connectors. The unit that houses EV charging ports is sometimes called a charging post, which can have one or more EV charging ports. EV charging ports are also sometimes referred to as electric vehicle supply equipment (EVSE) ports.
- **Connector:** A connector is what is plugged into a vehicle to charge it. Multiple connectors and connector types (such as CHAdeMO and CCS) can be available on one EV charging port, but only one vehicle will charge at a time. Connectors are sometimes called plugs.



Source: Alternative Fuels Data Center

[20] Brown, A., et al. Electric Vehicle Charging Infrastructure Trends from the Alternative Fuels Station Locator: First Quarter 2022. National Renewable Energy Laboratory (September 2022). https://afdc.energy.gov/files/u/publication/electric_vehicle_charging_infrastructure_trends_first_quarter_2022.pdf.

Figure 5: EV Connector Types



Source: Alternative Fuels Data Center

2024 and 2025 model years and several major charging network companies have announced plans to begin incorporating the new plug in their charging stations.[21,22]

The Nissan Leaf is the only new car available in the U.S. still using CHAdeMO plugs and is likely to be the last model sold in North America using the technology.

EV Charging Levels

There are three levels of EV charging infrastructure. Power output and charging speeds increase from level 1 to level 2 and from level 2 to level 3. However, charging speeds vary widely within each level. EV charging times vary based on the power output of the charger, the size of the vehicle's battery, and the vehicle's maximum charge rate. Vehicles that can only accept a charge at the 90kW level will charge at the same speed at a 100kW charger as a 300kW charger. Newer level 2 and level 3 chargers tend to provide higher power levels and enable faster charging than older versions.

EVs can connect to a standard three-prong 120v outlet for level 1 charging. Level 1 power cords may be included with vehicle purchase or purchased on their own. Anyone with a parking space at their residence with access to a standard outlet can charge their vehicle at home. Level 1 charging, which delivers 1.3-2.4 kW of power, can typically fully charge a battery-electric vehicle (BEV) from empty in 20-50 hours, or a plug-in hybrid electric vehicle (PHEV) in 5-6 hours. Level 1 charging is sufficient for many EV owners to top off their vehicle's charge overnight after a normal day's driving. The long charging times required for level 1 charging make it less appropriate in public or other shared-use settings.

Level 2 charging equipment, which uses a 240v current and can be hardwired or plugged in, provides 3-19.2 kW of power and can normally charge a BEV in 4-10 hours or a PHEV in 1-2 hours. Purchase and installation costs for residential level 2 charging equipment vary depending on the specific model and how it is installed, usually ranging from $500 to $2,000.

Level 3 charging, which delivers 50-400kW of power, can charge a BEV to 80% from empty in less than an hour.[23] Charging times may be reduced to as little as 15 minutes for level 3 chargers at the 300-400kW power levels.

Most PHEVs do not work with fast chargers. Due to their very high equipment and installation costs, which can easily exceed $100,000, DCFC chargers are not installed by homeowners for personal use.

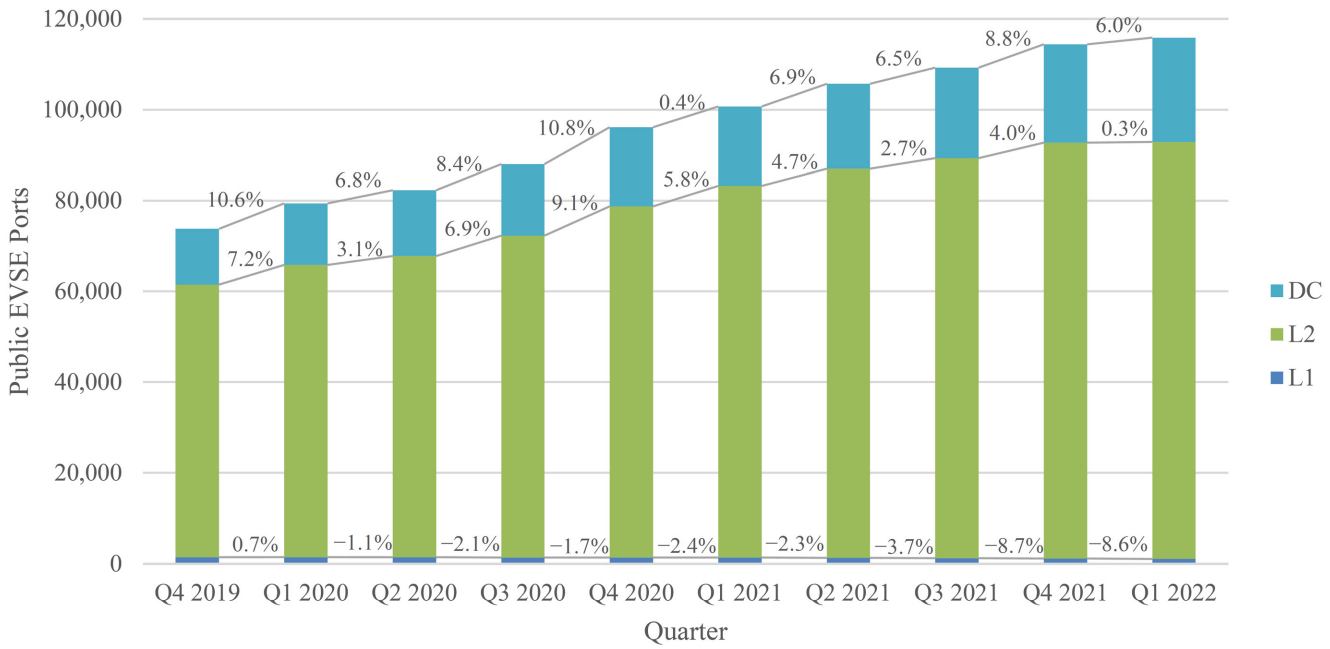
Level 3, or DCFC, ports make up a growing share of publicly available charging infrastructure in the U.S. Figure 6 shows the quarterly growth rates of level 1, level 2, and DCFC ports at public charging stations since the end of 2019. While DCFC ports have been growing at the fastest rate over this period, they currently make up only about 10% of all public charging ports. Level 2 charging makes up about 90% of public charging ports in the U.S., with level 1 ports representing a minimal and declining share of public charging ports.

[21] Lambert, Fred. "Jaguar signs deal with Tesla for Supercharger access, will adopt NACS." Electrek (9/21/2023). https://electrek.co/2023/09/21/jaguar-signs-deal-tesla-supercharger-access-adopt-nacs/.

[22] Tucker, Sean. "Other EV Charging Networks Adding Tesla Plug." Kelley Blue Book (6/19/2023). https://www.kbb.com/car-news/other-ev-charging-networks-adding-tesla-plug/.

[23] "Electric Vehicle Charging Speeds." U.S. Department of Transportation. https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds.

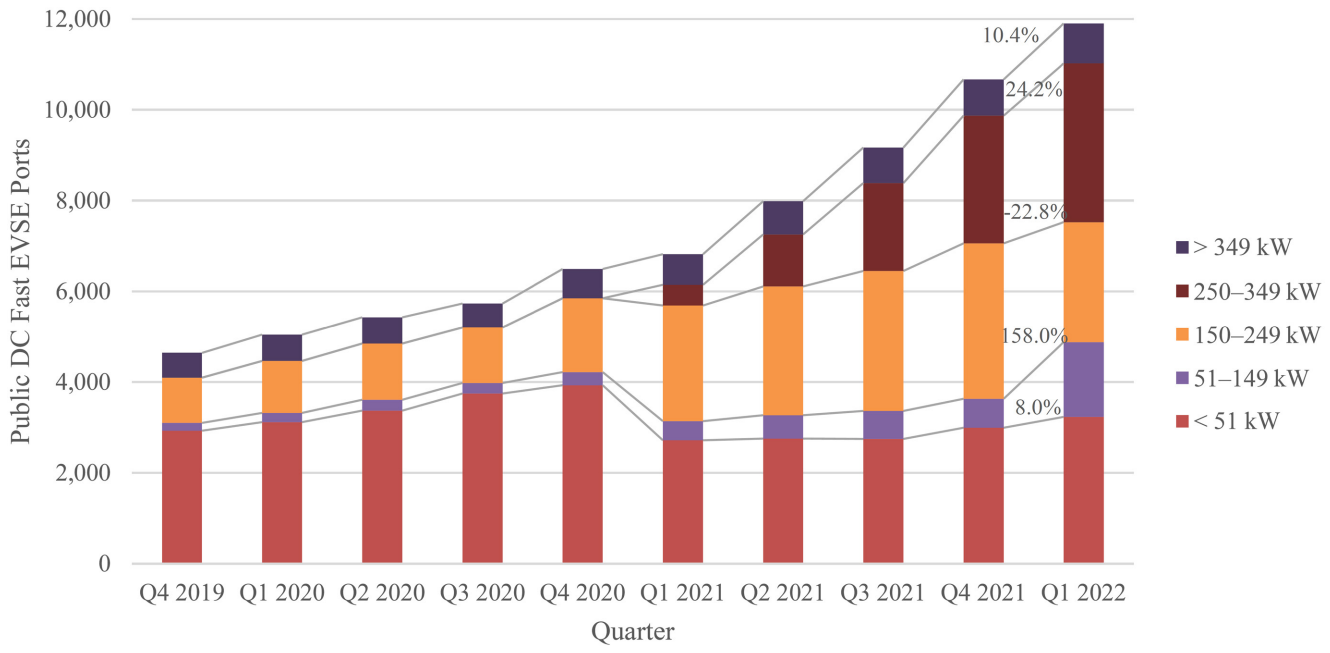
Figure 6: Quarterly Growth of Public EV Charging Ports by Charging Level



Source: Electric Vehicle Charging Infrastructure Trends from the Alternative Fuels Station Locator: First Quarter 2022

DCFC ports differ in their power supply. To qualify for federal funding, they must be supplied with at least 150 kW of electricity. As shown in Figure 7, about 40% of existing DCFC ports in the U.S. do not currently meet this standard. Higher power DCFC ports will likely grow more common in the coming years. According to a recent report from the National Renewable Energy Laboratory, 80% of 2023 investment in level 3 public charging infrastructure will be at the 150kW level, but that share is anticipated to decline to 27% by 2030. The

Figure 7: Quarterly Growth of DCFC Ports by Power Output



Source: Electric Vehicle Charging Infrastructure Trends from the Alternative Fuels Station Locator: First Quarter 2022

majority of investment in public DCFC is expected to be at the 350kW or greater level by 2026.[24]

Barriers to Charging Station Installation and Utilization

Over the last decade or so, EV station owners, operators, and others in the industry have had to learn from their missteps as they have developed an entirely new vehicle and fueling ecosystem. Many of the issues that have hindered the development of charging infrastructure can be traced to the early stage of charging technologies and EV adoption. Infrastructure standards, including plug types and power levels, are continuing to evolve. State and local governments are working to identify their proper roles and responsibilities in the expansion of EV infrastructure. Owners and operators of charging infrastructure installations are learning how to design charging sites, maintain infrastructure, anticipate demand, and select appropriate charging technologies.

The U.S. Department of Energy's 2014 report, A Guide to the Lessons Learned from the Clean Cities Community Electric Vehicle Readiness Projects, identified a number of obstacles that inhibit the development of charging facilities. As the number of EVs has grown since the report's publication and public and private sector stakeholders have grown more familiar with EVs and EV infrastructure, some of these have subsided. However, other challenges, particularly issues related to charger maintenance and perceptions of safety, have grown in importance. Table 2 lists the primary barriers to the installation and utilization of EV charging infrastructure.

Table 2: Barriers to Charging Station Installation and Utilization

Financial	Home charging equipment is often not sold or financed with EV purchases at dealerships.
	Cost of home charging equipment, installation, and permitting.
	Difficulty establishing a profitable business case for charging stations.
	Lack of established public or private funding for the purchase and/or maintenance of charging infrastructure.
Physical	Broken or otherwise non-functioning charging infrastructure.
	Long charge times at slower chargers may be inconvenient for drivers.
	Concerns about safety and crime, particularly in isolated or poorly lit locations.
Information and coordination	Difficulty providing charging stations at multi-unit residential, workplace, and other shared parking sites, such as cost, fairness, ownership, administrative, and legal issues.
	Lack of awareness about existing public charging stations.
	Uncertainty about the future intensity and location of demand for public charging stations.
	Uncertainty about the optimal charging power levels at public stations.
	Lack of compatibility among charging station payment methods, communications, and fast charging standards.
	Uncertainty about best practices for planning parking sites with public charging stations, including Americans with Disabilities Act (ADA) compliance.
	Efforts supporting charging station installation are not fully leveraged due to a lack of communication and coordination among potential partners.
Policy	Insufficient signage directing EV drivers to charging stations and non-uniform charging station signage.
	Expensive, complex, protracted, and non-uniform permitting and inspection procedures for residential and workplace charging station installation.
	Local zoning rules are vague or arduous for charging station siting.
	Charging-only use of public charging spaces cannot be enforced without new ordinances.

[24] Wood, E., et al. The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. National Renewable Energy Laboratory (2023). https://driveelectric.gov/files/2030-charging-network.pdf.

Charging Locations

Residences

With nearly 90% of EV charging taking place at home, residential charging is the most important component of the EV charging ecosystem. Current EV owners tend to have higher than average incomes and live in single-family homes. These owners may plug directly into a residential wall outlet for level 1 charging or install a faster level 2 charger.

In Dane County, those interested in installing level 2 charging infrastructure at home for personal use can take advantage of programs through local utilities that offer rebates for charger installation or offer owners the option of paying a monthly fee for the installation and use of a level 2 charger. However, simply plugging into a standard outlet for level 1 charging remains a popular option. A recent survey of 230 EV owners conducted by MGE found that among those who charged their vehicles at home, 42% used level 2 chargers and 58% used level 1.

Accessing charging infrastructure is more difficult for those living in multifamily homes or in other housing arrangements where they lack the ability to charge their vehicles at home. Zoning requirements, such as those in the City of Madison and the City of Verona that mandate the installation of charging infrastructure, are one way to increase charging access for these populations. In newer apartment buildings, particularly those catering to higher income residents, charging infrastructure beyond that required by local ordinances may be installed as an amenity to attract and retain residents.

Providing residential charging for people living in older, smaller, and lower-income apartment buildings, or in single family homes lacking off-street parking is more likely to require public investment. This may involve providing publicly accessible charging infrastructure in on- or off-street locations close to residences or providing funding for property owners to install charging facilities on-site.

Workplaces

Employer-provided charging infrastructure at workplaces is an amenity that has been used by employers to differentiate themselves from competitors, signal their commitment to sustainability, achieve corporate sustainability goals, and entice workers to return to an in-office work schedule following the large-scale telework brought on by the COVID pandemic. At some workplaces, charging infrastructure has also been installed to fuel fleet vehicles. Any workplace where employees leave cars parked for the duration of their shift is suitable for level 2 charging.

"Workplace charging" is normally defined as infrastructure installed by employers at workplaces for use by employees. To date, most charging infrastructure serving employees during the workday has fit this definition and has largely served higher income office workers.

Workplace charging may be either free or require payment. Data regarding workplace charging pricing policies is scarce, but as the number of EVs continues to rise, the number of workplaces offering free charging is expected to decline. Research has found that free workplace charging results in charging spaces being occupied more frequently by EVs that are not actively charging.[25]

The Alternative Fuels Data Center suggests setting workplace charging fees slightly higher than local utility rates.[26] This may help reduce charging station congestion by incentivizing those who can charge their cars at home to do so, while still providing low-cost charging to workers who cannot charge their vehicles at home. The decision of whether or not to offer workplace charging can raise equity issues. Some workplaces have been reluctant to install charging infrastructure due to concerns that it will disproportionately benefit high-

[25] Winn, Ryan. Electric Vehicle Charging at Work. University of California at Los Angeles, Luskin School of Public Affairs (n.d.). https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/EV_Charging_at_Work.pdf.

[26] Workplace Charging for Electric Vehicles. https://afdc.energy.gov/fuels/electricity_charging_workplace.html.

er income employees or have other workforce equity implications.

As EV ownership becomes more widespread across income levels, a growing share of employee charging during the workday is expected to take place at nearby public charging stations.

Corridor and Community Charging

Charging infrastructure along key transportation corridors and elsewhere in communities serves all types of users. Depending on how long drivers leave their cars parked, the length of their trips, and other factors, these non-residential non-work locations may offer either level 2 or level 3 charging, or both.

Charging in these locations may be funded publicly or privately for any number of reasons—to draw customers to nearby businesses or increase the time spent by visitors; to generate revenue through charging fees; or to incentivize people to park their cars at a multimodal transfer points and travel to their final destinations by transit, bike, or carpool.

In some cases, houses of worship and other organizations may install charging facilities for use by the public during certain times as a way to offer a service to the broader community and build goodwill.

Additional Considerations for Public Charging

Accessibility

The Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) generally require that publicly owned charging facilities, as well as public EV charging stations owned by private entities, are accessible to people with disabilities.

EV charging requires drivers to exit their vehicle, get the connector from the charging station, and carry the connector back to their vehicle's charging inlet. Since there is no standard location for a vehicle's charging inlet, drivers with mobility impairments must be able to maneuver around the entire vehicle. EV charging stations intended to serve people using mobility devices, such as wheelchairs and walkers, must be located on an accessible route and should include the following accessible mobility features:

- A vehicle charging space at least 11 feet wide and 20 feet long.
- Adjoining access aisle at least five feet wide.
- Clear floor or ground space at the same level as the vehicle charging space that enables unobstructed access to the charger.
- Accessible operable parts, including on the charger and connector.

EV charging stations should also have accessible communication features for people with disabilities that may interfere with their ability to use the charger interface, such as those with hearing or vision impairments. Key features include:

- Display screens that are easy to read and visible from a height of 40 inches.
- Speech output, with volume controls that can be used in conjunction with or instead of the display screen.
- Input controls that are high contrast and tactilely discernable.
- Related websites, card readers, and other features that are accessible to people of all abilities.

The U.S. Access Board's publication, Design Recommendations for Accessible Electric Vehicle Charging Stations, provides detailed information about EV charging station accessibility requirements.

Maintenance

Regular maintenance of public charging facilities is necessary to keep them in good working order. Non-functioning charging facilities inconvenience drivers and disrupt travel plans. They also present an equity issue. EV drivers who live in multifamily dwellings or are employed as ride-hail drivers (for Uber, Lyft, and other rideshare companies) tend to have lower incomes and are more likely to rely on public charging facilities for the bulk of their charging needs.

Maintenance of charging infrastructure is a significant obstacle to EV charging. Along with simple wear and tear issues, one of the most common and frustrating issues cited by steering committee members was problems connecting to the wireless network, which can prevent charging even when charging hardware is functioning and supplied with electricity. Vandalism is another common problem. In some areas, charging cables have been targeted by thieves for their copper content.

A shortage of maintenance staff and a lack of available replacement parts can result in charging facilities remaining out of order for long periods. Committee members noted that despite contractual maintenance agreements with charging networks, repairs are often not completed in a timely manner.

Researchers who evaluated all 181 public DCFC stations in the Bay Area that were open for general use (excluding Tesla Supercharger stations), found that only 72.5% were functional, despite the EV service providers (EVSP) who operate the stations indicating that over 95% of their chargers were operational.[27] These results are in line with other recent non-systematic surveys of EV owners. A 2022 survey of EV owners by Plug In

[27] Rempel, D., et al. Reliability of Open Public Electric Vehicle Direct Current Fast Chargers. UC Berkeley, 2022. https://arxiv.org/ftp/arxiv/papers/2203/2203.16372.pdf.

America found that 21%-26% of those using four major fast charging networks reported that non-functioning chargers presented a major difficulty. Just 4% of survey respondents said the same about the Tesla charging network.

About 5% of the stations in the Bay Area study had cables too short to reach the vehicle inlet, all of these occurred when drivers were attempting to charge a Chevy Bolt. Other non-functional stations suffered from nonfunctioning screens, payment system failures, charge initiation failures, network failures, or broken connectors. One potential source of the discrepancy in the percentage of operational chargers, as found by the researchers compared to that cited by EVSPs, is that EVSPs do not typically report the details of how they calculate uptime and downtime, such as the percentage of time that a given charger is or is not in working condition.

Effective compliance measures to ensure proper maintenance for charging infrastructure should be included in contracts with EVSPs to keep chargers in good working condition. Such compliance measures require clear definitions of reliability, uptime, downtime, and excluded time—time when charging infrastructure is nonfunctioning as a result of issues beyond the control of the EVSP. Measures such as mean recovery time and mean time between failures could also be useful benchmarks to assess the adequacy of EV infrastructure maintenance. Enlisting a third party to assess the adequacy of charging infrastructure maintenance may be a more effective means of assessing compliance than relying on assessments by EVSPs themselves. EV charging maintenance issues have led to the development of new businesses such as ChargerHelp!, a dedicated operations and maintenance service provider that contracts with clients to offer ongoing charger maintenance.

Networking

Charging networks can provide a wide variety of services related to infrastructure, financing, installation, operations, and maintenance.

Most commonly, they process payments via credit cards or smartphone applications, provide site owners with usage data, and provide customer support. They may also plan and coordinate installation, finance charging infrastructure purchases, and maintain charging infrastructure. Networked stations require wired or wireless internet access or cellular service.

In order to simplify and automate payment for EV charging, some vehicles and chargers feature plug-and-charge capability. This enables the charger to automatically determine the vehicle's make, model, ownership, and other relevant information, and to bill users using a linked credit or debit card—eliminating the need for drivers to log onto an app prior to charging. Tesla EVs and Tesla's level three charging network already have plug-and-charge capability. While standards[28] have been developed to enable plug-and-charge across vehicle types and charging networks, they have not yet been widely implemented.

According to the Rocky Mountain Institute's 2019 report, Reducing EV Charging Infrastructure Costs, networking contracts are typically $200-$250/year for each charger, with an additional $84-$240/year for data service. The report suggests that, to reduce data service costs, charging station operators should utilize Wi-Fi, ethernet connections, or other technology that enable multiple chargers to share their data service, rather than purchasing individual data plans for each charger.

Non-networked stations are not connected to the internet and cannot accept payments or offer advanced utilization monitoring.

Some charging infrastructure is "locked" to a certain network and is unable to be used with other charging networks. Charging infrastructure that uses the Open Charge Point Protocol (OCPP) version 1.6 or higher allows site hosts to switch networks without upgrading their hardware.

Installation

The biggest drivers of the cost of installing public EV charging infrastructure are:

- The power rating of the chargers.
- The existing grid power capacity at the site.

[28] ISO 15118.

- The location of the chargers within the site.[29]

The above-ground elements of the charging site—charging infrastructure, maintenance and communications contracts, and management software—typically only account for 10%–30% of total project costs. The larger share of costs are attributable to less visible infrastructure and installation work—conduit and feeder wire, trenching, etc.—and planning and permitting.[30]

Placement on Site

The placement of charging infrastructure on site affects usability, safety, and installation cost.

One of the most obvious obstacles to the use of EV charging infrastructure is blockage of EV charging spaces by vehicles with internal combustion engines (ICE). EV drivers sometimes refer to charging stations blocked in this way as being "ICEd." EV charging spaces in the most in-demand parking locations, such as adjacent to building entrances, appear to be ICEd more frequently than EV charging spaces located in less desirable locations.

Another way charging infrastructure placement can affect usability is when it makes it impossible to connect a vehicle to the charger without parking illegally. This is a common issue affecting vehicles with trailers. As more large EVs capable of pulling trailers come to market, this problem is likely to become increasingly visible. EV charging locations expected to serve substantial numbers of long-distance travelers should consider pull-through charging spaces, similar to those used for refueling at gas stations, which will enable use by vehicles with trailers.

Placement decisions should also account for the visibility of charging infrastructure and how safe users will feel charging their vehicles. Charging infrastructure should be located in visible, well-lit locations. This makes users feel safe and reduces the likelihood that unattended vehicles or charging infrastructure will be stolen or vandalized.

Finally, placement can drastically impact installation costs. Site owners should carefully consider the costs associated with trenching and installing conduit and wiring before deciding where charging infrastructure will be located on-site.

Electrical Grid Capacity

On most utility grids, the addition of a single 50kW DCFC port or a few level 2 chargers will not require additional power grid capacity. Larger or higher-powered charging installations are more likely to require upgrades to the power grid to provide them with a sufficient power supply. Most commonly, this would entail upgrading a distribution transformer, but sites drawing over one megawatt (MW) may also require upgrading the distribution grid feeder, which supplies power to the transformer. Even a small transformer can cost over $15,000, with an additional $8,000 in labor costs.[31]

Beyond the substantial cost of these upgrades, there is currently a transformer shortage affecting utilities across the U.S. This shortage has resulted in delays of up to two years.

Site owners interested in installing new EV charging infrastructure should contact their local utility as soon as possible to discuss the adequacy of the electrical infrastructure serving the proposed charging site and whether, and to what degree, the utility will share in the cost of required upgrades.

Safety

Personal Safety and Vandalism

Since charging infrastructure can be installed at a relatively low cost and does not require on-site staff for operation and monitoring, it can be installed in a variety of locations. As a result, charging infrastructure is sometimes located in dark or secluded areas.

Isolated installations create real and perceived personal safety issues that make users uncomfortable and unlikely to return. Secluded charging installations may also increase the likelihood that charging infrastruc-

[29] Nelder, Chris and Emily Rogers. Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute (2019). https://rmi.org/insight/reducing-ev-charging-infrastructure-costs.

[30] Ibid.

[31] Nelder, Chris and Emily Rogers. Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute (2019). https://rmi.org/insight/reducing-ev-charging-infrastructure-costs.

ture and unattended vehicles will be subject to theft or vandalism.

Placing charging infrastructure in visible, well-lit areas can help reduce real and perceived safety risks and the potential for vandalism.

Battery Fires

Fires involving EV batteries have made headlines in recent years. However, EVs are much less likely to catch fire than conventional or hybrid-electric vehicles, according to an analysis of data from the National Transportation Safety Board (NTSB) and the Bureau of Transportation Statistics (BTS) conducted by analysts from the auto insurance comparison site, AutoinsuranceEZ. Their analysis found that fires in EVs were 98% less frequent per 100,000 vehicles sold than in internal combustion vehicles.

While EVs catch fire far less frequently than other types of vehicles, fires involving EVs burn hotter and last longer than those involving conventional vehicles. According to the NTSB, they also pose unique risks to emergency responders due to the potential for electric shock and for batteries to explode or to reignite after being put out.[32]

EV fires related to batteries usually occur due to collisions, or during charging as a result of damage or manufacturing defects that increase the risk of fire while charging. To mitigate the risks of fires resulting from collisions, automakers have worked to reinforce battery protection in recent years to prevent their combustion following crashes. Auto manufacturers are currently exploring new types of EV batteries that may further reduce the risk of battery fires.[33]

Given the current early stage of EV development, battery technology is likely to continue improving in the coming years.

Vehicle Weight

Due to the weight of batteries, many EVs weigh hundreds or thousands of pounds more than equivalent ICE vehicles. Table 3 shows the difference in weight between 2024 EV and ICE vehicles of the same make and model.

The primary safety issue associated with these heavier vehicles is the risk they pose to other road users, with each additional 1,000 pounds of vehicle weight associated with a nearly 50% increase in baseline fatality risk for occupants of vehicles that are struck.[34] Vulnerable road users face a similarly elevated risk of serious injury or death when struck by heavier vehicles.

Beyond crash risks, however, the greater weight of EVs may present structural issues for parking structures, particularly those that are old or in poor condition. After a parking garage collapsed in lower Manhattan in early 2023, the weight of modern vehicles, including EVs, was identified as one potential contributing

Table 3: Comparing the Weight of EVs to Similar ICE Vehicles

Make	ICE Model	ICE Weight (lbs)	EV Model	EV Weight (lbs)	Difference
Ford	F-150	4,275	F-150 Lightning	6,015	1,740
Chevrolet	Blazer	3,918	Blazer	5,337	1,419
Audi	Q8	5,049	Q8 e-tron	5,798	749
Hyundai	Kona	3,005	Kona SE	3,571	566
Mini	Cooper	2,769	Cooper SE	3,143	374
*Weight shown is the lightest version of each model.					

[32] Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles. NTSB Report SR-20-01 (2020). https://www.ntsb.gov/safety/safety-studies/Pages/HWY19SP002.aspx.

[33] Cooley, Brian. "Why Electric Cars Burn, Why It's Overhyped and How to Fix It." CNET. December 10, 2022. https://www.cnet.com/roadshow/news/why-electric-cars-burn-why-its-probably-overhyped-and-how-to-fix-it/.

[34] Tucker, Sean. "Safety Experts Worried about Electric Cars' Weight." Kelley Blue Book. January 13, 2023. https://www.kbb.com/car-news/safety-experts-worried-about-electric-cars-weight/.

factor. American vehicles have become heavier in recent decades as light trucks and SUVs have grown in popularity. The transition to EVs will continue this trend. The weight of EVs and their extremely quick acceleration poses the additional risk of damage to walls and structural elements of parking garages, in the event of a vehicle crashing inside the facility.[35]

Parking facility operators should ensure their facilities are regularly inspected and properly maintained. There is currently no requirement for parking structure inspections unless they are being constructed or altered. However, following a partial collapse of the Bayshore Mall parking garage in Glendale, WI, Representative Darrin Madison (D-Milwaukee) has called for expanding the state's public building inspection law to ensure regular inspections of parking facilities.[36]

Signage

There are two main types of EV charging station signage:

- Wayfinding signage that helps people locate charging stations.
- Station signage that communicates information and policies.

Wayfinding signage located on roadways open to the public must comply with minimum design and placement standards defined in FHWA's Manual on Uniform Traffic Control Devices (MUTCD). The signs shown in Figure 8 are included in the MUTCD as approved wayfinding signage for EV charging stations and may be combined with directional arrows or mileage. State and local transportation departments may create their own custom signage as long as it meets the standards defined in the MUTCD.

Signage at charging stations highlights the location of charging infrastructure and informs drivers of the rules governing the use of the charging infrastructure and associated parking spaces. To be enforceable, signage in the public right of way must meet MUTCD requirements and be supported by local ordinances. Signage in private parking areas that are not open to the public is not required to meet MUTCD requirements, but signage that is consistent with the MUTCD may be easier for drivers to recognize and understand.

Figure 8: FHWA-Approved Wayfinding Signage for Charging Stations

Source: 2009 Manual on Uniform Traffic Control Devices, with Revision Numbers 1, 2, and 3 incorporated, dated July 2022.

Applications and Websites

The most common way that EV drivers locate charging stations on the road is through smartphone applications.

EV charging apps provide drivers with charging station locations, plug types, and the charging levels available, and may also inform users about maintenance issues, charger power levels (kW), current occupancy, or other information. Most EV manufacturers and charging networks have their own EV apps. Network apps may allow users to reserve chargers ahead of time, notify users when their vehicle reaches a certain charge level, or allow users to start or stop their charging sessions remotely.

PlugShare and ChargeHub both offer apps and websites featuring regularly updated information about all publicly accessible charging stations, in addition to other services. The Department of Energy's Alternative Fuels Data Center hosts the Electric Vehicle Charging Station Locations website with similar information.

While some apps offer trip planning among their other functionality, there are also apps specific to trip planning, such as A Better Route Planner (ABRP) that allow users to plan trips with suggested charging stops based

[35] Walker, Alissa. "Heavier Vehicles in Aging Parking Garages Are a Recipe for Disaster." Curbed. April 21, 2023. https://www.curbed.com/2023/04/parking-garage-collapse-heavier-electric-vehicles-suvs.html.

[36] Yount, Benjamin. "Milwaukee State Rep. Madison wants more inspections after mall parking garage collapse." The Center Square. February 23, 2023. https://www.thecentersquare.com/wisconsin/article_50292ff6-b6d8-11ed-8bef-6f6126a509d1.html.

on their specific vehicle's range, compatible plug types, and other features.

Ownership Model

Charging infrastructure is either owned by the owner of the charging site or by a third party, often a utility or charging network operator. Different types of ownership arrangements entail different levels of responsibility for maintenance and operating expenses and different levels of financial risk and reward for site owners.

Site owners who own their charging infrastructure and do not charge a fee for usage can take full responsibility for operations and maintenance themselves. However, site owners who want to charge users a fee must work with a charging network to process payments.

There are several common models for owning and operating charging stations that can reduce the risk and investment required for property owners interested in hosting EV charging infrastructure on their site.[37]

Supply and Operate

Under a "supply and operate" arrangement, the contractor supplies the charging equipment and ensures that it is up and running before passing some operational and maintenance obligations to the site owner. The level of ongoing maintenance and operational support is negotiated between the site owner and contractor.

This model offers the client the opportunity to benefit from increasing usage over time to generate an ongoing revenue stream. However, this arrangement also involves some risk, as it leaves clients responsible for a certain amount of maintenance and operational expenses.

Infrastructure as a Service

Under "infrastructure as a service" (IaaS) arrangements, site owners rent charging infrastructure from a contractor that is responsible for installation and continuing maintenance and operational responsibilities. IaaS arrangements allow the client to avoid risk and responsibility for the charging infrastructure. Revenue generated from charging fees goes to site owners.

Own and Operate

The "own and operate" model is a "turnkey" EV charging solution for site owners and is common in public sector settings. Under this arrangement, the client provides space for the provider to install and operate charging stations. The provider then handles operations and maintenance and keeps the revenue generated from charging fees.

Charging as a Service

"Charging as a service" (CaaS) arrangements are similar to the own and operate model but more common in private sector deployments. Under this arrangement, the client provides land for the charging infrastructure and the provider provides everything else, from maintenance to driver support services. Depending on the agreement between the client and the provider, the client may receive a portion of the revenue generated from charging fees.

Opportunities for Cost Reduction

The Rocky Mountain Institute's 2019 report, Reducing EV Charging Infrastructure Costs, identifies several strategies to lower the costs associated with expanding public charging infrastructure:

- Procure charging infrastructure in larger volumes. As the transition to electric vehicles continues to gather momentum and manufacturers increase their production, vendors are expected to offer larger discounts to buyers willing to purchase hardware in bulk.
- Consolidate charging sites. Larger charging installations reduce costs by spreading the fixed site preparation and utility connection costs across more chargers and reducing the number of sites that maintenance personnel need to visit.
- Carefully consider conduit runs. Digging trenches and laying conduit to connect charging infrastructure to utilities is costly. Locating charging infrastructure where there is a short, simple conduit path to the utility connection can significantly reduce installation costs.
- Plan for future infrastructure upgrades. Consider building new charging sites with the necessary con-

[37] "Expanding EV charging ownership models provide opportunities for both public and private sector investment." Smart Cities Dive. May 3, 2021. https://www.smartcitiesdive.com/spons/expanding-ev-charging-ownership-models-provide-opportunities-for-both-publi/599046/.

duit, grid capacity, and other required underground infrastructure so that additional or higher-powered chargers can be added more easily later.

- Install charging infrastructure during construction. Installing charging infrastructure during construction can save on design and installation costs and avoids the need to dig trenches through existing parking lots.

Pricing

To provide consistency to travelers and improve fairness for consumers, the federal government requires that federally-funded EV charging infrastructure calculate charging fees by kilowatt-hours used ($/kWh) rather than by time. Since different vehicles can accept vastly different levels of power from EV charging infrastructure, when charging fees are based on time rather than kWh, drivers pay much different rates for the power received. This discrepancy disadvantages lower-income EV drivers because older and less expensive vehicles, which usually cannot accept as fast of a charge, cost more to charge when fees are based on time rather than energy used.

Because Wisconsin state law currently prohibits anyone other than utilities from charging fees based on electricity usage, EV charging stations in the state generally charge fees based on time spent charging rather than by kWh. The state will need to change this law to unlock federal funding for charging infrastructure.[38] As of February 2024, legislation to make this change is moving through the State Legislature.

Pole-Mounted Chargers

Pole-mounted chargers (PMCs), charging infrastructure mounted on streetlight or utility poles, can be a flexible and low-cost way to provide on-street charging infrastructure. London, England has over 7,000 PMCs, but the technology is still in its infancy in the U.S. Los Angeles currently leads the nation with over 430 PMCs mounted on streetlights.[39]

Research and guidance for communities in the U.S. interested in PMCs is sparse, but a 2021 paper from the World Resources Institute, based on interviews with city governments, utilities, charging equipment manufacturers, and others involved in efforts to deploy the technology in the U.S., offers some helpful insights for communities interested in this technology:

- PMCs can reduce installation costs by 55%-70% compared to ground-mounted chargers and can be shifted to other locations fairly easily, if needed.
- The ability to site PMCs in developed areas without the need for land acquisition or additional curbside space makes them a good option for providing residential charging access to people who cannot currently charge their vehicles at home.
- Although PMCs can be successfully mounted on streetlight poles, utility poles are usually a better option because of their higher electrical capacity.
- Streetlight and utility pole ownership and rules affecting their viability as PMC mounting locations vary widely across jurisdictions. The first steps for any community exploring the installation of PMCs should be to determine who owns the streetlight and utility poles, and to contact their utilities and any public agency staff that manage the poles to discuss any obstacles (infrastructure, regulations, etc.) that might render PMCs infeasible.

MGE currently has a pilot program to test PMCs in the Madison area. It is installing PMCs on utility poles at several locations in the area. The first of these was installed on Madison's east side in the Darbo-Worthington neighborhood.

[38] Letter from Wisconsin Department of Transportation Office of the Secretary. August 10, 2022. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=476785.

[39] Los Angeles Streetlight EV Charging Stations: https://lalights.lacity.org/connected-infrastructure/ev_stations.html.

Policy and Planning Tools

Local and state governments have a wide variety of plans, policies, ordinances, and procedures that can affect the expansion of EV charging infrastructure.

Comprehensive plans

Comprehensive plans are the foundation of local transportation and land use planning and decision making. Identifying EVs as a part of the local transportation strategy provides a basis for zoning and other local ordinances to be tailored to promote the use of EVs and encourage the development of EV charging infrastructure.

Zoning

Zoning codes that explicitly address EV charging infrastructure reduce confusion for installers and government officials, making installation faster and more efficient.

EV charging-related issues that can be dealt with in the zoning code include:

- Where charging stations are permitted, by right or conditionally.
- Charging power levels allowed in different locations.
- Requirements that parking areas be equipped with EV charging infrastructure or be EV ready—equipped with electrical infrastructure needed to facilitate future installation of EV charging infrastructure.
- Site design guidelines—signage, lighting, accessibility, etc.
- Incentives for installation—density bonuses, relaxed parking minimums, etc.

Even in the absence of requirements or incentives for parking areas to be EV ready or have charging infrastructure installed, ensuring that zoning regulations pertaining to EV infrastructure installation are clear can make it simpler and less costly to install.

Parking Regulations and Enforcement

Local parking ordinances set the terms of use for publicly-accessible parking facilities, including curbside parking spaces. Because EVs need to park to charge, it is important to ensure that these ordinances support community EV charging goals.

Key considerations include:

- Parking restrictions and penalties for EV-designated spaces.
- Minimum proportion of EV-designated spaces.
- EV parking space design and location.

If EV-designated parking spaces are included in municipal parking facilities, local governments need to clarify their terms of use, including days and hours of operation, fees, time limits, and whether to offer reduced parking fees for charging vehicles.

Some communities, including Washington, D.C., Portland, OR, and Cambridge, MA, allow EV owners to charge their vehicles in public on-street parking spaces adjacent to their homes using an extension cord across the sidewalk. Charging is limited to level 1 and cords must be covered with ADA-accessible ramps where they cross the sidewalk. Residents are required to move charging cords when not in use and comply with other rules regarding safety and accessibility. Enabling residents to charge their vehicles on the street using extension cords offers an immediate charging solution that may be particularly effective in older neighborhoods consisting of single-family homes and small apartment buildings with limited off-street parking.

Right-to-Charge Laws

Right-to-charge laws give residents of condominiums, rental apartments, and homes subject to oversight by homeowners' associations the right to install charging infrastructure for their individual use. Residents are responsible for all installation costs and must comply with reasonable restrictions set by owners or governing associations on the number, size, placement, and manner of charger installation. Right-to-charge laws most commonly apply to residents of owner-occupied residential units, but some also apply to renter-occupied housing and commercial properties.

Normally, the right-to-charge extends only to designated parking spaces, but some laws allow residents to install charging infrastructure in common parking areas as well.

Right-to-charge laws generally include:

- A prohibition against provisions in leases, contracts, or other agreements that prohibit or unreasonably restrict the installation and use of charging infrastructure.
- Exceptions to the prohibition, such as dimensions or placement.
- Conditions with which the resident tenant or homeowner must comply or that the condominium association, homeowners' association, or landlord may require.

States have taken the lead in implementing right-to-charge policies, with at least 12 states having enacted some version of right to charge legislation. While the City of Chicago and other local governments have considered right-to-charge ordinances, no local right-to-charge laws have been implemented.

Current and Future EVs

In January 2023, there were 3,397 EVs registered in Dane County, representing 0.7% of all vehicles registered in the County, and there were 13,893 EVs registered in Wisconsin, representing 0.2% of all vehicles registered in the state. Although EVs account for just a fraction of a percent of vehicles on the road today, the number of EVs in Dane County, and in the state overall, grew by about 50% during 2022.

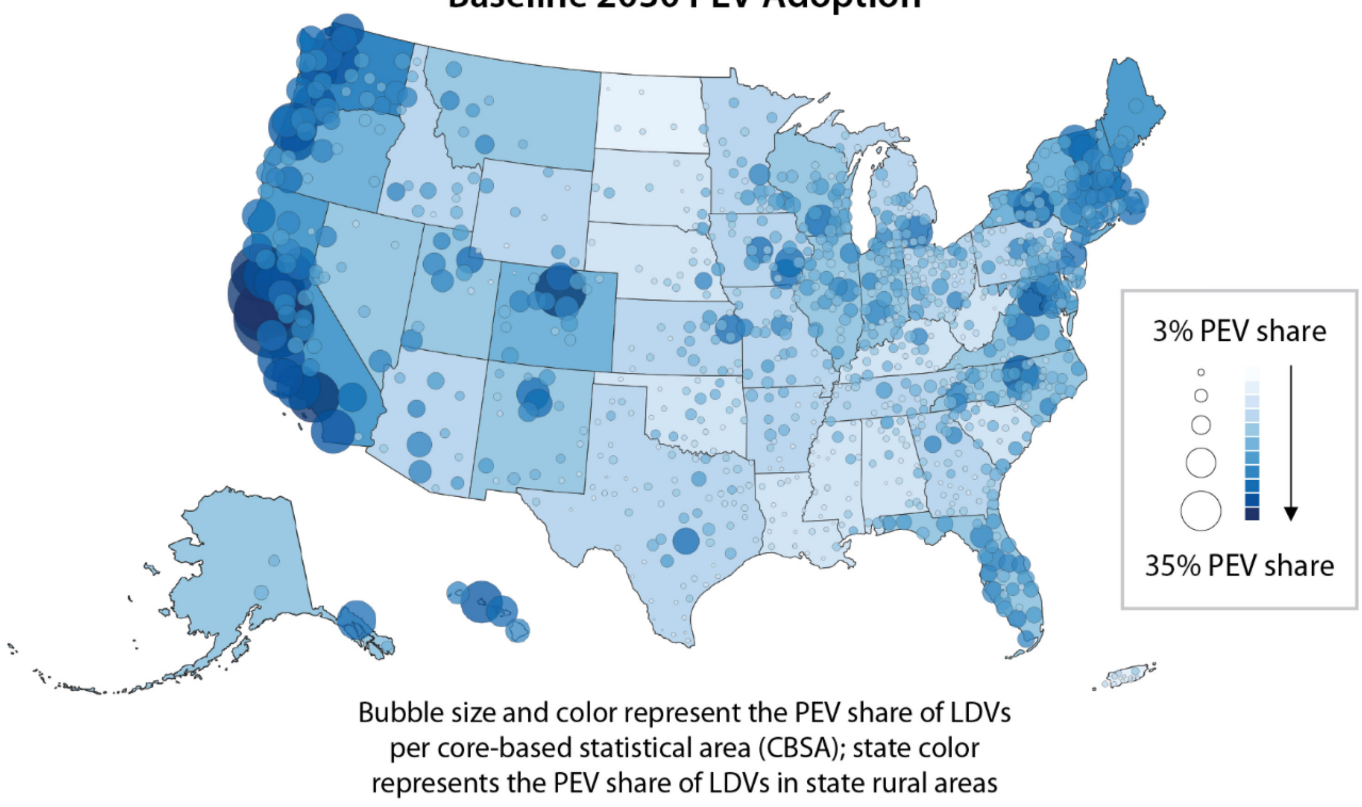
This tremendous growth is in keeping with the Wisconsin Electric Vehicle Infrastructure (WEVI) Plan's projection that the number of EVs in the state will grow Soto nearly 1.9 million, 31% of all vehicles in the state, by 2050. Depending on whether Dane County EV adoption tracks with the rest of the state or continues on its current, more rapid trajectory, we can expect 45,000-85,000 EVs (13%-16% of all vehicles) by 2030 and 185,000-470,000 EVs (32%-81% of all vehicles) by 2050.

These projections align with recent estimates from the National Renewable Energy Laboratory. As shown in Figure 9, the Madison area is expected to have one of the highest shares of EVs—shown in the figure as PEVs, plug-in electric vehicles—in the Midwest in 2030.

Charging Stations

The U.S. Department of Energy recommends 3.4 public DCFC ports and 40 public and workplace level 2

Figure 9: Plug-In Electric Vehicle (PEV) Adoption in 2030



Source: 2030 National Charging Network: Estimating U.S. Light Duty Demand for Electric Vehicle Charging Infrastructure

charging ports per 1,000 EVs.[40] Dane County currently exceeds these recommendations. As of late 2022, there were 284 public charging ports in Dane County—55 DCFC and 229 level 2 ports. This equates to 16 DCFC and 67 level 2 ports per 1,000 EVs in the County. This figure does not include workplace and other charging facilities that are not open to the public.

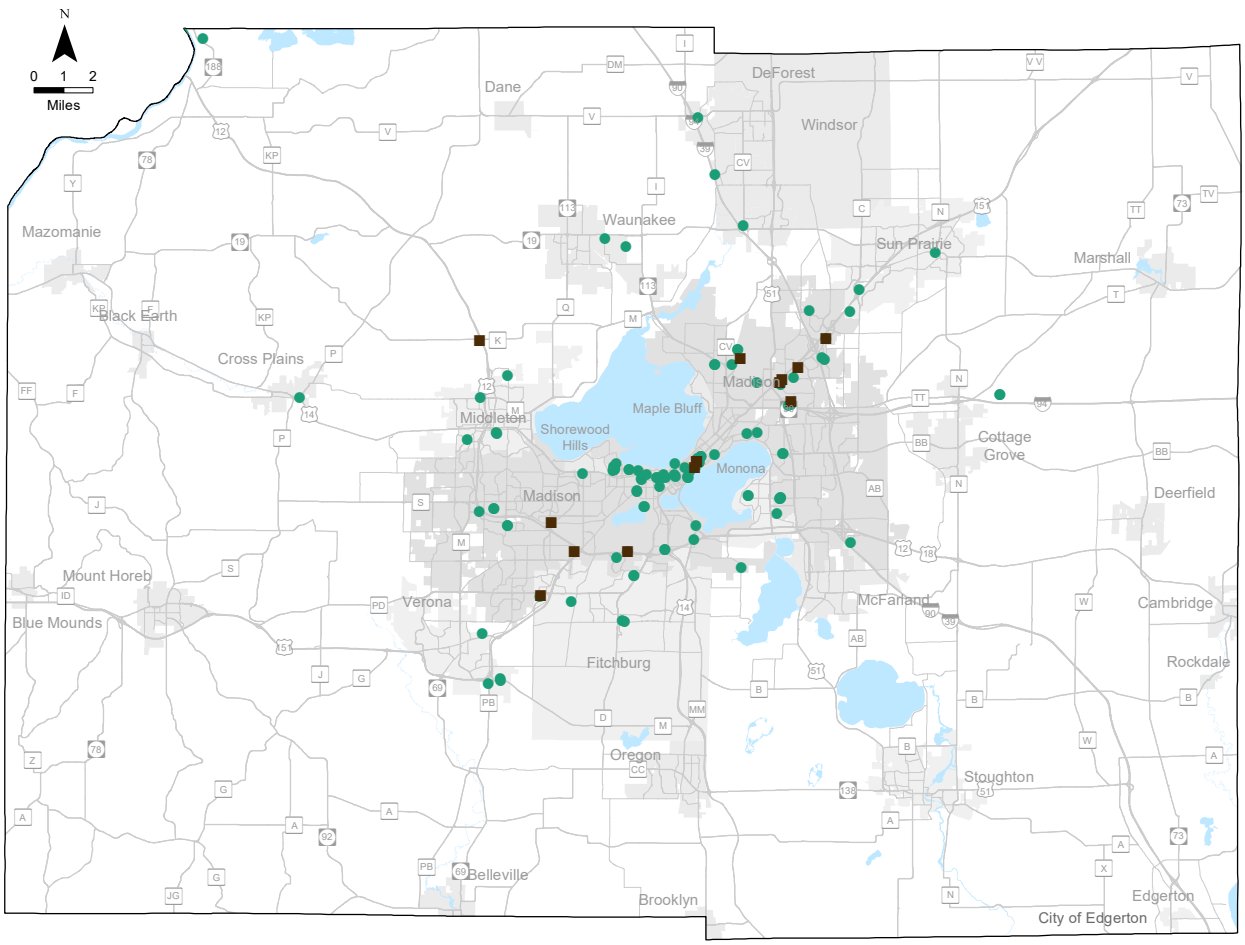
While the County currently exceeds the suggested minimum ratio of chargers to EVs, it must continue to expand the availability of charging infrastructure to ensure that the County's charging infrastructure is sufficient for the increasing number of EVs expected in the coming years.

Figure 10 details the locations of current level 2 and 3 public charging stations in the County.

Networks

There are 24 charging networks operating in the US, 8 of which are operating in Dane County. The ChargePoint network is the largest in the US, operating 41% of all charging ports. ChargePoint is also the most widespread in Dane County, with the overwhelming majority

Figure 10: Public Charging Stations in Dane County



Source: Alternative Fuels Data Center

[40] Wood, E., et al. National Plug-In Electric Vehicle Infrastructure Analysis. U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. September 2017. https://www.energy.gov/sites/default/files/2017/09/f36/NationalPlugInElectricVehicleInfrastructureAnalysis_Sept2017.pdf.

of level 2 charging ports and about 20% of DCFC ports. Tesla is the most widespread fast charging network in the U.S. and in Dane County, operating more than half of all level 3 chargers in the County.

Tesla is the most widespread fast-charging network in the U.S. and in Dane County, operating more than half of all level 3 chargers in the County.

Table 4: Level 2 Charging Networks in Dane County (December 2022)

Network	Charging Locations	Ports
ChargePoint	64	182
Non-Networked	19	35
Shell Recharge	1	4
Blink	2	3
AmpUp	1	2
Tesla	1	2
SemaCharge	1	1

Table 5: Level 3 Charging Networks in Dane County (December 2022)

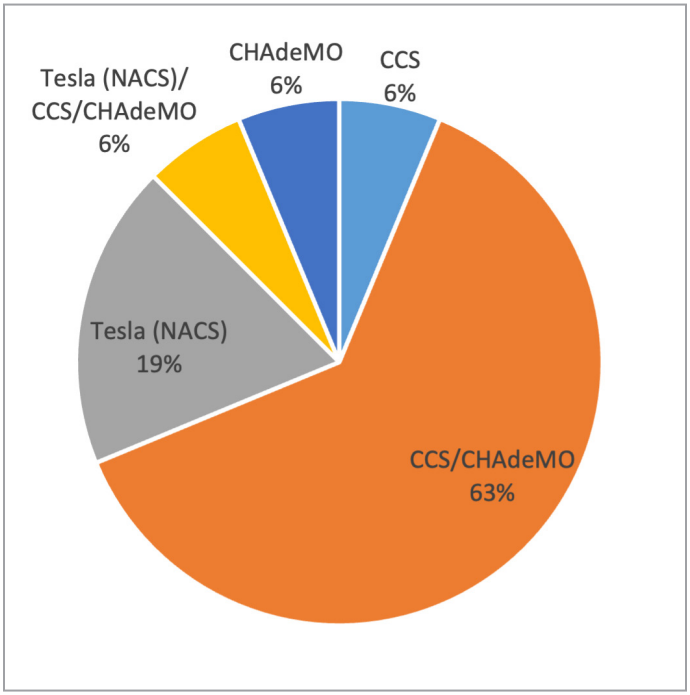
Network	Charging Locations	Ports
Tesla	3	19
Tesla/Shell Recharge	1	16
ChargePoint	6	8
Blink	1	4
Electrify America	1	4
eVgo	2	2
Non-Networked	2	2

Plug Types

Over 96% of level 2 charging locations in Dane County are equipped with J-1772 connectors, which can charge all non-Tesla EVs, and can charge Tesla vehicles using an adaptor.

There is more variation in plug types among DCFC charging locations, as shown in Figure 11. While only 25% of fast charging locations are equipped with Tesla (NACS) plugs, they are concentrated at larger charging stations and represent about half of all fast charging ports in Dane County. Similarly, although CCS and CHAdeMO plugs are available at a similar number of locations, these normally have only a single CHAdeMO plug paired with a larger number of CCS plugs. CCS plugs are now the dominant non-Tesla plug type.

Figure 11: Plug Types at Level 3 Charging Locations (December 2022)



Fees

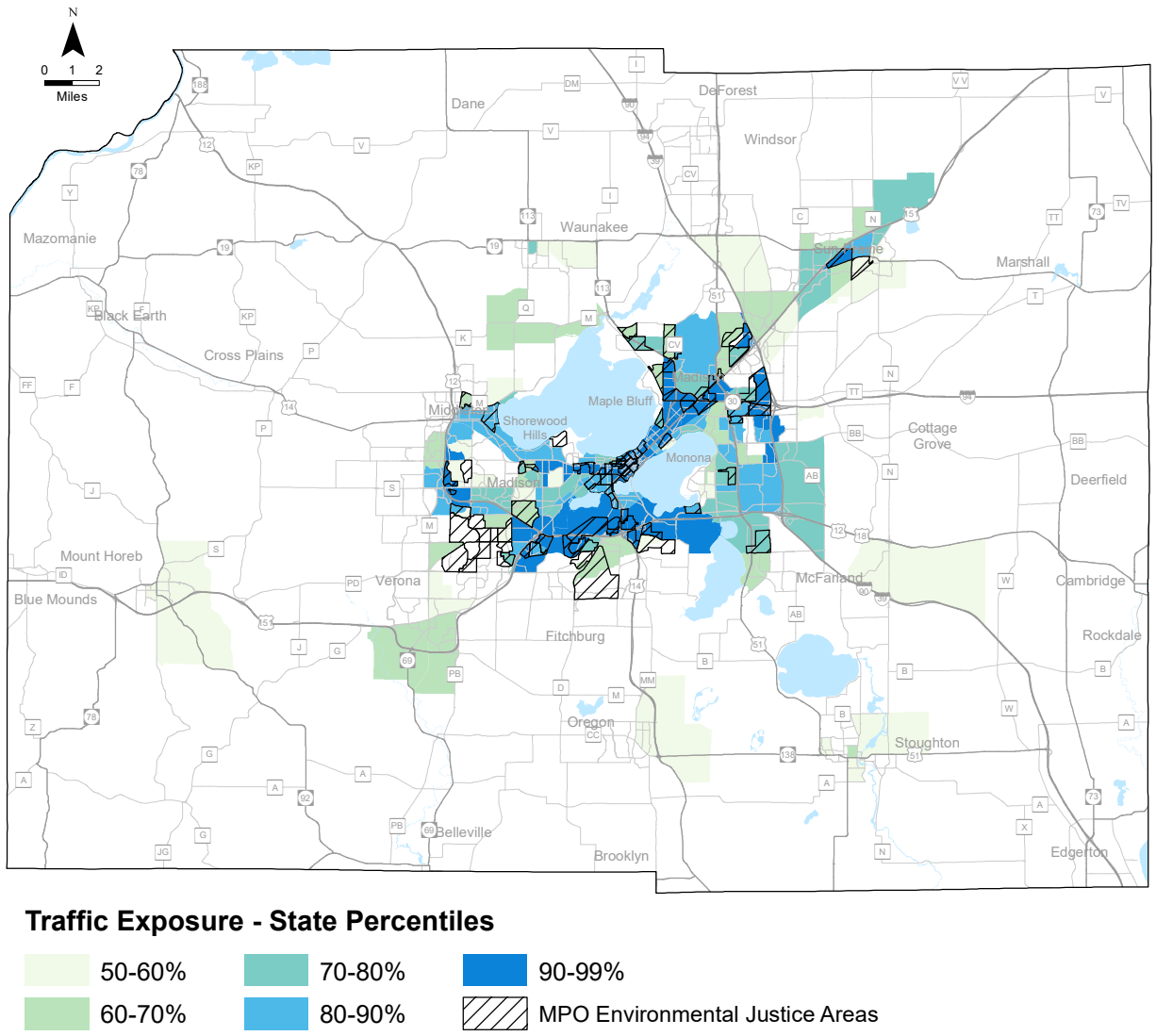
EV charging costs vary widely. Due to state laws limiting the sale of electricity to utilities, fees are normally based on the time spent plugged into the charger rather than the amount of electricity used.

For level 2 charging, the most common rate is $2 per hour, with a discount for members of Madison Gas and Electric's (MGE) EV Owners Group, as shown in Table 6. Free charging is also common for level 2 charging. However, free chargers are often located in paid or permit-only parking areas.

Table 6: Level 2 Charging Fees (December 2022)

Fee Structure	Charging Locations	Ports
$2 per hour, 50% discount for MGE EV Owners Group Members	19	56
Paid/permit parking, free charging	12	32
Free (may have restrictions)	11	24
Paid parking, paid charging	3	14
Other/Unknown	41	103

Figure 12: Traffic Exposure by Census Block



Source: EPA EJScreen

As shown in Table 7, Level 3 charging is most commonly $5 per hour, with a discount for members of MGE's EV Owners Group.

Table 7: Level 3 Charging Fees (December 2022)

Fee Structure	Charging Locations	Ports
$5 per hour, 50% discount for MGE EV Owners Group Members	6	22
$0.30-$0.32/minute	3	6
Other/Unknown	7	27

While MGE has based the fees for its chargers on time, the utility is currently seeking approval from Wisconsin's Public Service Commission (PSC) to change its rate structure to one based on a cost per kWh. Regardless of whether MGE's proposed rate structure is approved, state statutes will need to be amended to enable EV charging infrastructure operators that are not public utilities to base fees on kWh.

Households and Housing Type

According to the most recent 5-year American Community Survey estimates, 49% of households in Dane County live in owner-occupied single-family detached homes and 37% live in owner- or renter-occupied attached or multifamily homes.

It is generally easier for those living in owner-occupied single-family homes to access electrical outlets to charge their vehicles overnight and install desired EV charging infrastructure—lowering the barriers to ownership. Renters and those living in multi-family homes are often unable to charge their vehicles at home. Even if they can charge their vehicles at home, they often are unable to install level 2 chargers to facilitate faster charging. Single-family homeowners who lack off-street parking face many of the same issues.

Lower-income people are more likely to live in homes where it is difficult or impossible to charge their vehicles. Because EVs are less costly on a per-mile basis than fossil-fueled vehicles, residential charging access an important equity issue.

Rural areas present unique opportunities and challenges for the EV transition. Because they tend to drive more on a daily basis than their urban counterparts, rural residents can expect greater savings from driving an EV. Rural residents are also more likely to live in a single-family home with off-street parking where they can charge their vehicles. On the other hand, publicly accessible EV charging infrastructure is concentrated in urban areas, which is an obstacle to rural residents who are unable to charge a vehicle at home.

Public Health and Environmental Justice

Air quality is a major community health and environmental justice concern in Dane County. Regulatory air quality sensors in Dane County[41] have recorded some of the highest concentrations of particulate matter air pollution in the state. Particulate matter air pollution, especially fine particles ($PM_{2.5}$), poses serious respiratory and cardiovascular health risks. The size of this contaminant poses a barrier to removal by the natural defenses of the human body leading to the settling of the material in the lungs. Exposure to $PM_{2.5}$, even short-term peaks or spikes in air pollution, can lead to an increased risk of human respiratory and cardiovascular diseases, with a greater disease burden among vulnerable populations.

For both ozone and $PM_{2.5}$, Madison is passing the health-protective standards set by the EPA, but there is still reason to value the benefits of EVs on these two major air pollutants.[42] First, compliance with EPA regulations does not on its own reflect healthy air. Dane County has been given a "C" for ozone by the American Lung Association in its most recent ranking.[43] Similarly, regional $PM_{2.5}$ measurements do not reflect the much higher $PM_{2.5}$ concentrations near high traffic roadways. The City of Madison is currently deploying a network of 68 low-cost $PM_{2.5}$ sensors to collect data about $PM_{2.5}$ "hot spots" that are not captured by the two existing regulatory $PM_{2.5}$ monitors.[44]

Research shows that vehicles are the leading contributor to high particulate matter pollution in our region, producing over a fifth (21%) of all $PM_{2.5}$ pollution.[45] These emissions are disproportionately concentrated in low-income and minority communities. A majority of the MPO's Environmental Justice Priority Areas are in the top 10% of block groups statewide in their exposure to motor vehicle traffic and related emissions, as shown in Figure 12.

Exposure and vulnerability to air pollution are experienced more acutely by low- and moderate-income residents, historically marginalized racial and ethnic groups, people with disabilities, children, and the elderly. In Wisconsin, racial and ethnic minority and low-income communities are disproportionately burdened by respiratory and cardiovascular illnesses—with a higher

[41] The Wisconsin Department of Natural Resources operates two high-tech air quality monitors in Dane County to ensure compliance with the Clean Air Act.

[42] 2022 Wisconsin Air Quality Trends Report. Wisconsin Department of Natural Resources. https://widnr.widen.net/s/kdnkqvxxzl/am620.

[43] American Lung Association, State of the Air (2023). https://www.lung.org/research/sota/city-rankings/states/wisconsin/dane.

[44] Hubbuch, Chris. "Madison to use low-cost sensors to measure neighborhood air quality." Wisconsin State Journal (Nov 27, 2022). https://madison.com/news/local/environment/madison-to-use-low-cost-sensors-to-measure-neighborhood-air-quality/article_558f2731-5094-5b7f-b28a-a40a0ca08b3e.html.

[45] Jackson, C.M., Holloway, T., & Tessum, C.W. City-scale analysis of annual ambient PM2.5 source contributions with the InMAP reduced-complexity air quality model: a case study of Madison, Wisconsin. Environmental Research Infrastructure and Sustainability (2023). https://iopscience.iop.org/article/10.1088/2634-4505/acb0fa.

frequency and greater severity of asthma and heart disease than non-Hispanic White, and non-low-income populations.[46, 47, 48, 49]

Electricity Generation

Dane County has set ambitious goals for the transition from fossil fuels to renewable electricity generation. The goals identified in the Dane County Climate Action Plan call for wind power to meet half of the County's energy needs by 2030, with solar generating another third. The Plan calls for 100% of electricity generation to be derived from renewable sources by 2045.

MGE is currently on track to meet its goal of reducing carbon emissions by 80% (from 2005 levels) by 2030 and to achieve net-zero carbon electricity by 2050.[50] It is currently phasing out coal and plans to use it only as a backup energy source by 2030, and to have phased it out completely by 2035.[51]

Alliant Energy and WPPI Energy are on similar paths of GHG reduction. Alliant will be retiring its remaining coal-fired power plants in Wisconsin by mid-2026 and plans to cut its carbon emissions 80% (from 2005 levels) by 2040.[52] WPPI is on track for a 45% reduction in carbon emissions by 2025 (relative to 2005 levels) and plans to be carbon neutral by 2050.[53] Even with the current mix of renewable and non-renewable energy sources, EVs represent a significant improvement in total emissions relative to conventional vehicles. These emissions benefits will dramatically improve as electricity generation shifts to renewable, non-emitting energy sources.

Permitting and Inspections

The state of Wisconsin has adopted the NFPA 70 National Electrical Code, (NEC)—2017, with some exceptions, as the state electrical code. Article 625 of the NEC details requirements for EV charging infrastructure.

EV charging infrastructure is not specifically addressed by municipal building or electrical codes in Dane County but, like other electrical work, must be inspected and

Table 8: City of Madison EV Charging Station Requirements

	Residential Spaces		Non-residential spaces	
Years	EV Ready	EV Installed	EV Ready	EV Installed
2021-2025	10%	2%	10%	1%
2026-2030	20%	4%	20%	2%
2031-2035	30%	6%	30%	3%
2036-2040	40%	8%	40%	4%
2041+	50%	10%	50%	5%
Application:	Where six or more parking spaces are being provided for residential uses		Where parking is being provided for certain uses where people park in excess of six hours	

[46] Wisconsin Department of Health Services, et al. Asthma in Wisconsin. 2020. https://www.dhs.wisconsin.gov/publications/p02412-20.pdf.

[47] Wisconsin Department of Health Services. Health Disparities in Wisconsin Hospitalizations for Asthma. 2019. https://www.dhs.wisconsin.gov/publications/p01727.pdf.

[48] Wisconsin Department of Health Services, et al. Wisconsin Asthma Plan 2021-2025. https://www.chawisconsin.org/wisconsin-asthma-coalition-releases-2021-2025-wisconsin-asthma-plan/.

[49] Public Health Madison and Dane County. Healthy Dane Community Health Dashboards. http://healthydane.org/?hcn=CommunityDashboard.

[50] MGE Energy Inc. CDP Climate Change Questionnaire 2022 Friday, July 29, 2022. https://www.mge.com/MGE/media/Library/environmental-report/2022/2022-CDP-Climate-Change-Questionnaire.pdf.

[51] "Messages from Leadership." MGE. https://www.mge.com/responsibility-and-sustainability/2022-corporate-report/messages-from-leadership.

[52] WPPI Energy. 2022 Annual Report. https://wppienergy.org/wp-content/uploads/resources/2022-Annual-Report.pdf.

[53] "Clean Energy Vision and Goals." Alliant Energy. https://www.alliantenergy.com/cleanenergy/ourenergyvision/responsibilityreport/cleanenergyvisiongoals.

permitted in accordance with general electrical code requirements.

Excluding site alterations that require zoning approval, the permitting and inspection process for EV charging infrastructure is fairly straightforward. According to City of Madison staff, the most common inspection-related stumbling block for new EV charging infrastructure, particularly in older residential settings, is a lack of sufficient electrical panel capacity to accommodate the additional load associated with EV charging.[54]

Planning for EVs in Dane County

Dane County Climate Action Plan

The Dane County Climate Action Plan highlights the need to rapidly transition from conventional vehicles to EVs as a top priority. It identifies accelerating EV uptake as one of the biggest determinants of whether the County will attain its goal of reducing total greenhouse gas (GHG) emissions by 50% by 2030 and achieving carbon neutrality by 2050. The plan sets a goal of EVs accounting for 40% of new vehicles sold in the County by 2030 and 57% by 2040.

Connect Greater Madison 2050 Regional Transportation Plan

The Greater Madison MPO's 2050 Regional Transportation Plan notes the importance of facilitating the transition to EVs from conventional vehicles as a way to reduce vehicle emissions, slow climate change, and reduce reliance on fossil fuels. It suggests that local governments work to speed the growth of charging networks by allowing, incentivizing, or requiring property owners to make the necessary improvements to increase the availability of charging infrastructure.

The plan also recommends a vehicle charging infrastructure readiness assessment to help local governments understand the current state of charging infrastructure and provide them with the information needed to prepare for the increasing number of EVs. The present plan was completed, in part, to satisfy this recommendation.

Local Programs and Policies

Public EV Charging Infrastructure in Publicly-Owned Parking Facilities

The cities of Madison, Fitchburg, Monona, and Middleton as well as Dane County have partnered with MGE to place public charging infrastructure in their parking facilities.

The City of Madison has partnered with MGE to install chargers at six city-owned parking facilities. Each facility has one charger serving the general public and one ADA-accessible charger.

The Cities of Fitchburg, Monona, Middleton, and Sun Prairie have each installed a total of four ADA-accessible and general purpose chargers at municipal parking facilities in central locations serving their community centers, city halls, and libraries.

Dane County has installed charging infrastructure at the Dane County Regional Airport and at several County parks.

Zoning Code Requirements for EV Ready and EV Installed Parking Spaces

City of Madison

The City of Madison amended its zoning code in 2021 to implement EV Ready/EV Installed Requirements for Parking Facilities[55] stipulating that certain new, expanded, or significantly reconstructed parking facilities must include parking spaces that are EV ready—equipped with electrical infrastructure needed to facilitate future installation of EV charging infrastructure, as well as parking spaces with fully installed charging infrastructure.

The requirements pertain to parking facilities with at least six residential parking spaces and those that provide parking in locations where people are expected to remain for more than six hours. As shown in Table 8, the minimum number of EV-ready and EV-installed spaces increases every five years until 2041.

Parking lots required by the ordinance to include at least three EV-installed parking spaces must ensure that at least one ADA-accessible parking space is served by installed EV charging infrastructure. The

[54] Kyle Bunnow, P.E., Plan Review and Inspection Supervisor, City of Madison Building Inspection Division. July 13, 2023.
[55] 28.141(8)(e).

required number of ADA-accessible parking spaces equipped with charging infrastructure rises along with the required number of EV installed spaces, as shown in Table 9.

Table 9: City of Madison ADA Accessible EV Charging Requirements

Accessible Stations	
Number of EV Installed Spaces Required	Minimum Accessible EV Installed Spaces
0-2	0
3-50	1
51-100	2
101+	3 +1 for each additional 50 spaces

The same ordinance also amended the zoning code to specify that electric vehicle charging facilities—standalone facilities existing for the purpose of providing electric vehicle charging on a retail basis—are a permitted use in commercial, employment, mixed-use, parks and recreation, and airport districts.[56]

City of Verona

The City of Verona requires[57] every new parking facility with at least 50 parking spaces include at least one space served by EV charging infrastructure and that another charging space be provided for every additional 50 spaces or fraction thereof.

Utility-driven Programs and Policies

Madison Gas and Electric

Madison Gas and Electric (MGE), Dane County's largest utility, supports the transition from conventional to electric vehicles through several programs:

- Promoting and providing information about EVs.
- Leasing level 2 home charging infrastructure to customers.
- Managing EV home charging demand to reduce energy bills.
- Operating a network of charging stations.

The LoveEV website provides a wealth of information about EVs, ranging from general information about EV charging and costs, to specific information about available vehicles, to information on MGE's EV-related programs.

The Charge@Home program provides homeowners with a level 2 charger installed at their home for a monthly fee of $20, which includes system installation and maintenance. The chargers installed through the program can provide 10 to 25 miles of range per hour.

Whether they use a level 2 charger or plug directly into a wall outlet for level 1 charging, EV owners can recharge their vehicle at a lower cost by enrolling in the Charge Ahead program, which directs electricity to EVs during periods of lower demand or when renewable energy is more productive and offers incentives to drivers for charging during off-peak hours. EV owners can increase their savings by also enrolling in the Shift & Save program, which offers discounted electric rates during off-peak hours.

MGE also operates a charging network with over 40 locations in the Madison area, all of which are powered with 100% renewable energy. MGE recently completed a new EV fast-charging hub on the 700 block of East Washington Avenue in downtown Madison. The hub includes eight fast charger stalls with power levels up to 350 kW, which enable charging at a rate of 12-18 miles per minute, as well as eight Tesla Superchargers.

To provide charging options to underserved communities, MGE is embarking on a pilot program to install pole-mounted charging infrastructure (PMCs) in neighborhoods where residents are less likely to have an off-street place to charge at their homes. Over the next year, they plan to install five level 2 PMCs on utility poles in the City of Madison. While the PMCs will serve nearby residents, they are also prioritizing locations near free amenities, such as parks and libraries, where drivers can wait while their vehicles charge.

Alliant Energy

Alliant Energy also supports the transition to EVs with the WattPlan website that helps users understand the

[56] Ordinance No. ORD-21-00001, https://library.municode.com/wi/madison/ordinances/code_of_ordinances?nodeId=1068590.

[57] Sec. 13-1-151(d)(5).

financial benefits of driving an EV, and by promoting their Nights and Weekends rate plans, which can help users reduce EV charging costs.

The WattPlan website walks users through potential EV options, compares them to similar ICE vehicle options, and details the total costs and benefits of choosing an EV. It details the expected charging infrastructure installation and electricity costs, monthly expenses, available tax credits and incentives, and the breakeven point at which the additional cost of purchasing an EV is outweighed by lower fuel and maintenance costs.

Alliant Energy's Nights and Weekends rate plans offer residential customers lower electrical rates during weekends and off-peak hours (8 p.m.–10 a.m.) during the week, with higher rates during weekday peak hours. EV drivers enrolled in the program can lower their utility bills by charging their cars in the evening.

WPPI Energy

WPPI Energy member utilities in Dane County—Sun Prairie Utilities, Waunakee Utilities, Stoughton Utilities and Mount Horeb Utilities—all provide customers with educational resources, rate plans, and financial incentives to help customers transition to EVs.

Each utility has dedicated web content that provides information on the benefits of EV ownership, potential cost savings, and different types of EVs. They also provide resources to help users locate EV charging stations.

They also offer special rate plans to help EV customers lower their monthly bills by charging during off-peak times—after 8 p.m. on weekdays and anytime on weekends. In 2023, Waunakee Utilities implemented a new Nighttime EV charging plan for EV owners to charge at a reduced rate during the hours of 12am to 5am every day.

In addition, the WPPI member utilities offer rebates of up to 50% of the cost of installing level 2 charging infrastructure. Residential customers are eligible for rebates of up to $250. Commercial customers can receive up to $1,500 for the installation of a dual port level 2 charger.

Funding Sources and Incentives

The Bipartisan Infrastructure Law and the Inflation Reduction Act created a number of new programs focused on increasing environmental sustainability, which can provide funding for EV charging infrastructure. Some of these programs are focused specifically on EV charging infrastructure but most are broader, with the installation of EV charging infrastructure representing just one potential activity.

Beyond these, there are other USDOT programs that can provide funding or financing for EV-related projects, but which are not specifically focused on EV infrastructure.

Bipartisan Infrastructure Law

The Bipartisan Infrastructure Law (BIL), also known as the Infrastructure Investment and Jobs Act, established two new programs to support investment in fueling infrastructure for EVs and other alternative fuel vehicles: the National Electric Vehicle Infrastructure (NEVI) Formula Program and the Discretionary Grant Program for Charging and Fueling Infrastructure. The BIL also created the Carbon Reduction Program, which can provide funding for a wide variety of projects that reduce GHG emissions, including EV-related projects.

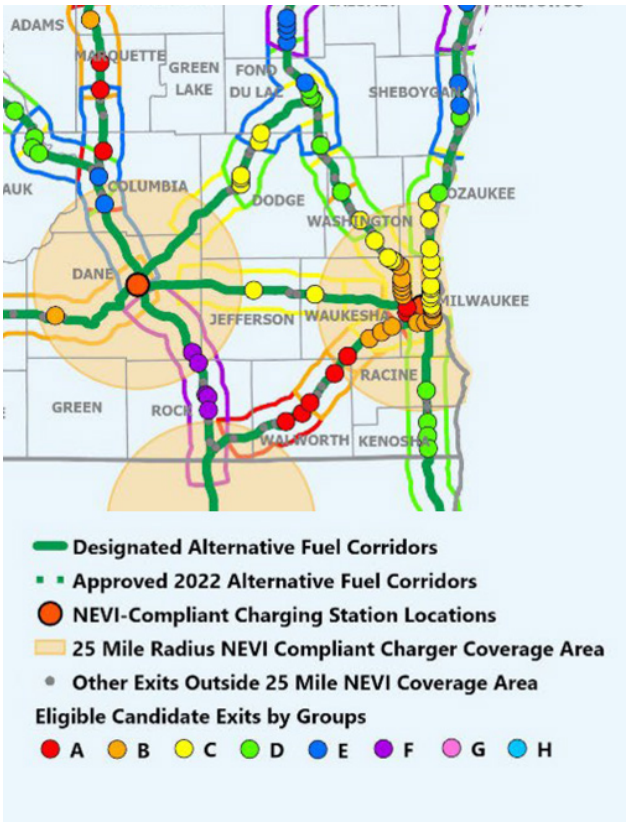
National Electric Vehicle Infrastructure Program

The goal of the National Electric Vehicle Infrastructure (NEVI) program is to ensure there are a sufficient number of high-speed EV charging stations spaced at intervals no greater than 50 miles along key highways to facilitate long distance travel by EVs. The program provides $5 billion in grant funding for the deployment of publicly accessible DC fast-charging infrastructure and to establish a network to facilitate EV charging data collection, access, and reliability.

WisDOT estimates that Wisconsin will receive approximately $78.65 million in program funding over the next five years. The funding will be used to develop a publicly accessible network of charging stations along designated Alternative Fuel Corridors (AFCs) in the state. Projects must involve private sector partners and require at least a 20% non-federal match. All NEVI-funded stations along the state's AFC network must have at least four level 3 charging ports of at least 150 kW equipped with CCS connectors.

Wisconsin's Electric Vehicle Infrastructure (WEVI) Plan, the state's implementation plan for the federal NEVI program, identifies the state's network of AFCs, existing fast-charging stations that qualify under the program, and potential new fast charging locations that could be funded under the NEVI program. The plan identifies the charging station at the Walmart Supercenter on Nakoosa Road in Madison as qualifying, and identifies highway exits in Mount Horeb and Edgerton as locations in Dane County that would be likely to qualify for NEVI funded charging stations (see Figure 13).

Figure 13: Wisconsin Full NEVI-Compliant EV Charging Station Build-Out Coverage Map[58]



[58] For full map see WEVI Plan (p. 66), https://wisconsindot.gov/Documents/projects/WEVI-plan-final-22-0914.pdf#page=66.

The NEVI program will be unable to fund projects in Dane County other than at these two locations until all of the state's designated AFCs have been fully built out with charging stations.

Carbon Reduction Program

The Carbon Reduction Program (CRP) provides over $1.2 billion per year over five years (2022-2026) in grant funding to support projects that will reduce greenhouse gas (GHG) emissions from transportation. Wisconsin is expected to receive a total of $124.6 million over the five-year period.

The Greater Madison MPO awarded funding to four projects during the 2022 federal fiscal year (FFY 2022) totaling $1.1 million. Two of the projects, in Fitchburg and Madison, would have converted conventional streetlights to LEDs, and the two others, in Middleton and Sun Prairie, would have purchased electric fleet vehicles and charging infrastructure for municipal use. Unfortunately, the funding was delayed and previous applicants were directed to reapply during the 2023 funding cycle. Prior to the 2023 cycle, however, the Wisconsin State Legislature's Joint Finance Committee severely restricted the types of projects that could be funded with CRP grant funding, making EVs and charging infrastructure ineligible. All projects selected in the 2023 application cycle involve LED streetlight conversion.

It is uncertain whether EV infrastructure will be eligible for CRP funding in Wisconsin in the future.

Charging and Fueling Infrastructure Grant Program

The new Charging and Fueling Infrastructure (CFI) Grant Program will provide $2.5 billion over the next five years for EV charging and other alternative fuel infrastructure along AFCs and in communities.

Dane County, the Greater Madison MPO, the City of Madison, and a number of other Dane County communities, utilities, and non-profit organizations worked together to submit an application for CFI funding in June 2023, to install EV infrastructure in the County, with a particular focus on underserved communities. The project would fund the planning—including extensive public outreach—and installation of a network of 92 publicly accessible EV charging stations over a period of three years. The goal of the project is to eliminate charging availability gaps that are unlikely to be addressed by the private market while improving equity, maximizing emissions reductions, and preparing for projected EV growth.

The proposed budget is $18.7 million, $14.7 million of which would be federally funded, with the remainder funded locally.

Inflation Reduction Act Programs

The Inflation Reduction Act of 2022 (IRA) also created a number of different programs that can provide funding for EV charging infrastructure.

The Alternative Fuel Infrastructure Tax Credit and the Green and Resilient Retrofit Programs are the most direct—with funding provided directly to businesses, homeowners, or multifamily building owners. The Neighborhood Access and Equity Grant Program, the Carbon Pollution Reduction Grant Program, the Greenhouse Gas Reduction Fund, and the Environmental and Climate Justice Block Grant Program are less direct and more flexible, with funds directed to units of government or nonprofit organizations that will provide funding to recipients.

Alternative Fuel Infrastructure Tax Credit

Under the IRA, businesses that install new EV charging infrastructure, or other eligible alternative fueling infrastructure, in certain low-income or non-urban areas are eligible for an alternative fuel infrastructure tax credit of 30% of the cost, or 6% in the case of property subject to depreciation, up to a maximum of $100,000. Eligible projects that meet prevailing wage and apprenticeship requirements are eligible to receive the full 30% tax credit regardless of depreciation status.

To receive the credit, fueling equipment must be installed in census tracts that meet at least one of the following conditions:

- Are not in an urban area.
- Have a poverty rate of at least 20%.
- Have a median family income less than 80% of the state median family income level.

Census tracts eligible for the tax credit are shown on the U.S. Department of Energy's 30C Tax Credit Eligibility Locator.

Individuals who place EV charging infrastructure at their homes are also eligible for a tax credit of 30% of the cost of hardware and installation, up to a maximum of $1,000.

Green and Resilient Retrofit Program

The Green and Resilient Retrofit Program ($1.47 billion) provides funds to invest in energy efficiency, greenhouse gas emissions reductions, energy generation, green and healthy housing, and climate resilience strategies in HUD-assisted multifamily housing. The program prioritizes properties with a high need for investments in energy efficiency, emissions reduction, and climate resilience. EV charging infrastructure projects that can meet these goals are eligible for funding under the program. Owners of properties that receive HUD assistance are eligible to apply. Applications are being accepted during multiple application periods through May 31, 2024.

Neighborhood Access and Equity Grant Program

The Neighborhood Access and Equity Grant Program ($3.2 billion) will provide funds for projects that improve walkability, safety, and affordable transportation access through context-sensitive strategies and address existing transportation facilities that create barriers to community connectivity or negative impacts on the human or natural environment, especially in disadvantaged or underserved communities. The program also provides funding for planning and capacity building activities in disadvantaged or underserved communities as well as funding for technical assistance to units of local government to facilitate efficient and effective contracting, design, and project delivery and to build capacity for delivering surface transportation projects. State, local, tribal, and territorial governments are all eligible to apply. EV charging infrastructure projects that mitigate the impacts of environmentally burdensome facilities or that improve transportation access, particularly in disadvantaged communities, are eligible for funding under the program.

Carbon Pollution Reduction Grants

The Climate Pollution Reduction Grant (CPRG) program offers a total of nearly $5 billion for the development and implementation of plans to reduce GHG emissions and other harmful air pollution. Climate action plans should identify measures to reduce economy-wide GHG emissions in six key sectors: electricity generation, industry, transportation, buildings, agriculture/natural and working lands, and waste management.

A total of $250 million in noncompetitive planning grant funding was awarded in 2023 to 46 states, including Wisconsin, as well as a number of tribes, tribal consortia, territories and metropolitan statistical areas. Recipients of funds are required to submit a Priority Climate Action Plan (PCAP) by March 1, 2024 and a Comprehensive Climate Action Plan by mid-2025.

An additional $4.6 billion in competitive implementation grant funding will be made available in 2024 to support projects identified in a CPRG-funded PCAP.

Greenhouse Gas Reduction Fund

The $27 billion Greenhouse Gas Reduction Fund is administered by the EPA as three separate competitions—the National Clean Investment Fund, Clean Communities Investment Accelerator, and Solar for All. Both the National Clean Investment Fund ($14 billion) and the Clean Communities Investment Accelerator ($6 billion) will award their funding to a small number of national entities that will work with local partners to provide financing to clean technology projects, which may include EV charging infrastructure. Applications were due in October 2023.

Environmental and Climate Justice Block Grants

The $3 billion Environmental and Climate Justice Program provides funding for financial and technical assistance to carry out environmental and climate justice activities to benefit underserved and overburdened communities. The funding is being distributed through several different programs: the Community Change Grant Program ($2 billion), Environmental Justice Thriving Communities Grantmaking Program ($550 million), Environmental Justice Collaborative Problem-Solving Cooperative Agreement Program ($30 million), and Environmental Justice Government-to-Government Program ($70 million). Each of these programs will award funding to partnerships involving community-based nonprofit organizations that they can use to support a wide variety of projects, which could include EV charging infrastructure.

Charging Needs in Dane County

The expected surge in EV ownership over the next few decades will require a major expansion in charging infrastructure. Since the vast majority of EV owners who have residential charging access charge their vehicles at home and do not regularly charge their vehicles at other locations, much of the required infrastructure will be installed in private homes and parking facilities without the need for outside incentives or intervention. However, a lack of access to charging facilities is significant barrier to EV adoption for renters and people without off-street parking.

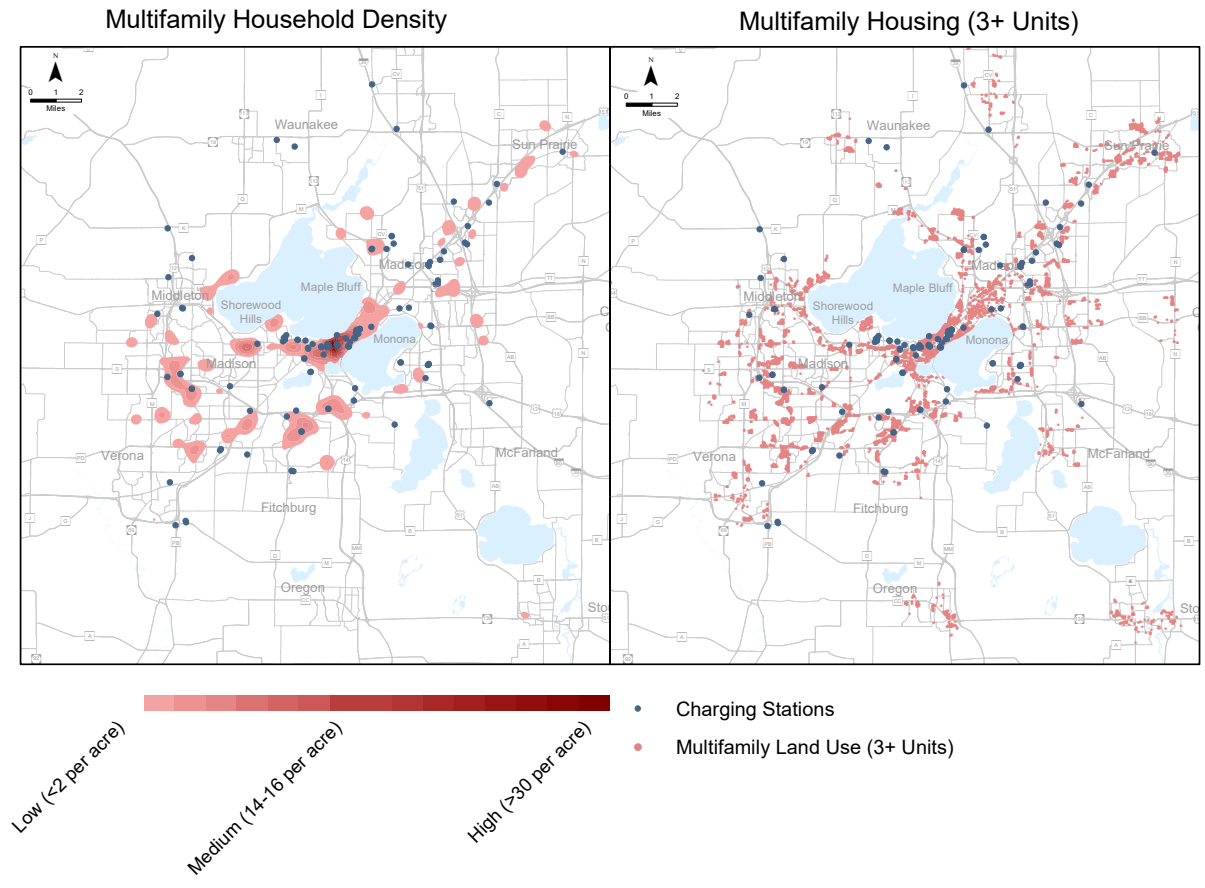
The most pressing needs are for infrastructure serving people who cannot charge their vehicles at home, or whose travel patterns make it necessary for them to charge their vehicles away from home:

- People without residential access to charging.
- Long-distance travelers.
- Ride-hailing and delivery drivers.

To make the ownership and use of EVs more convenient and to provide redundancy in the system, charging infrastructure should also be made available to serve:

- Worksites where employees leave their cars parked during their shift.
- Destinations where drivers park their vehicles while they attend to day-to-day activities—shopping, socializing, dining, or running errands.
- Multimodal hubs where drivers can leave their EVs charging as they travel to work or elsewhere by alternate modes.

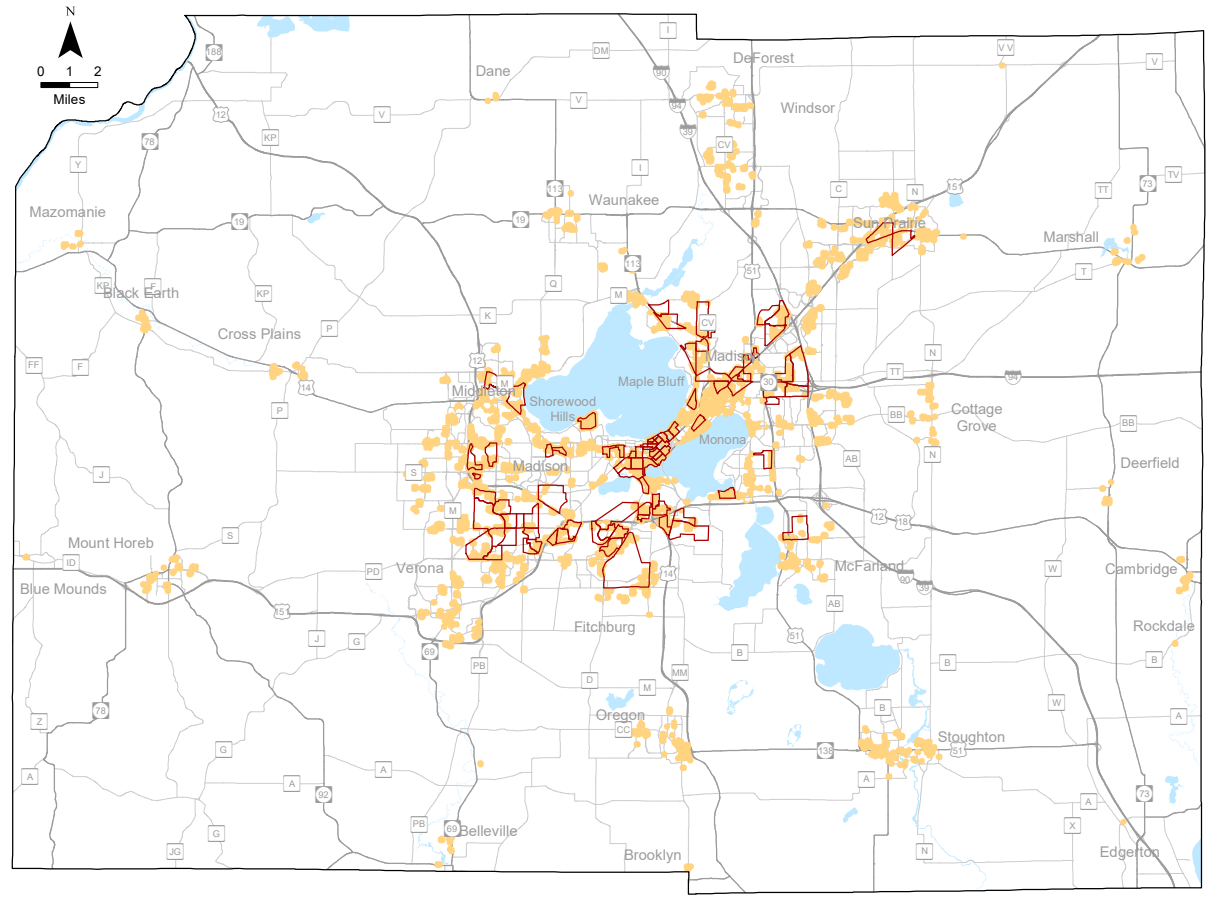
Figure 14: Multifamily Household Density and Land Use



Source: City of Madison Planning, CARPC, MPO, 2016.

Source: CARPC, Dane County, 2020.

Figure 15: Multifamily EV Charging Zone and Environmental Justice Areas



- Rural communities where there are few nearby charging locations.

Recent estimates suggest that there will be 33 million light-duty EVs in the U.S. by 2030, served by:

- 26.8 million private charging ports (level 1 and level 2) at workplaces and residences (52% of the total national investment).
- 1.1 million public charging ports (level 2 and limited level 3) primarily serving neighborhood employment and retail locations (9% of the total national investment).
- 182,000 public level 3 charging ports along key corridors and in communities (39% of the total national investment).[59]

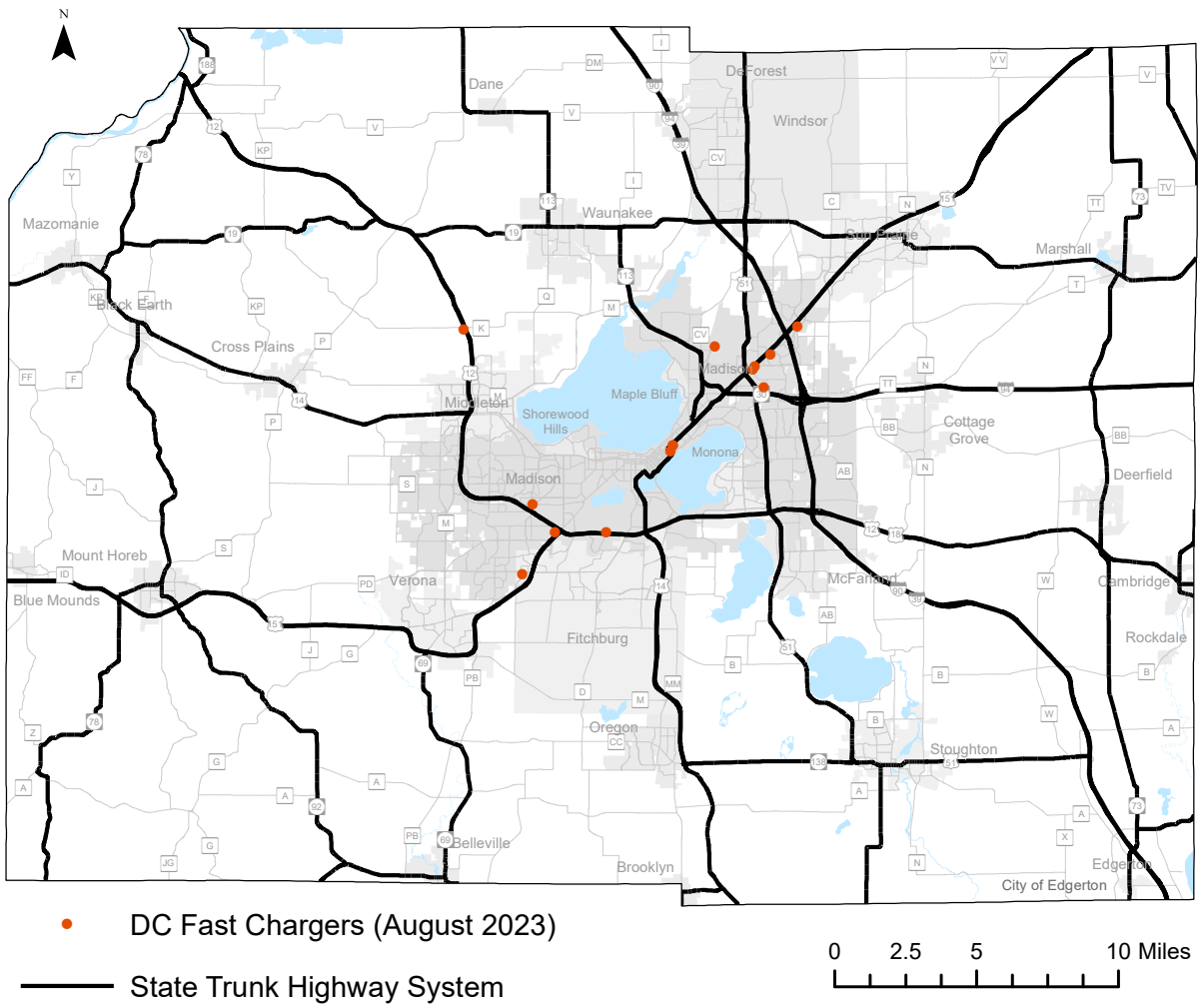
While different drivers will use these facilities to different degrees, they are all key building blocks of a system that will enable a large-scale transition to EVs.

People without Residential Access to Charging

While most people living in single-family homes have an off-street parking area where they can park their

[59] Wood, E., et al. The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. National Renewable Energy Laboratory (2023). https://driveelectric.gov/files/2030-charging-network.pdf.

Figure 16: DC Fast Charging along the State Trunk Highway System in Dane County



cars to charge, charging at home can be much more challenging for residents of multifamily buildings, households without off-street parking, renters, and others who lack a place to charge their vehicles at home.

Figure 14 shows multifamily household density and multifamily housing land use. While there are a number of public charging stations near apartment buildings in downtown Madison, many clusters of apartment buildings, including areas with relatively high densities of households residing in multifamily buildings have no nearby public charging infrastructure.

Figure 15 shows areas that are within 1/10th of a mile of a multifamily building and are at least 1/10th of a mile away from an existing public charging station. The MPO's Environmental Justice (EJ) Priority Areas—areas with greater than the MPO average proportion of low-income and minority residents, are also shown.

Most residents in most EJ areas live in multifamily buildings. Residents of multifamily buildings, even in neighborhoods outside of designated EJ areas, tend to have fewer economic resources than people living in single family homes. Apartment residents and people living in EJ areas are more likely to purchase used EVs, which tend to have lower battery capacity, making convenient residential charging access particularly important.

Providing charging infrastructure that is convenient to people living in multifamily residences and in other locations where they lack access to charging infrastructure is a key equity goal. While lower income people are currently less likely to own EVs, the number of used EVs on the market is projected to grow alongside sales of new EVs. Ensuring that people have convenient access to charging infrastructure will give people the option of transitioning to an electric vehicle.

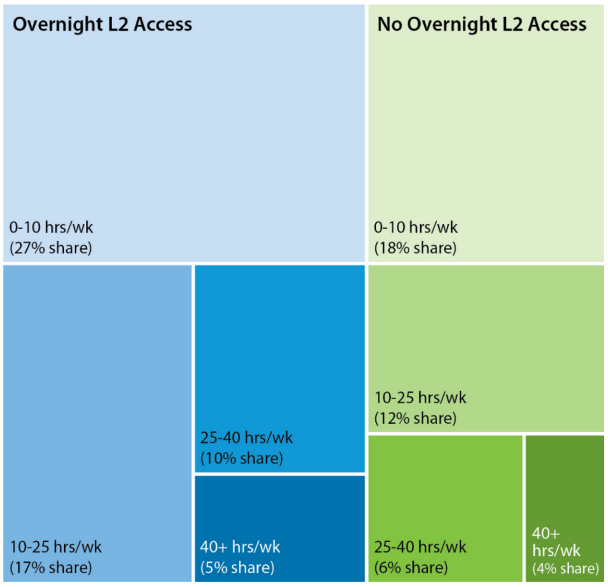
Long Distance Travelers

Building a sufficient network of charging infrastructure along key highways is a critical piece of a large scale transition from internal combustion vehicles to EVs. One of the most commonly cited reasons for deciding against the purchase of an EV is "range anxiety," the fear that the vehicle will run out of power before it can be charged.

Existing level 3 chargers are concentrated in the central part of Dane County. As shown in Figure 16, travelers can pass through the County without ever getting within 10 miles of a fast charger.

Long-distance travelers are a key part of our regional economy and contribute emissions that impact public health. A robust network of level 3 charging infrastructure spread throughout the County along key highways supports the economic relationships that strengthen our economy and makes a transition to EVs from fossil-fueled vehicles more feasible for people who drive to, from, and through our region.

Figure 17: Assumed National Composition of Ride-Hailing Drivers by Shift Type and Residential Access to Level 2 Charging



Source: The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure

Ride-Hailing and Delivery Drivers

Although only 4% of Uber's trips were made using an EV in the third quarter of 2022, this share is expected to grow rapidly, as both Uber and Lyft have goals of shifting 100% of their U.S. drivers to EVs by 2030.[60] Ride-hailing drivers, people who work as drivers for transportation network companies (TNCs) like Uber and Lyft, are disproportionately lower income and much more likely to use EVs than the general population. Their enthusiasm for EVs is driven by the lower fuel and maintenance costs relative to fossil-fueled vehicles, as well as incentives from TNCs.

Recent estimates suggest that across the U.S., about 40% of ride-hailing drivers lack level 2 charging at home.[61] Figure 17 shows the estimated share of ride-hail drivers who do (blue) and do not (green) have access to level 2 charging at home according to their weekly hours worked. Of the 9% of ride-hail drivers working over 40 hours per week, nearly half lack residential access to level 2 charging. While level 1 charging is an option for some of these drivers, the extended time required for level 1 charging makes it infeasible for most ride-hailing drivers.

Ride-hailing drivers who use EVs are heavy users of public DCFC infrastructure and rarely use slower level 2 public charging infrastructure. Figure 18 details the estimated demand for public DCFC and residential charging for ride-hailing drivers based on their average hours worked per week and whether they have access to charging at their residence. When working less than 25 hours per week, drivers who can charge their vehicles at home normally do not charge at other locations. Drivers who exceed 25 hours per week, however, tend to do at least half of their charging at public DCFC stations, even if they can charge at home. By 2030, ride-hailing drivers are expected to account for an average of 21% of public fast-charging demand.[62]

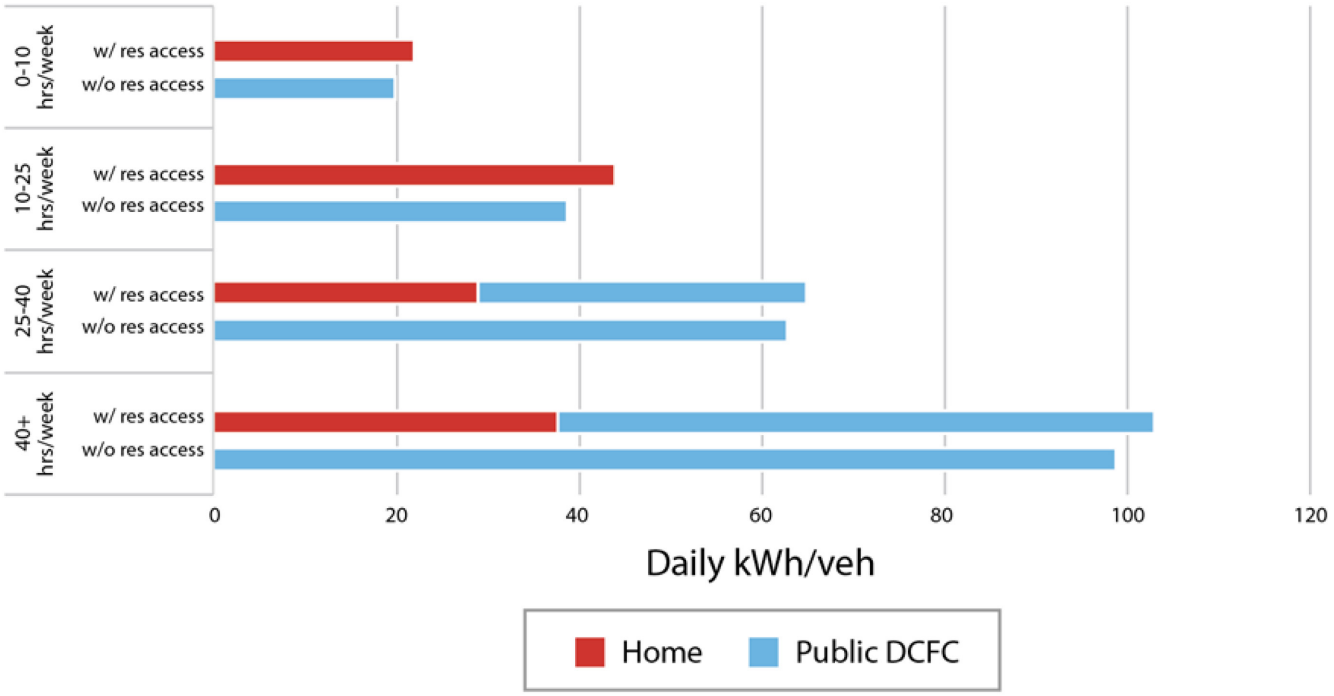
People who work as food delivery drivers also tend to have lower incomes and are likely to have similar charging needs as ride-hailing drivers. As a greater variety of EVs become available, more local and region-

[60] Zukowski, Dan. "Uber and bp to provide fast EV chargers to the ride-hailing company's drivers." Smart Cities Dive. 3/31/2023. https://www.smartcitiesdive.com/news/uber-bp-fast-ev-electric-vehicle-chargers-ride-hailing-drivers/646527/.

[61] Wood, E., et al. The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. National Renewable Energy Laboratory (2023). https://driveelectric.gov/files/2030-charging-network.pdf.

[62] Ibid.

Figure 18: Average Daily Charging Demand for Ride-Hailing Drivers by Work Schedule and Residential Access



Source: The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure

al delivery drivers are expected to transition to using electric vans and other small trucks. When these drivers need to charge during their workday, they will also likely opt for level 3 charging.

Workplaces

Charging facilities used by workers while they are at their place of employment may be either private or publicly accessible. Most workplace charging today is believed to be private access at office buildings. As the number of EVs grows and they become more accessible to people at lower income levels, more charging infrastructure will be needed to serve retail and other non-office employees during their workdays. Many of these workers have lower incomes than those served by existing workplace charging infrastructure and may have fewer opportunities to charge at home and a greater need for charging while they are at work.

By 2030, half of all workday charging is expected to take place at publicly accessible charging facilities.[63]

Destinations

Destination charging infrastructure allows people to charge their vehicles as they attend to day-to-day activities—shopping, socializing, dining, running errands, or as they travel elsewhere by alternate modes. While some of this charging infrastructure may be private, serving only customers or employees of certain businesses, much of it consists of publicly accessible charging stations. Charging infrastructure can also help to draw in customers or extend their visits.

Public charging stations needed at different types of destinations vary widely based on dwell times (how long vehicles are parked), how many visitors are on long trips away from home, and other factors.

Widespread charging availability at different types of destinations helps to provide redundancy in the system and makes EV ownership more convenient.

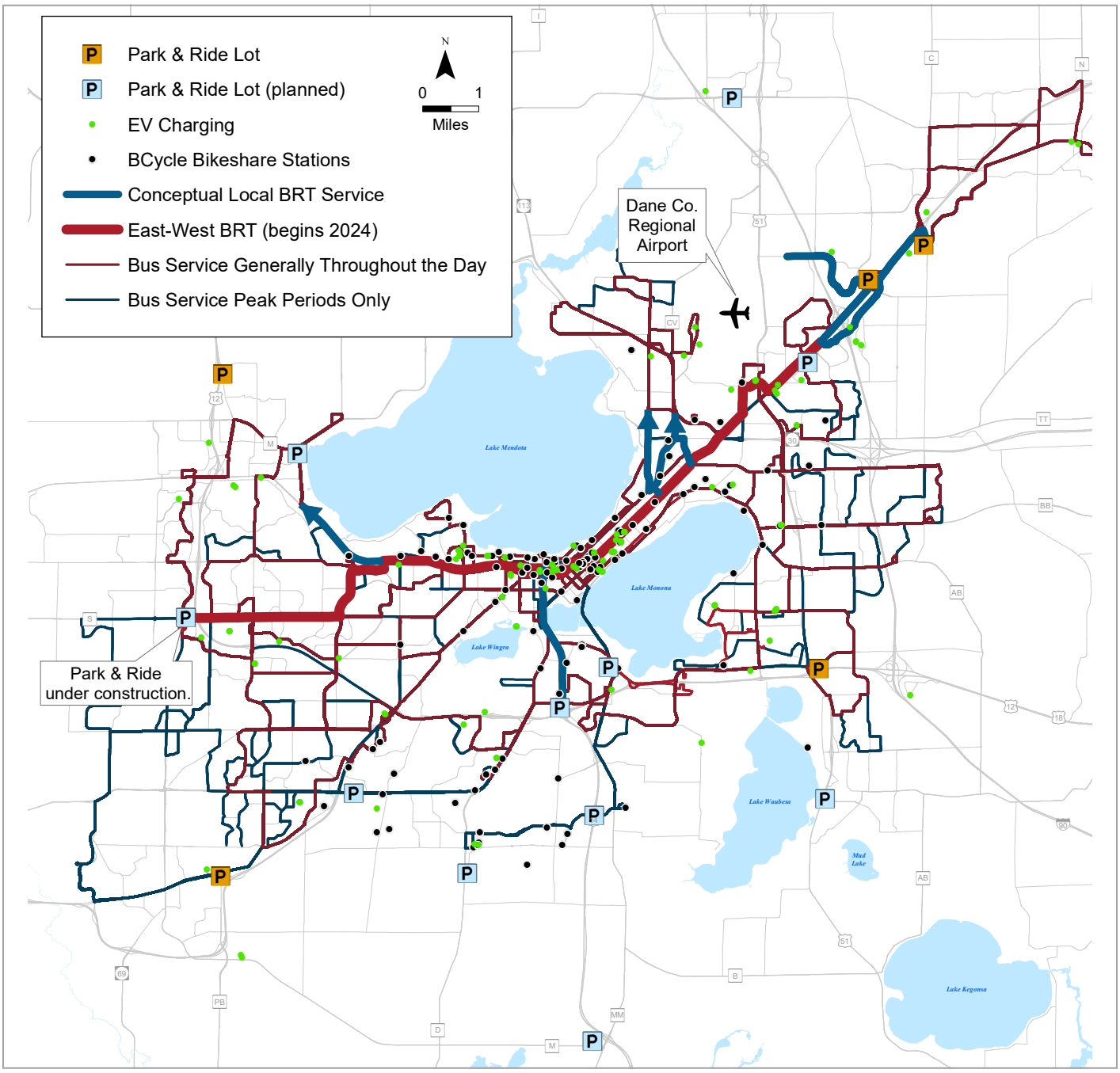
[63] Wood, E., et al. The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. National Renewable Energy Laboratory (2023). https://driveelectric.gov/files/2030-charging-network.pdf.

Multimodal Transportation Hubs

Charging facilities at bikeshare stations, along transit routes, and at park and ride lots, may help reduce traffic by giving EV drivers the option of charging their vehicles while they continue their trips using an alternate mode of transportation. Reducing the number of cars on the road, particularly in dense heavily trafficked downtown areas, helps to reduce traffic congestion, emissions, and roadway maintenance and construction needs.

Figure 19 details key multimodal transportation hubs in the Madison area. While there is a relatively high concentration of EV charging infrastructure in downtown Madison and the UW-Madison campus area, they are scarce in other areas. Making EV charging more accessible at park and ride lots, near bikeshare stations, and along bus routes in peripheral areas could help to encourage some EV drivers to leave their vehicles charging while they continue their trips by bike, carpool, or transit.

Figure 19: Multimodal Transportation Hubs and EV Charging Infrastructure



Rural Communities

Increasing EV adoption in rural areas is particularly important, due both to the types of vehicles likely to be replaced and the typical distances driven.[64] Rural drivers tend to drive more than their urban and suburban counterparts and to drive less fuel-efficient vehicles. This makes their transition to EVs uniquely important to reducing GHG emissions.

It is likely that most rural residents would be able to charge an EV at home. However, for those that lack the ability to charge an EV at home, nearby public charging infrastructure is needed to support their transition to an EV. A network of public charging infrastructure that is convenient to rural residents also supports drivers on long trips and provides another charging option for rural drivers who normally charge their vehicles at home.

[64] See Gasoline Superusers from Coltura at https://www.coltura.org/gasoline-superusers/ for a discussion of the emissions impact associated with transitioning superusers into EVs.

Expanding Dane County's EV Charging Network

Dane County has the most developed EV ecosystem in the state, with the highest share of EVs and a dense network of charging facilities. As the number of EVs in the County continues to grow, the charging network will also need to grow.

Most charging is done using level 1 or level 2 charging infrastructure located in the garages of single family homes. This is expected to remain the case for the foreseeable future due to the low cost and convenience of home-based charging. Most residents of single-family homes with an off-street parking space can charge at level 1 with no infrastructure investment at all, by plugging into an existing wall outlet. Level 2 charging infrastructure at single-family homes is generally paid for by homeowners, but programs offered by local electrical utilities, as well as federal tax incentives, can significantly reduce the cost.

Since residents of single-family homes with off-street parking can easily charge their EVs at home, additional efforts to boost their access to residential charging should be a low priority. Many newer and higher-end apartments also have charging facilities available for residents. However, additional charging infrastructure is needed to serve EV drivers who cannot charge their cars at home, particularly those living in older and more affordable apartment buildings or who need to charge on the go. This will require a mix of publicly accessible level 2 and level 3 charging stations along with level 2 stations at workplaces, apartment buildings, and other locations that may be either public or restricted to residents or employees.

Getting the right type of charging infrastructure in the right location is the key to creating an efficient and user-friendly charging network.

Level 1 charging may be suitable for drivers who have a place to park with access to an electrical outlet at home. Since level 1 charging can take two days to fully charge a battery electric vehicle (BEV), it is most appropriate for those who drive less than about 40 miles per day or drive a plug-in hybrid electric vehicle (PHEV). The long charging times required for level 1 charging make it less appropriate in public or other shared-use settings. The following analysis and siting recommendations focus on level 2 and level 3 charging infrastructure.

Level 2 charging is the most common charging level for shared-use and public charging applications. It can fully charge a BEV overnight and can provide a meaningful charging boost in an hour or so. Level 2 chargers are generally appropriate in any parking lot where people park more than 30 minutes.

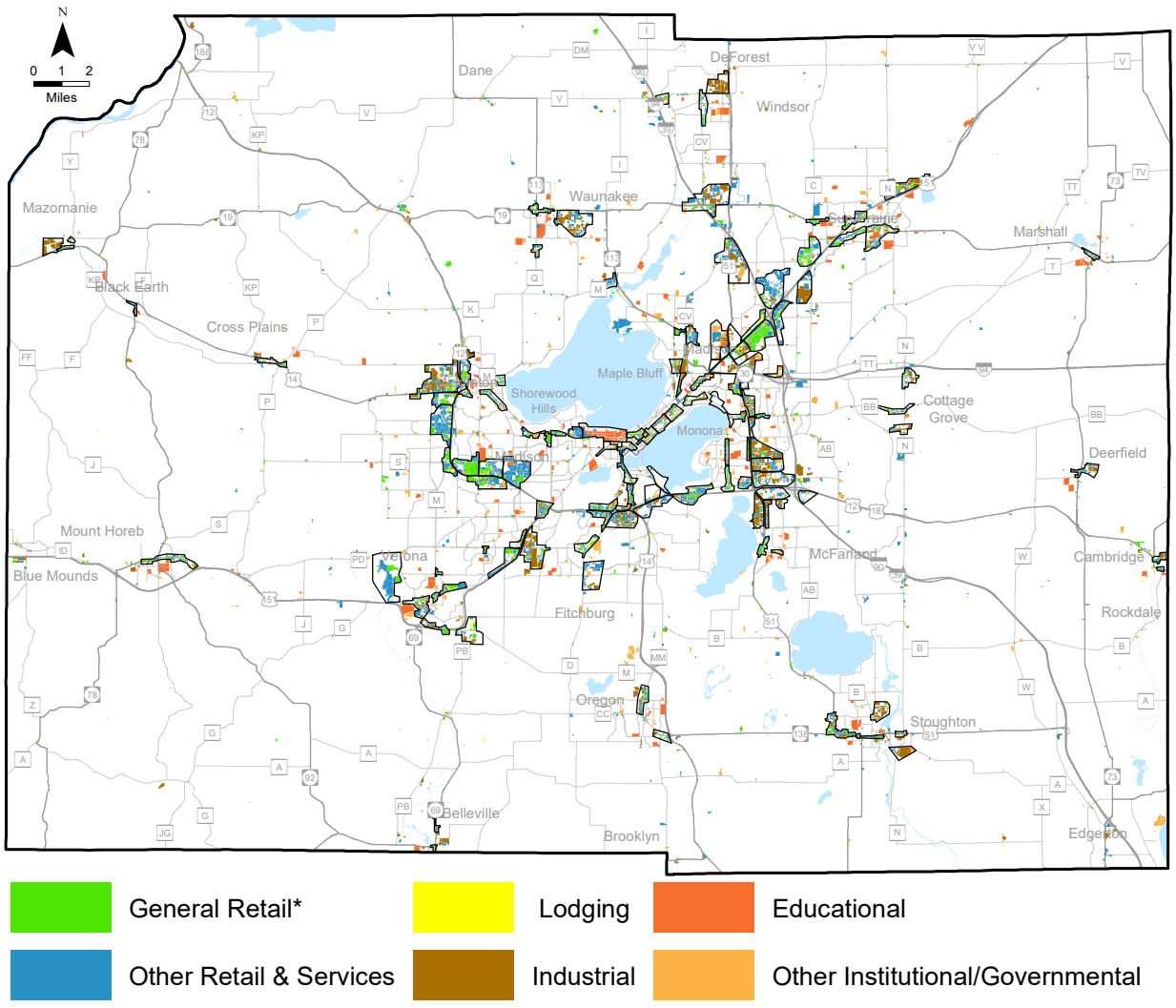
The ability of level 3 charging infrastructure to recharge BEV batteries in as little as 20 minutes makes it a critical element of a robust charging network. Only level 3 chargers can provide a fast enough charge for ride-hail, delivery, and long-distance drivers who are anxious to get back on the road. Technical challenges and high installation costs, however, limit the number of locations where it is feasible. Level 3 infrastructure needs to be sited in locations where there is sufficient electrical grid capacity and a large enough customer base willing to pay for fast charging.

Commercial and Employment Zone Analysis

The MPO conducted a "big data" analysis to prioritize locations for investment in charging infrastructure serving commercial and employment areas and long-distance travelers. Because the transition to EVs is still in its infancy, the analysis focused on clusters of commercial and employment land uses, where charging infrastructure could serve large volumes of customers, employees, and other visitors. The clusters were grouped into a set of zones which were analyzed to understand the average daily volume, travel time, and distance of trips beginning and ending in each. The MPO also contracted with StreetLight Data, the data provider, for a dwell-time analysis of 100 of the zones to understand how long vehicles stopped in each zone.

Employment and commercial land uses not located in development clusters were excluded from the analysis. While charging infrastructure is just as important

Figure 20: Analysis Zones and Land Uses (2020)



*Includes shopping, restaurants, and gas stations.

in these locations, it is easier to understand travel volumes. These development clusters also offer EV drivers a variety of destinations they can visit while their vehicle is charging. Furthermore, business clusters are more likely to have sufficient electrical grid capacity (3-phase power) to enable the installation of level 3 charging infrastructure.

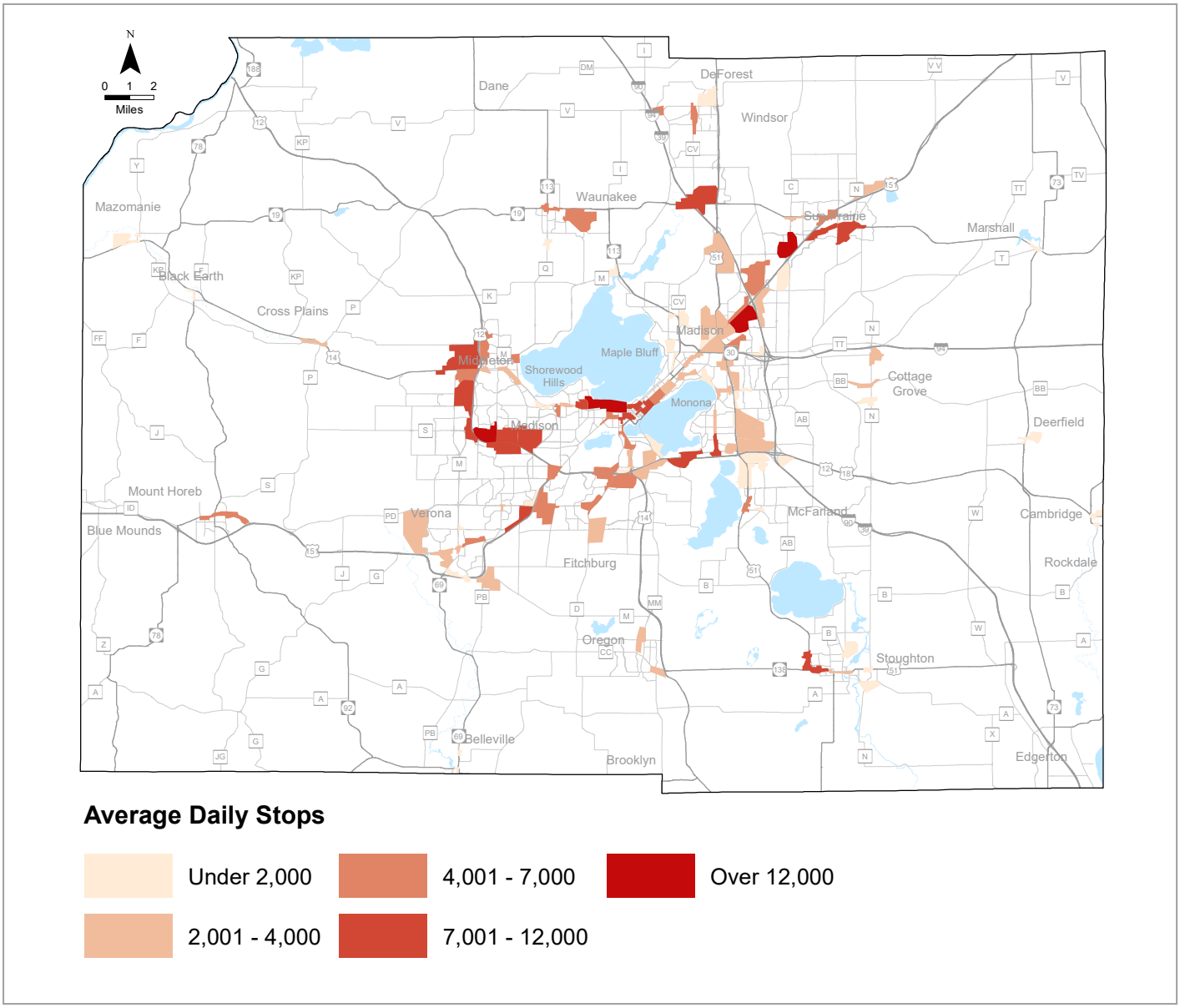
The MPO analyzed travel data in a set of 123 zones encompassing clusters of commercial and industrial land uses and other points of interest. All travel data estimates used in these analyses came from StreetLight Data and were gleaned from anonymized travel data collected from location-based services—generally smartphone applications. All data estimates were based on trips taken between May 1, 2021, and April 30, 2022.

Dwell time data, which provides estimates of how long motorists stopped in each zone, was purchased from StreetLight for 100 of the zones for the same time period.

The following maps are meant to provide a high-level overview of the potential charging needs and travel characteristics of commercial and employment zones in Dane County. Larger format maps and data tables can be found in Appendix A.

Decisions about specific locations for EV charging

Figure 21: Estimated Average Daily Stops (May 1, 2021–April 30, 2022)



installations and the amount and type of charging frastructure needed should incorporate a more robust fine-grained analysis, with guidance from professionals with experience in charging infrastructure site selection, installation, and management.

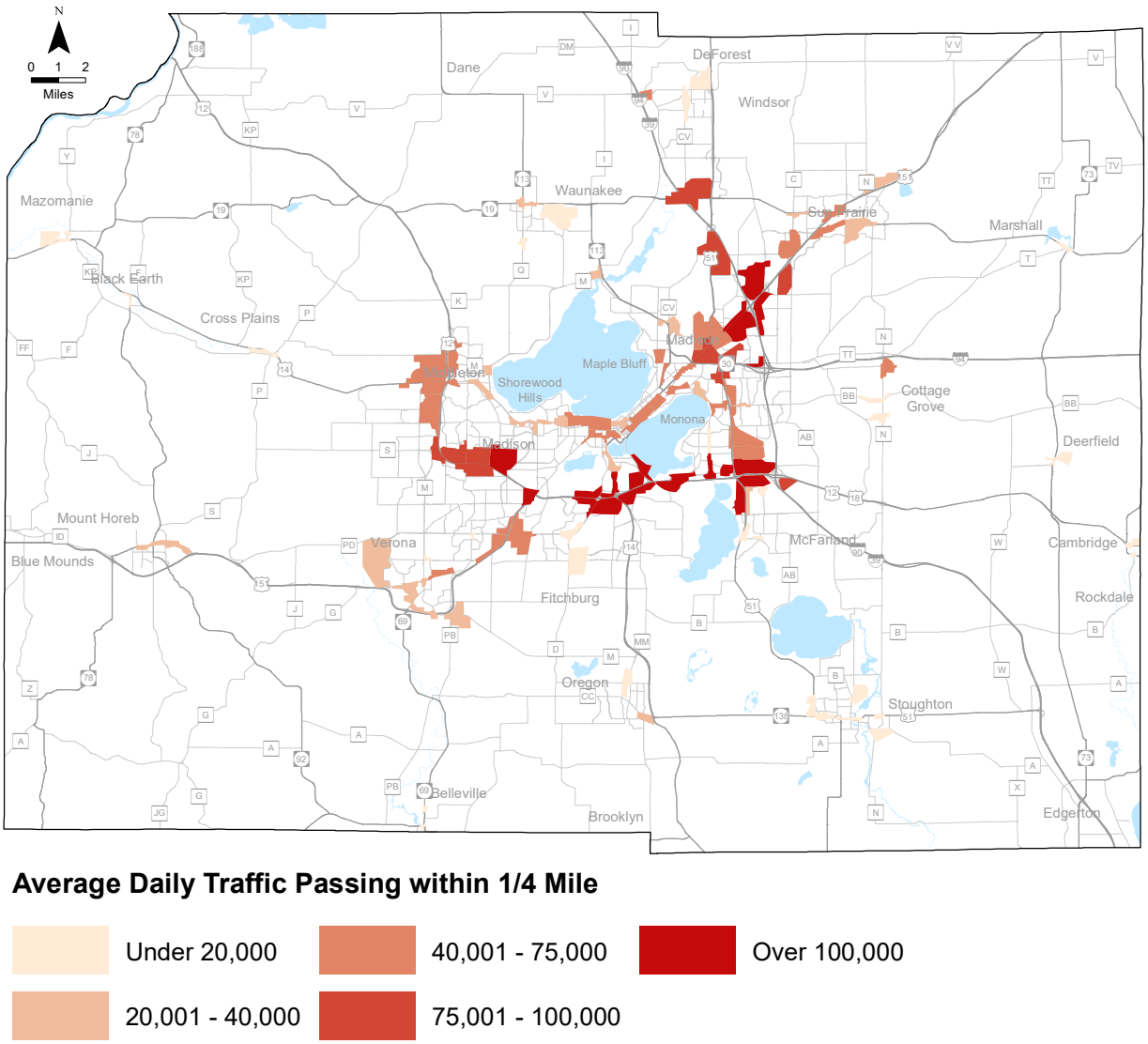
Figure 20 shows the analysis zones and the land uses in each.

Daily Stops and Pass-Through Traffic

The number of vehicles stopping in each zone is the clearest indication of its potential demand for charging infrastructure. While zones with fairly small numbers of trips may still generate sufficient demand for a charging installation, the relatively small number of EVs currently on the road makes busier areas better candidates for charging infrastructure investments. Figure 21 shows the average number of stops in each zone. East Towne and West Towne shopping centers and the shopping area along Grand Avenue in Sun Prairie had the highest trip volumes, with more than 20,000 vehicles stopping per day.

Pass-through traffic, traffic passing through or within ¼ mile of each zone, is a measure of potential latent or future demand. Some portion of the drivers that pass in or near each zone each day might be enticed to stop, and potentially patronize local businesses, if there were charging facilities that met their needs. Of the zones analyzed, 15 had over 100,000 vehicles passing within ¼

Figure 22: Estimated Average Daily Traffic Passing within 1/4 Mile (May 1, 2021-April 30, 2022)



mile each day. Unsurprisingly, these zones are located near major interchanges along the Beltline and Interstate highways, as shown in Figure 22.

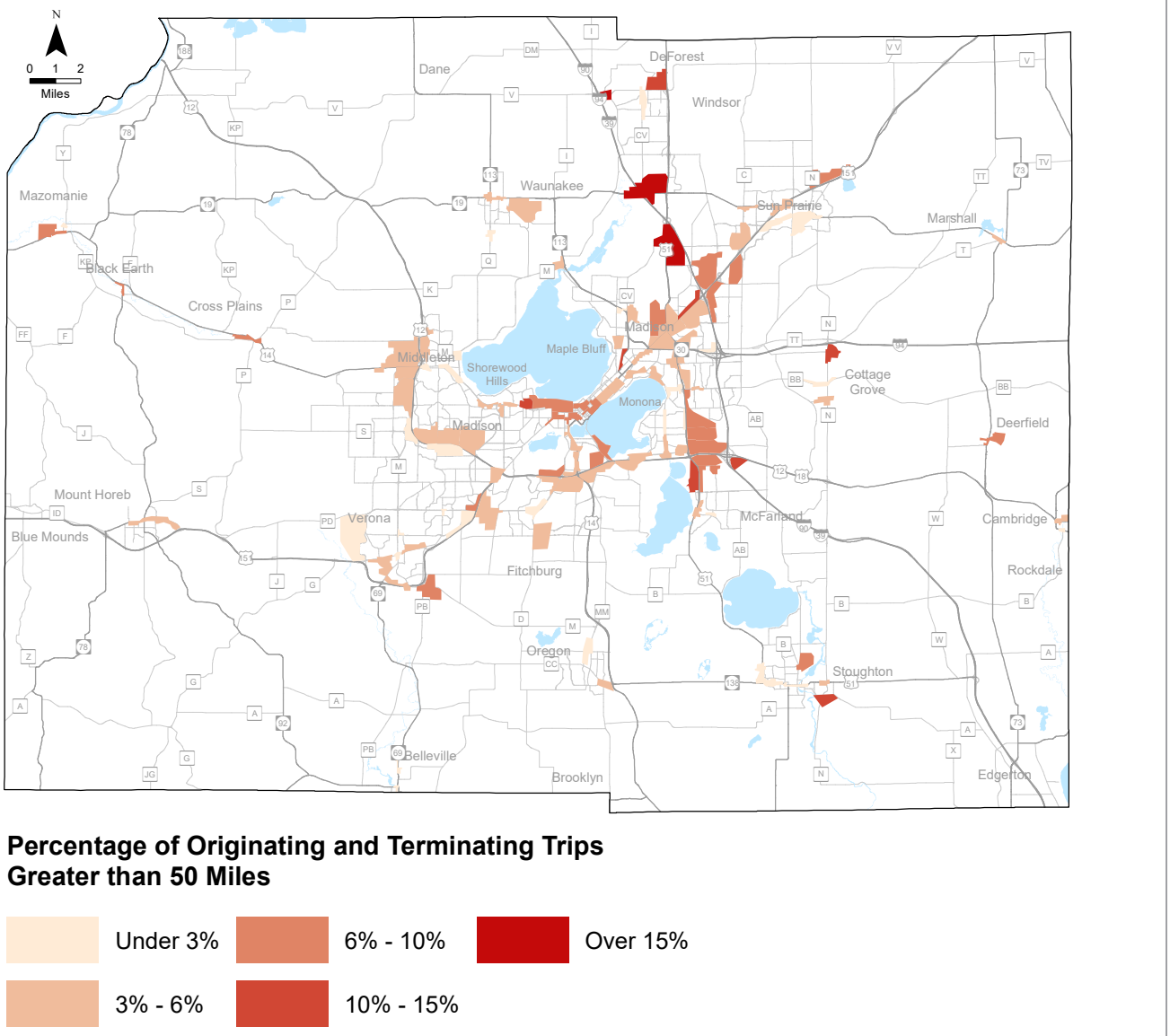
Long Trips

The distance an EV can drive on a single charge varies widely—from less than 100 miles to more than 400 miles, with the average being around 200 miles. Long trips make it more likely that drivers will need to charge their vehicles away from home.

Figure 23 shows the percentage of trips starting and ending in each zone that are greater than 50 miles. Zones with more than 10% of their trips over 50 miles include several zones along the Interstate, UW Hospital, and industrial areas in Cottage Grove, DeForest, Madison, McFarland, and Stoughton.

While zones with large percentages of long trips may have higher demand for charging infrastructure, the appropriate charging level will depend on how long people are likely to spend in these locations. Level 2 charging is likely sufficient to serve hotel guests, employees at industrial parks, and hospital visitors and employees. In zones along the Interstate that serve as short-term stopping points for long-distance travelers, level 3 infrastructure may be most appropriate.

Figure 23: Estimated Percentage of Trips over 50 Miles (May 1, 2021–April 30, 2022)



Dwell Time

Dwell time, the amount of time vehicles spend stopped, in each zone is one of the most important variables in determining the appropriate type of charging infrastructure. Locations where vehicles park for less than 30 minutes are potential sites for level 3 charging infrastructure. Areas with substantial numbers of vehicles parked between 30 minutes and four hours are likely suitable for level 2 and potentially level 3 charging. Areas with dwell times over four hours are suitable for level 2 charging.

Figure 24 shows the estimated number of daily stops under 30 minutes in each zone. The East Towne and West Towne Mall areas in Madison and the Grand Avenue shopping area in Sun Prairie have over 11,000 of these stops per day, far more than any other zone. Sun Prairie's Main Street commercial area, the zone that includes the Walmart Supercenter in Stoughton, and the area between Junction Road and the Beltline in Madison, make up the next tier, each with a bit more than 6,000 of these short stops per day.

Figure 25 details the estimated daily number of stops between 30 and 240 minutes in each zone. The East Towne and West Towne mall areas and the Grand Avenue shopping area see between 9,000 and 10,500 of these stops per day—more than twice the number of any other zone.

Figure 24: Daily Stops under 30 Minutes (May 1, 2021-April 30, 2022)

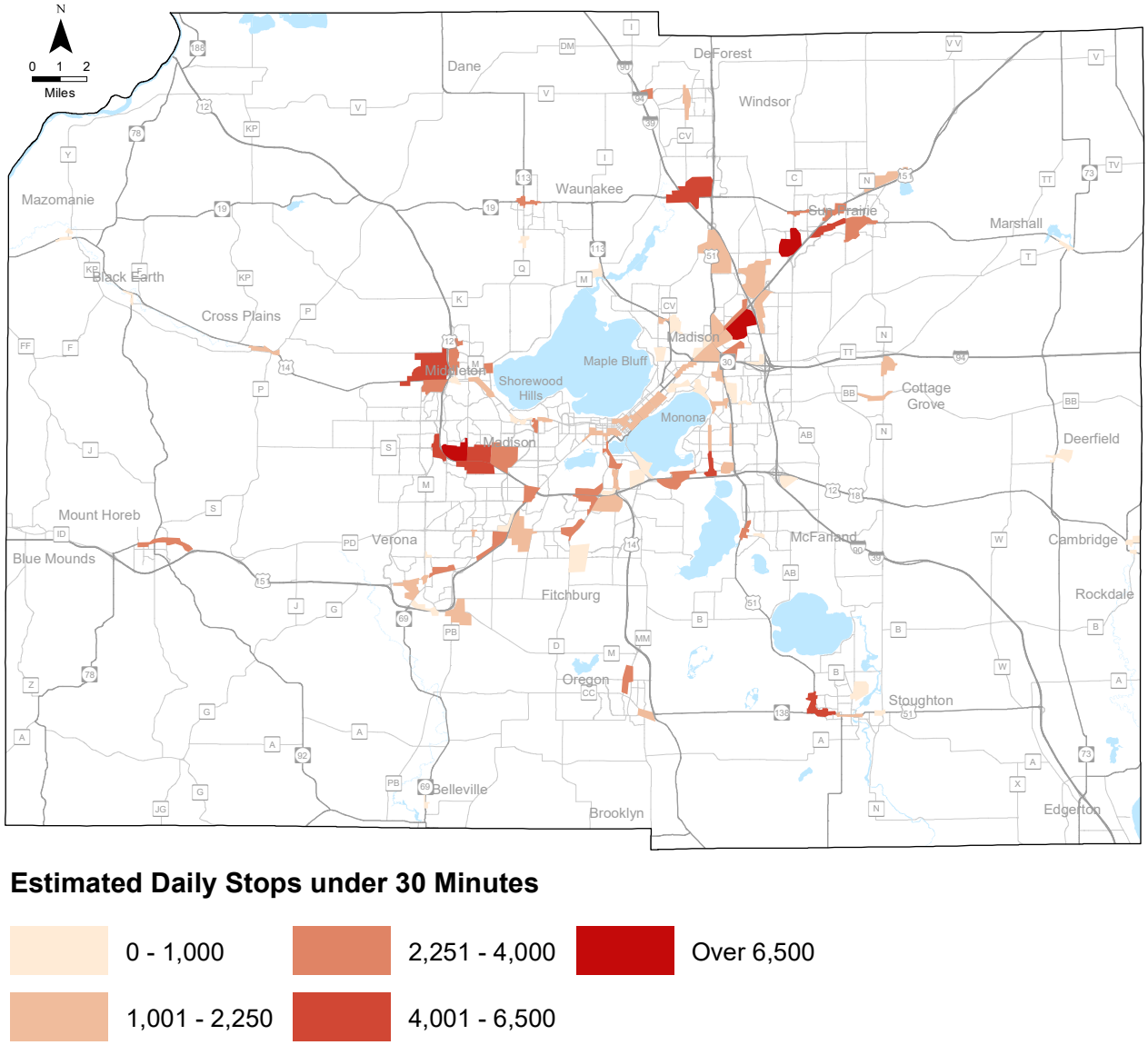


Figure 26 shows the estimated daily stops over 240 minutes in each zone. The zones with the highest number of these long stops are all in central Madison—the two zones surrounding the Capitol Square and the zone encompassing Meriter Hospital and other businesses at the intersection of Regent and Park streets. Each of these zones has over 3,000 of these long-duration stops per day.

Priority Charging Locations

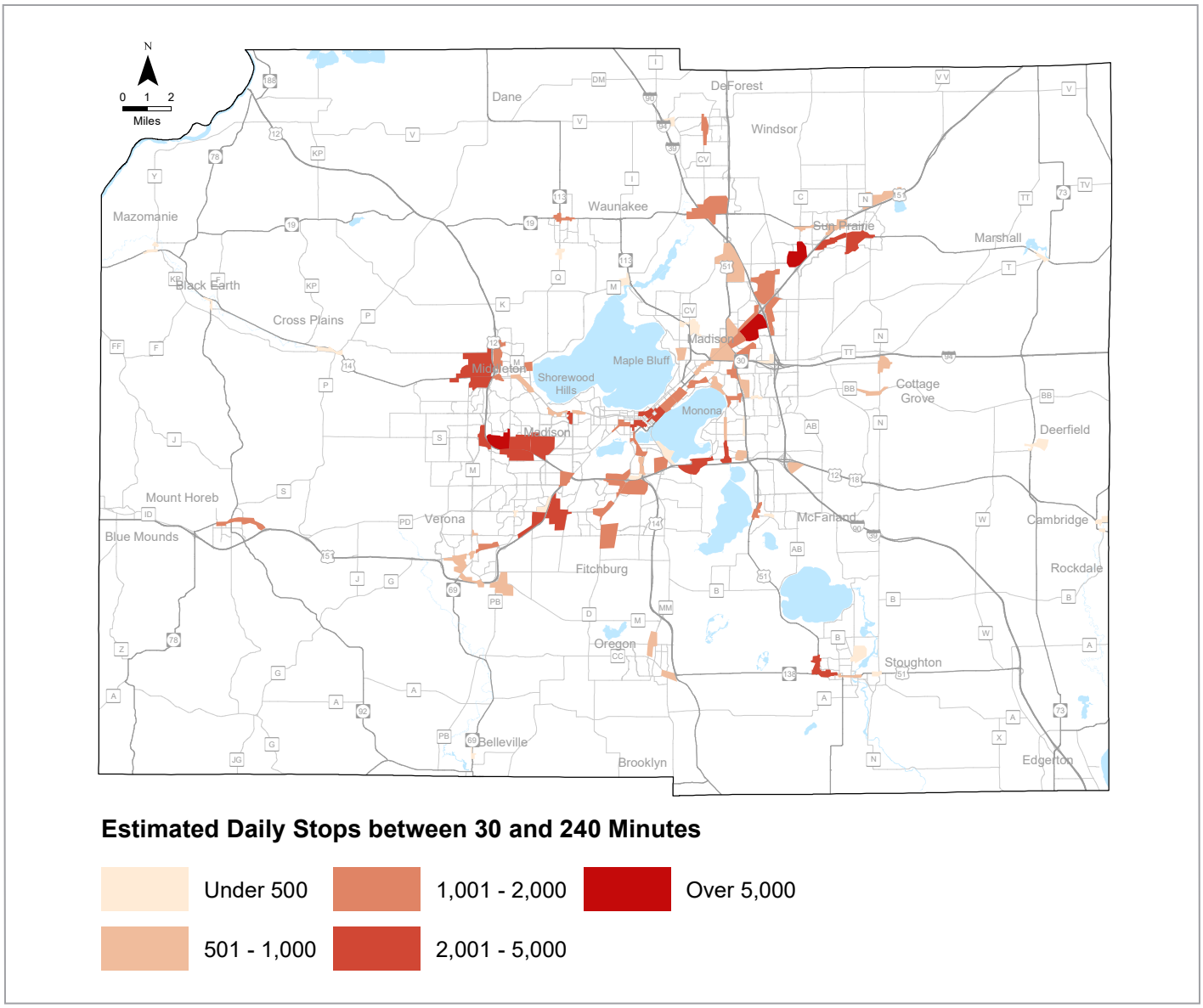
New EV charging infrastructure will be needed throughout Dane County to support the growing number of EVs.

Level 2 charging is generally appropriate to serve employment and residential areas where additional charging capacity is needed.

Additional Level 3 charging infrastructure will be needed to support travelers, ride-hail and delivery drivers, and others who need to charge their vehicles as quickly as possible. Level 3 infrastructure will also provide valuable redundancy in Dane County's charging ecosystem.

Funding for new EV charging installations may come from a variety of sources. Local businesses and apartment buildings may fund charging infrastructure to serve their employees, customers, or residents. Private charging networks may fund installations in locations they believe will be profitable. While local governments

Figure 25: Daily Stops 30-240 Minutes (May 1, 2021-April 30, 2022)



may choose to provide funding or parking spaces (on- or off-street) for new charging infrastructure in certain locations to meet environmental justice or other goals, they are not expected to be a major source of funding for EV infrastructure expansion. The most important roles for local governments in expanding EV charging infrastructure are in assisting businesses and residents in navigating regulatory issues and ensuring that plans, policies, and ordinances support private-sector infrastructure investments.

In addition, local governments also play a valuable role in securing federal EV infrastructure grant funding for their communities.

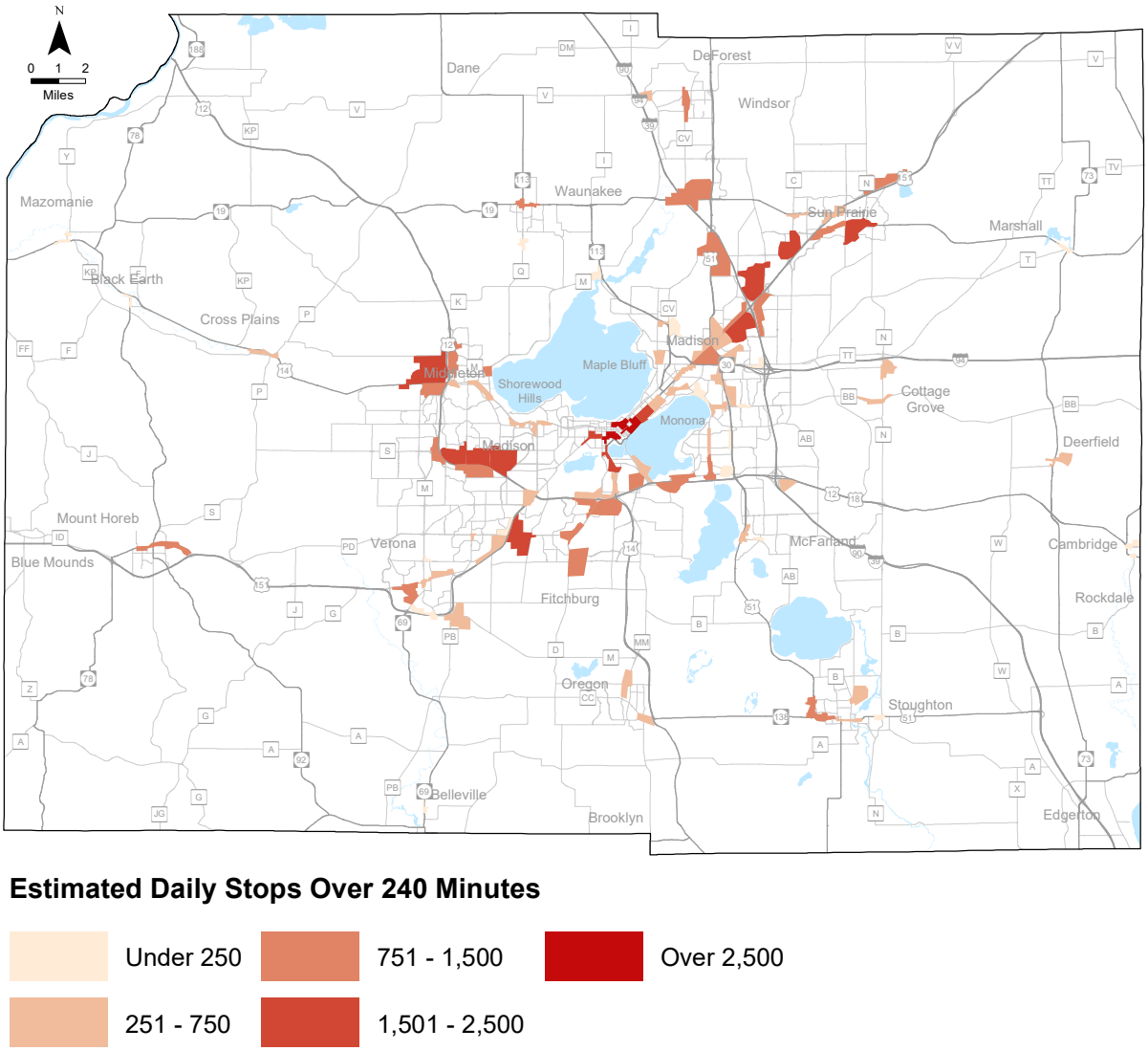
Level 2

Level 2 charging infrastructure is relatively low cost and can be useful wherever people are stopped for more than 30 minutes or so.

Newer, more powerful level 2 chargers, delivering up to 19.2 kWh, can charge a vehicle about twice as fast as a standard level 2 charger. These faster level 2 chargers, which are still only a fraction of the cost of a level 3 charger, will make level 2 charging more attractive to people making short stops.

The highest priority locations for level 2 charging infrastructure are:

Figure 26: Daily Stops Over 240 Minutes (May 1, 2021-April 30, 2022)



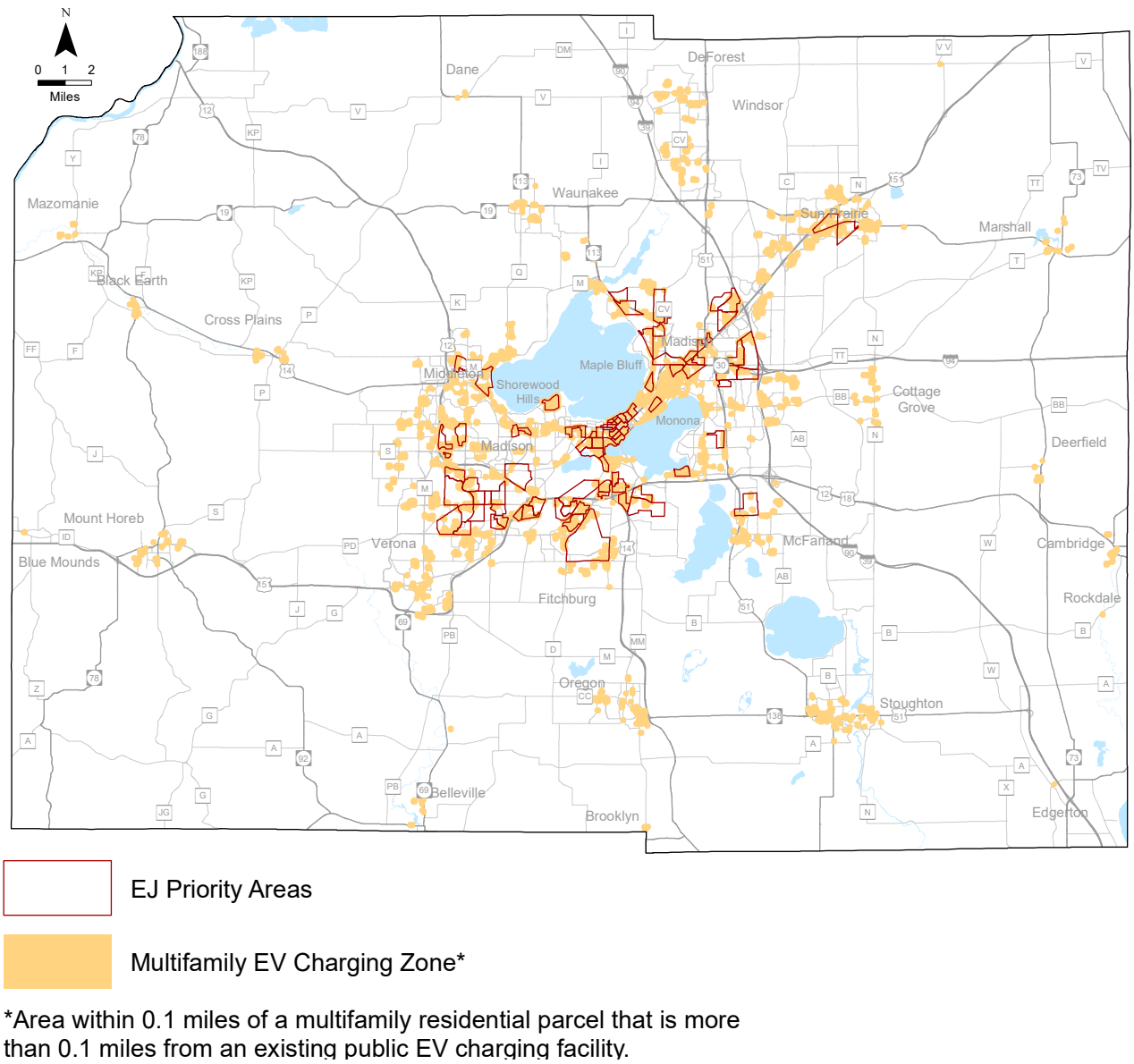
- Residential areas, where residents cannot charge their vehicles while they are home.
- Employment areas, where employees park for the length of their workday.

Level 2 charging is also sufficient for destination charging in many locations, allowing drivers to top off their charge while away from home. However, the time required to charge using level 2 infrastructure and the fact that most people charge their vehicles at home makes level 2 chargers unlikely to be a significant draw for customers to most businesses. Hotels are the exception, with level 2 chargers attracting customers who want to charge their vehicles overnight.

Residential Areas

The most pressing need for additional level 2 charging infrastructure is in residential areas where residents cannot charge their vehicles at home. These areas consist primarily of multifamily dwellings as well as older neighborhoods with single-family homes lacking off-street parking. EV charging infrastructure in new parking lots will not have an impact on charging availability in existing neighborhoods until existing parking lots are reconstructed, which could be many years in the future. While the number people in rural communities who lack the ability to charge their vehicles at home is likely smaller than in urban areas, providing them with the ability to charge at home can pay big dividends in terms of both emissions reductions and economic benefits.

Figure 27: Multifamily EV Charging Zone and Environmental Justice Areas



As shown in Figure 27, multifamily residential developments lacking nearby public charging infrastructure are located throughout the County in both urban and rural areas, and many are located in Environmental Justice Priority Areas identified by the Greater Madison MPO. Expanding level 2 charging infrastructure to serve areas where people cannot charge their vehicles at home, particularly in low-income and rural areas, should be a top priority over the coming years as used EVs become more widely accessible.

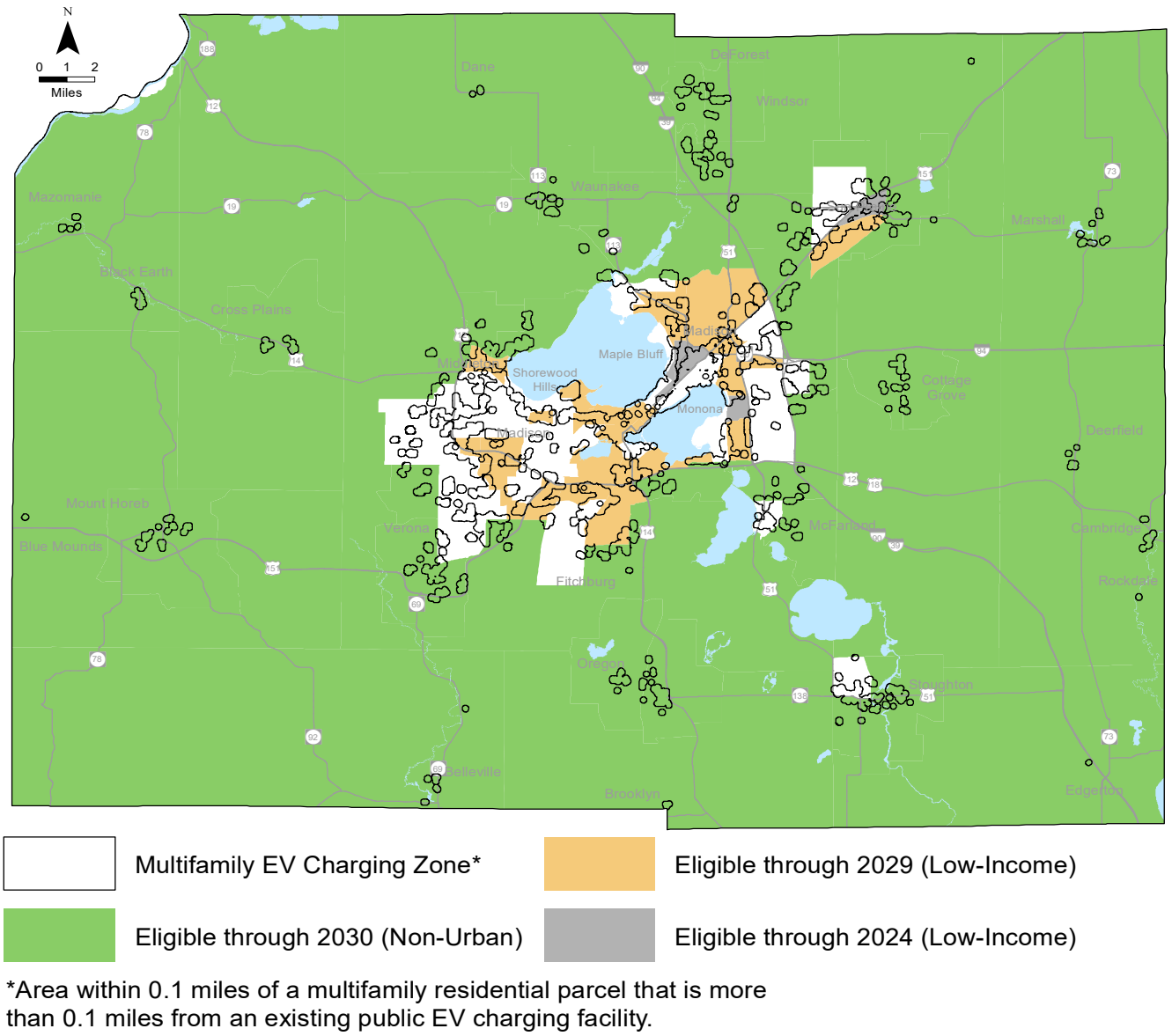
As shown in Figure 28 many of these areas are in tracts that the quality for tax credits of up to 30% of the cost of installing new charging infrastructure.

Workplaces

At workplace parking facilities, including schools, offices, and other locations where employees work on-site and tend to leave their cars parked for the duration of their shift, level 2 charging infrastructure offers employees a valuable amenity. This is particularly true if employees tend to live in places where they are unable to charge at home. Workplace charging infrastructure at these types of locations is often restricted to employees, and potentially customers, but may be open to the public as well.

At workplaces located in commercial and employment clusters without dedicated parking facilities, level 2 charging infrastructure in public parking lots can serve

Figure 28: Multifamily EV Charging Zone with Infrastructure Tax Credit Eligbility Areas



the same purpose. In Figure 26 (page 55), which shows the estimated number of vehicles stopping for more than four hours, the zones around the Capitol Square stand out as having over 2,500 of these stops per day. The density of businesses and general lack of onsite parking indicates that level 2 charging infrastructure in public parking facilities in this area would be well-positioned to serve employees in the area, as well as other visitors.

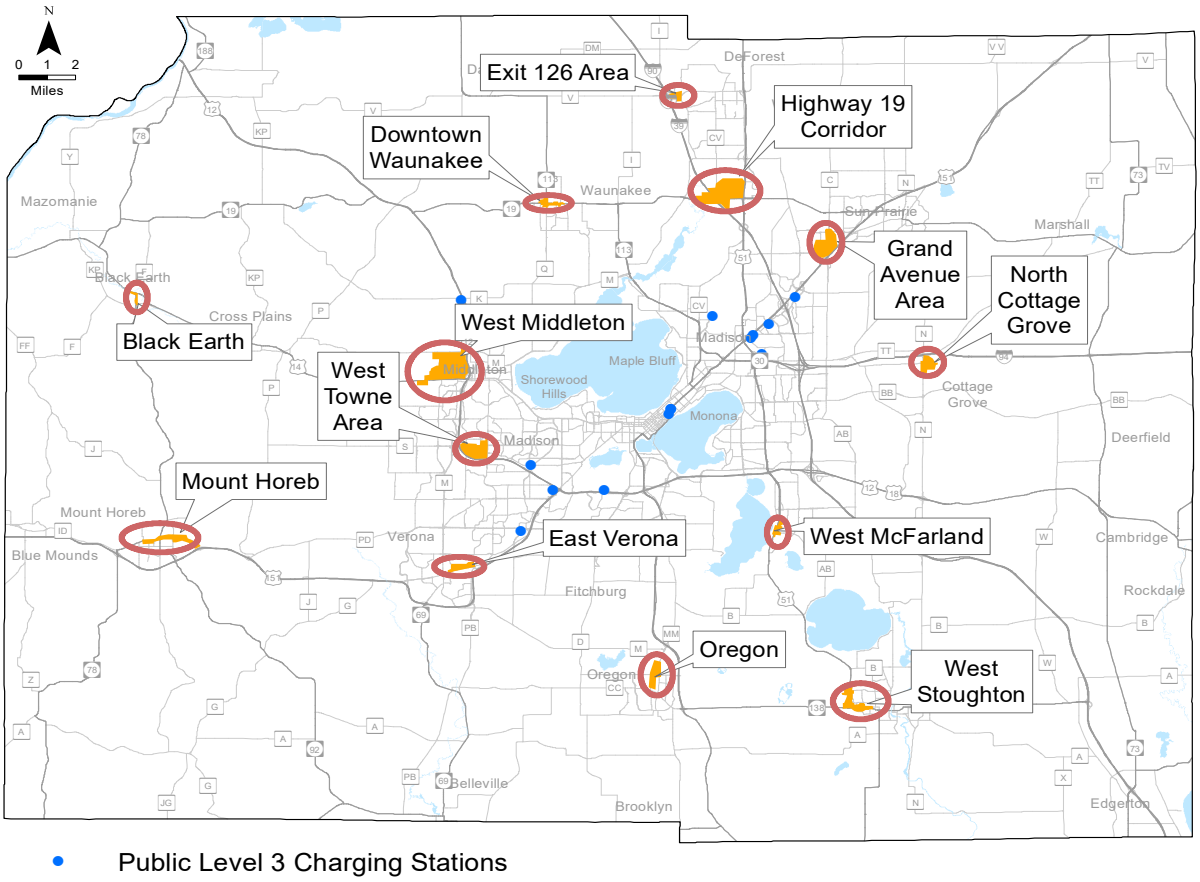
Other zones shown on the map as having large numbers of these long stops, as well as the many dispersed schools and businesses throughout the County where employees are parked throughout their workday, are all promising locations for additional level 2 charging infrastructure.

Level 3

Level 3 charging is a critical part of the charging network, allowing drivers to charge quickly and get back on the road. This is particularly important for ride-hail and delivery drivers and people on long-distance trips.

A network of level 3 chargers spread throughout the County in business districts along key travel routes can serve these groups and provide rural residents with an additional charging option away from home.

Figure 29: Priority Level 3 Charging Zones



The following screening level analysis is a first attempt to identify potential level 3 charging sites that may be suitable for development over the coming years to meet the needs of the increasing number of EVs in the County. The key considerations in identifying the 13 zones shown in Figure 29 were the total number of vehicles stopping in each zone on a daily basis, traffic passing nearby, the percentage of vehicles stopping for less than 30 minutes, the percentage of trips over 50 miles beginning and ending in each zone, and the proximity of each zone to existing charging infrastructure.

More information about the zones is located in Appendix A, beginning on page 64. Figure 31 (page 65) shows a more detailed county-level view. Figure 42 (page 76) and Figure 43 (page 77) provide a close-up view of each of the level 3 priority zones. The tables on pages 78 through 80 detail the total volume of vehicles stopping, dwell time, ending in each zone, and the proximity of each zone to existing charging infrastructure.

Most of these zones are in tracts that qualify for tax credits of up to 30% of the cost of installing new EV charging infrastructure, as shown in Figure 30.

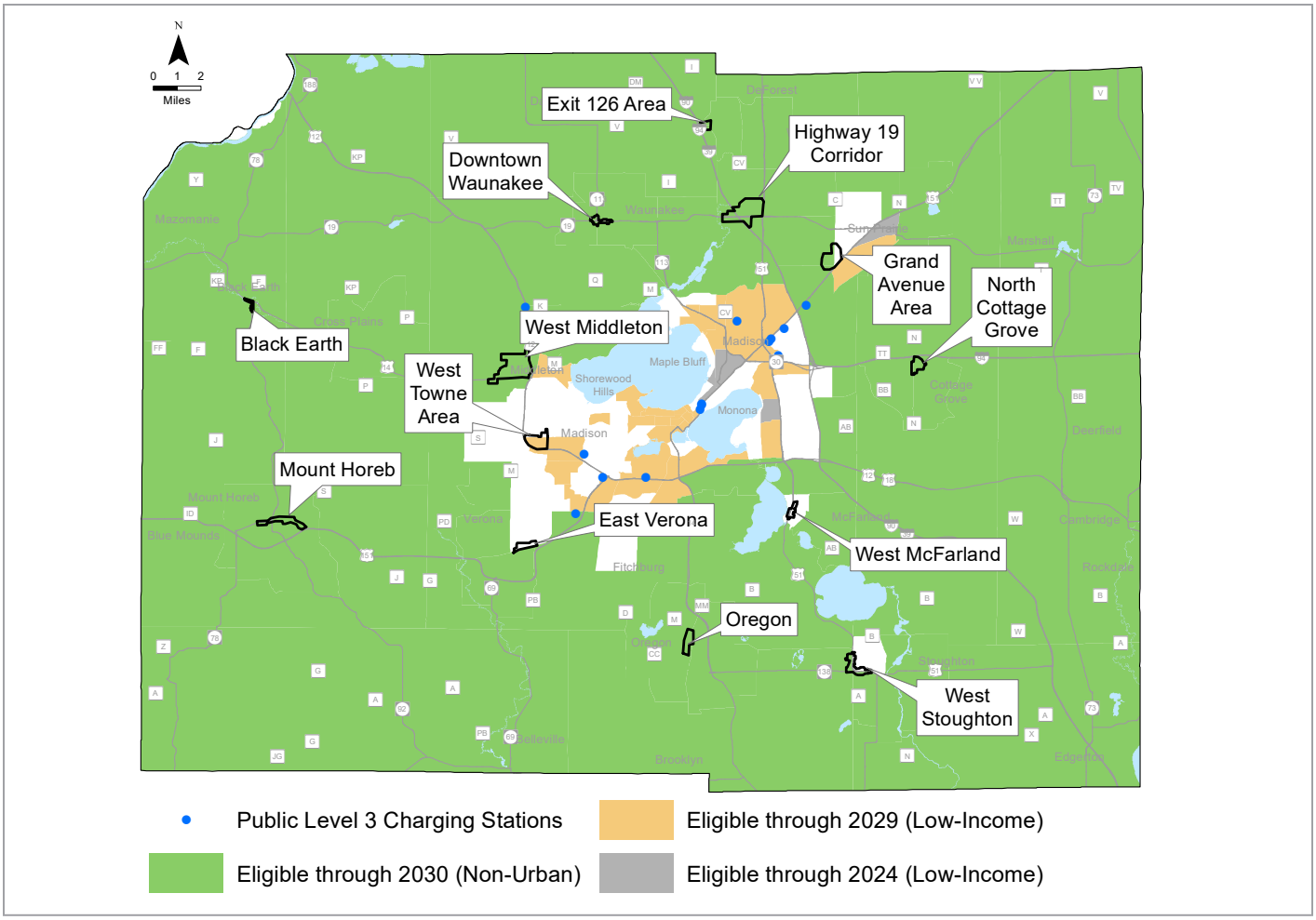
West McFarland (Zone 43)

The commercial area along U.S. Highway 51 in McFarland is home to a wide variety of businesses and gets over 4,000 stops per day, 65% of which are under 30 minutes. With no existing level 3 charging stations in the southeastern part of the Madison Metropolitan Area and more than 15,000 vehicles passing within ¼ mile of the zone each day, new, fast charging infrastructure would be well positioned to serve drivers in a large part of the County, as well as those visiting destinations in the zone.

Grand Avenue Area, Sun Prairie (Zone 49)

This zone is one of the most heavily visited commercial areas in Dane County, with over 21,000 vehicles stopping each day. Just over half of these stops are less than 30 minutes and 4% of trips starting and ending in the zone are longer than 50 miles. In addition, over 65,000

Figure 30: Priority Level 3 Charging Zones with Infrastructure Tax Credit Eligibility Areas



vehicles pass within ¼ mile each day. Level 3 charging infrastructure would be well-positioned to serve area shoppers and may attract potential users passing on U.S. Highway 151.

Highway 19 Corridor, DeForest/Windsor (Zone 55)

With over 7,000 vehicles stopping in the zone each day, 63% of which are stopped for less than 30 minutes, and 18% of which are at the beginning or end of a trip of at least 50 miles, this is one of the most promising sites for new level 3 charging infrastructure. There are no level 3 charging sites in the zone and over 94,000 vehicles pass within ¼ mile each day. New fast-charging infrastructure would serve local shoppers, drivers stopping to refuel on long trips, and ride-hail drivers operating in the northern part of the metropolitan area.

Exit 126 Area, DeForest (Zone 58)

With over 4,000 vehicles stopping and 65,000 vehicles passing within ¼ mile each day, this zone has lower traffic levels than the Highway 19 Corridor (Zone 55), but the characteristics of those who do stop are somewhat more favorable for level 3 charging. Of the stops in this zone, 83% are for less than 30 minutes and 28% of trips to and from the zone are over 50 miles long. This zone is well positioned to serve the needs of long distance travelers and would provide rural residents with a valuable non-home charging location.

Downtown Waunakee (Zone 59)

This zone encompasses downtown Waunakee. It has an average of 5,000 daily stops, 62% of which are less than 30 minutes, and over 20,000 vehicles passing within ¼ mile each day. While only 3% of trips starting and ending in the zone are over 50 miles in length, this zone could be an appropriate site for level 3 charging infrastructure serving drivers visiting local businesses. In addition, the large amount of traffic passing by and lack of nearby level 3 charging infrastructure may allow charging infrastructure in this zone to attract passing drivers. This site could also serve rural EV owners in the area as a non-home charging location.

North Cottage Grove (Zone 63)

Almost 60% of the roughly 3,500 vehicles stopping in this zone each day are stopped for less than 30 minutes; 11% of trips starting and ending in the zone exceed 50 miles; and nearly 60,000 vehicles pass within ¼ mile each day. The short stop times, long trips, and passing traffic volumes all indicate that this zone could be a good level 3 charging site. Chargers in this zone also have the potential to serve rural communities in eastern Dane County.

West Towne Area, Madison (Zone 98)

Madison's West Towne Mall area is one of Dane County's key activity centers. With over 22,000 vehicles stopping in this zone each day, 50% of which are stopped for less than 30 minutes, this zone's high volumes and short stops make it a good candidate for level 3 charging. In addition, over 90,000 vehicles pass within ¼ mile of the zone each day, some of which may be drawn in by the availability of fast-charging infrastructure.

West Middleton (Zone 106)

This zone houses a number of businesses, including a Costco, and gets over 11,000 daily stops, 41% of which are under 30 minutes. It also has more than 67,000 vehicles passing by within ¼ mile each day. The west side of the Madison Metropolitan Area has much less level 3 charging infrastructure than the east side, and this zone's location at the intersection of U.S. Highway 12 and U.S. Highway 14 make it well-suited to serve long-distance travelers, shoppers, and ride-hail drivers operating in the area.

West Stoughton (Zone 59)

Encompassing a wide variety of businesses, including a Walmart Supercenter on Stoughton's west side, this zone receives over 10,000 daily stops, 60% of which are less than 30 minutes. Level 3 charging infrastructure in this area could serve area shoppers, rural residents in southeastern Dane County and long-distance travelers on U.S. Highway 51.

Oregon (Zone 113)

With over 3,000 daily stops, this zone has lower activity than many of the others identified as potential level 3 charging sites. Yet, with 68% of the stops being less than 30 minutes, its distance from existing level 3 charging infrastructure, and its ability to serve rural areas in the southern part of Dane County, it is a good candidate for level 3 charging infrastructure.

Black Earth (Zone 119)

This zone, which gets fewer than 1,000 vehicles stopping each day and less than 10,000 passing by, is the least trafficked zone identified as a priority level 3 charging location. Despite its relatively low traffic levels, it is included in this list because there is no nearby charging infrastructure, 51% of vehicles stop for less than 30 minutes, and 10% of trips starting or ending in the zone are greater than 50 miles. Charging infrastructure in this area would be used by shoppers and long-distance travelers, and would also provide residents and visitors in the surrounding rural communities with a non-home charging location.

Mount Horeb (Zone 120)

This zone, encompassing Mount Horeb's business district, has over 5,000 daily stops, 57% of which are less than 30 minutes and 5% of which are starting or ending trips of greater than 50 miles. With no nearby charging infrastructure and over 25,000 vehicles passing within ¼ mile each day, level 3 charging infrastructure in this zone could serve visitors to local businesses as well as long-distance travelers. The lack of nearby charging infrastructure would also make this location valuable as a way to spread charging infrastructure across the County to serve rural residents and visitors.

East Verona (Zone 130)

This zone, located between East Verona Avenue and Badger Prairie County Park, has over 5,000 daily stops, 67% of which are for less than 30 minutes. In addition, 51,000 vehicles pass within ¼ mile of this zone each day. The large number of short stops, the high volume of pass-through traffic, and this zone's location along U.S. Highway 151 make it a good candidate for level 3 charging infrastructure.

Recommendations

Providing the charging infrastructure needed to support the continued growth of EVs in Dane County will require coordinated actions from agencies and jurisdictions throughout the Greater Madison region: the County, the MPO, the City of Madison, and other communities throughout the County, as well as utilities, nonprofit groups, and employers. The State of Wisconsin also has an important role to play in modifying rules governing electricity sales. In addition, the State can help to facilitate EV adoption by repealing its ban on the direct sale of vehicles by manufacturers.

Monitor Trends in EV Ownership and Charging Needs, with a Focus on Equity

The number of EVs in Dane County is growing rapidly but currently accounts for less than 1% of the County's registered vehicles. While EVs are certain to make up a significant portion of vehicles on the road in the years to come, there is still a great deal of uncertainty as to just how rapid the transition will be. Forecasts of EV penetration in Dane County in 2050 range from about one-third to more than three-quarters of all registered vehicles.

As EVs continue to grow in popularity and the used EV market matures, they will become more accessible to lower-income drivers who are less likely to have access to charging infrastructure at their residences. Nonprofit community organizations may be able to help communities understand the EV charging needs of their economically disadvantaged residents.

Discussing EV charging infrastructure access during public engagement activities for local planning efforts is one way to gauge your community's interest and need for additional charging infrastructure. Utilities are highly involved in EV charging and have a great deal of information about local charging trends and issues. They can help communities better understand charging behavior and identify emerging needs.

Communities should keep track of EV growth trends and public charging infrastructure utilization and engage EV drivers, community organizations, utilities, charging station operators, and others to better understand potential issues as they arise.

To facilitate this, the Greater Madison MPO will issue annual updates on charging stations, EV registrations, and other relevant information.

Increase Residential Access to Charging

About 90% of charging is currently done at home, but people living in apartments or in homes without off-street parking, who also tend to have lower incomes, often lack this option.

To increase the ability of people in these types of living situations to charge their cars while they are at home, communities should consider:

- Requiring the installation of charging infrastructure and EV-ready parking spaces in new or reconstructed parking facilities.
- Installing or supporting the installation of new public charging infrastructure in residential areas where residents cannot charge at home.
- Revising ordinances to allow residents to use extension cords to charge their vehicles in public on-street parking spaces in front of their homes.
- Implementing local right-to-charge ordinances or advocating for right-to-charge legislation at the state level to give residents of condominiums, rental apartments, and homes subject to oversight by homeowners' associations the right to install charging infrastructure for their personal use.
- Engaging with businesses, houses of worship, and community organizations that may be willing to host charging infrastructure where nearby residents can charge their vehicles overnight.

Communities should assess their residential charging needs and, if necessary, explore ways to provide residents the means to charge their vehicles at home.

Update Plans and Regulations to Support EV Infrastructure Installation

Soft costs associated with site selection and permitting can significantly increase the total cost of EV charging installations. Community plans, zoning codes, and parking ordinances can play an important role in reducing these costs and increasing charging infrastructure access.

Identifying EVs as a part of the local transportation strategy in comprehensive planning documents provides a foundation for zoning and other local ordinances to be similarly tailored to promote the use of EVs and the installation of charging infrastructure.

Zoning codes that explicitly address EV charging infrastructure reduce confusion for installers and government officials, making installation faster and more efficient. Zoning codes should, at a minimum, identify where charging stations are permitted by right and conditionally. Communities should also consider including requirements and incentives for the installation of charging infrastructure in parking lots, and site design guidelines.

EV-supportive parking ordinances that clarify restrictions and penalties for non-EVs parked in EV-designated spaces promote the expansion and use of EV charging infrastructure by reducing the likelihood that it will blocked by fossil-fueled vehicles.

Communities should work to identify and correct gaps and ambiguities in their local plans and regulations that may inhibit the expansion of EV charging infrastructure. They should also consider amending their zoning codes to include incentives or requirements for the installation of EV charging infrastructure in new parking facilities.

See the Policy and Planning Tools section (page 27) for additional information.

Encourage and Facilitate Private Sector Charging Infrastructure Investments

Most public charging infrastructure is owned and operated by private businesses. As the number of EVs and demand for new charging infrastructure grows, most new charging installations will be developed by the private sector.

Providing information and assistance to private sector partners that are considering new charging infrastructure investments can lower the cost and risk faced by private sector investors while giving local governments an opportunity to help direct new charging infrastructure to areas where it is most needed.

Local governments should work with private sector charging infrastructure developers to share information, help them navigate required approval processes, and highlight areas with a need for additional charging infrastructure.

Revise Wisconsin State Statutes to Enable Charging Fees Based on Energy Use

The federal requirement that charging infrastructure receiving federal funding must base charging fees on kilowatt-hours of energy will prevent businesses and communities in Wisconsin from accessing NEVI and CFI grant funding included in the BIL due to current state law that regulates entities selling electricity as public utilities. EV charging station operators are averse to classification as a public utility because it would place them under the oversight of the state's Public Service Commission (PSC) and impose burdensome requirements that they share data with the PSC.

Failure to amend this statute will jeopardize the NEVI funding allocated to the state for the expansion of charging infrastructure along the state's network of Alternate Fuel Corridors as well as the joint CFI grant application submitted by Dane County communities.

The State Senate passed a bill to make this change in January 2024.[65] A similar bill is currently circulating in the State Assembly, as of February 2024.[66] Legislation to enable non-utilities to base charging fees on energy

[65] SB 791.

[66] AB 846.

use is expected to be signed into law by the governor later in 2024.

The state legislature should amend its definition of a public utility to include an exemption for EV charging stations so that they are not subject to regulation as public utilities.

See Pricing (page 26) for more on this issue.

Repeal Wisconsin's Statewide Prohibition on Vehicle Sales by Manufacturers

Wisconsin's ban on "factory stores," auto dealerships owned by vehicle manufacturers, effectively blocks the sale of several EV models in the state, including those made by Tesla. Although buyers are free to purchase these vehicles from dealerships in other states, repealing this ban would increase market competition in Wisconsin and reduce the time, effort, and expense required to purchase some popular EV models.

The state legislature should remove the statutory ban on "factory stores," to provide greater choice to EV purchasers in Wisconsin and keep vehicle purchase-related taxes and fees in Wisconsin.

Remove State Restrictions on the Use of Federal Funding for EVs and EV Infrastructure

The purpose of the federal Carbon Reduction Program (CRP) is to provide funding for a wide variety of project types that reduce transportation-related CO_2 emissions from on-road sources. The Wisconsin Legislature's Joint Finance Committee, however, has made EVs and EV infrastructure ineligible for funding under the program. Removing these restrictions would provide a valuable source of funding for EV infrastructure projects, particularly projects serving low-income residential areas and other locations that are less likely to generate sufficient revenue to attract private investment.

The Wisconsin Legislature's Joint Finance Committee should remove the restrictions on the use of federal funding for EVs and EV charging infrastructure that it has enacted to provide local decision makers with greater flexibility and help prepare the state for the transition to EVs.

APPENDIX A

Commercial and Employment Zone Analysis

The following full-page maps and data tables provide a more detailed view of the data used in the Commercial and Employment Zone Analysis section. All maps detailing vehicle travel behavior are based on travel data estimates from StreetLight Data for the period May 1, 2021 through April 30, 2022.

Figure 31: Commercial and Employment Analysis Zones

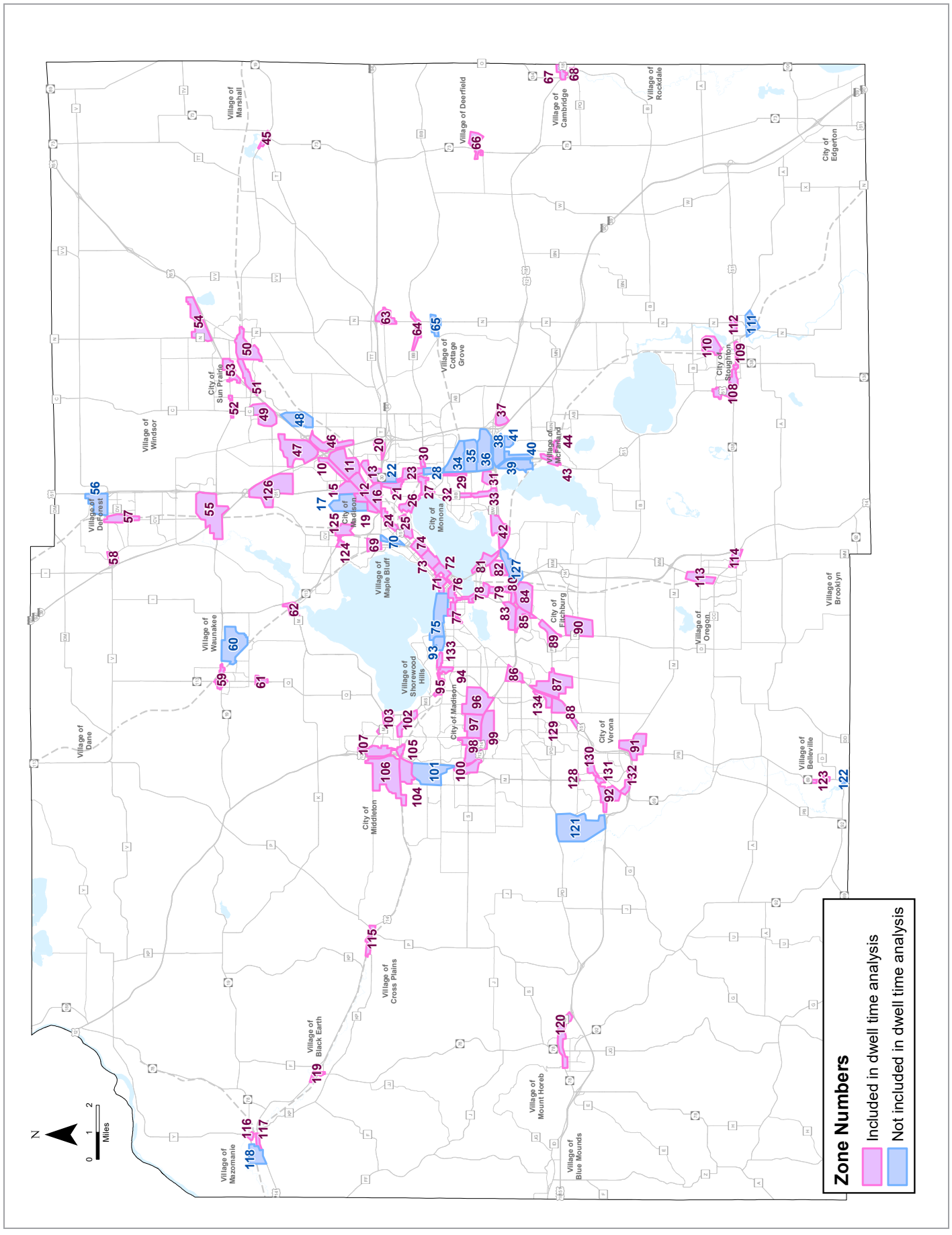


Figure 32: Analysis Zones and 2020 Commercial and Employment Land Uses in Dane County

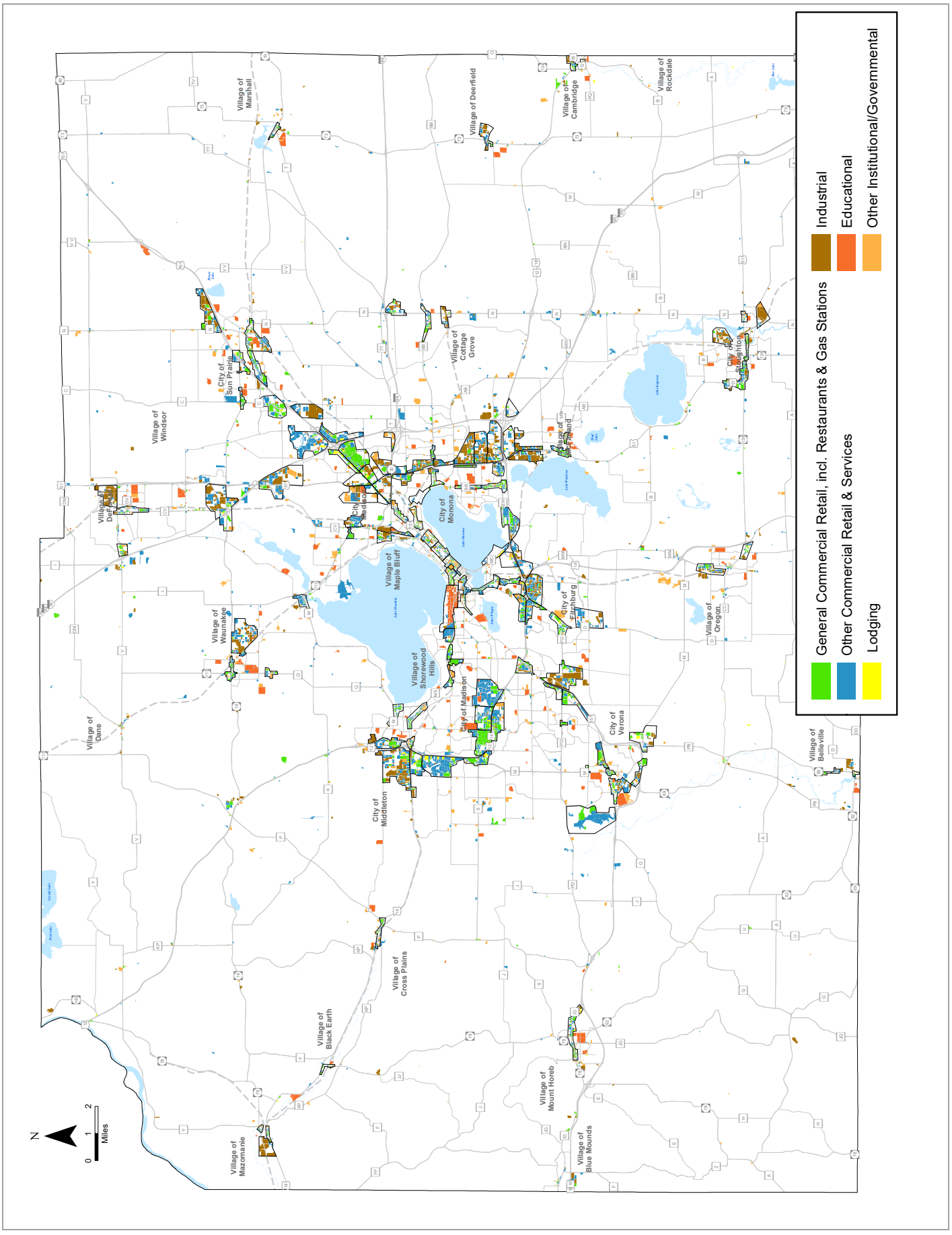


Figure 33: Average Daily Stops

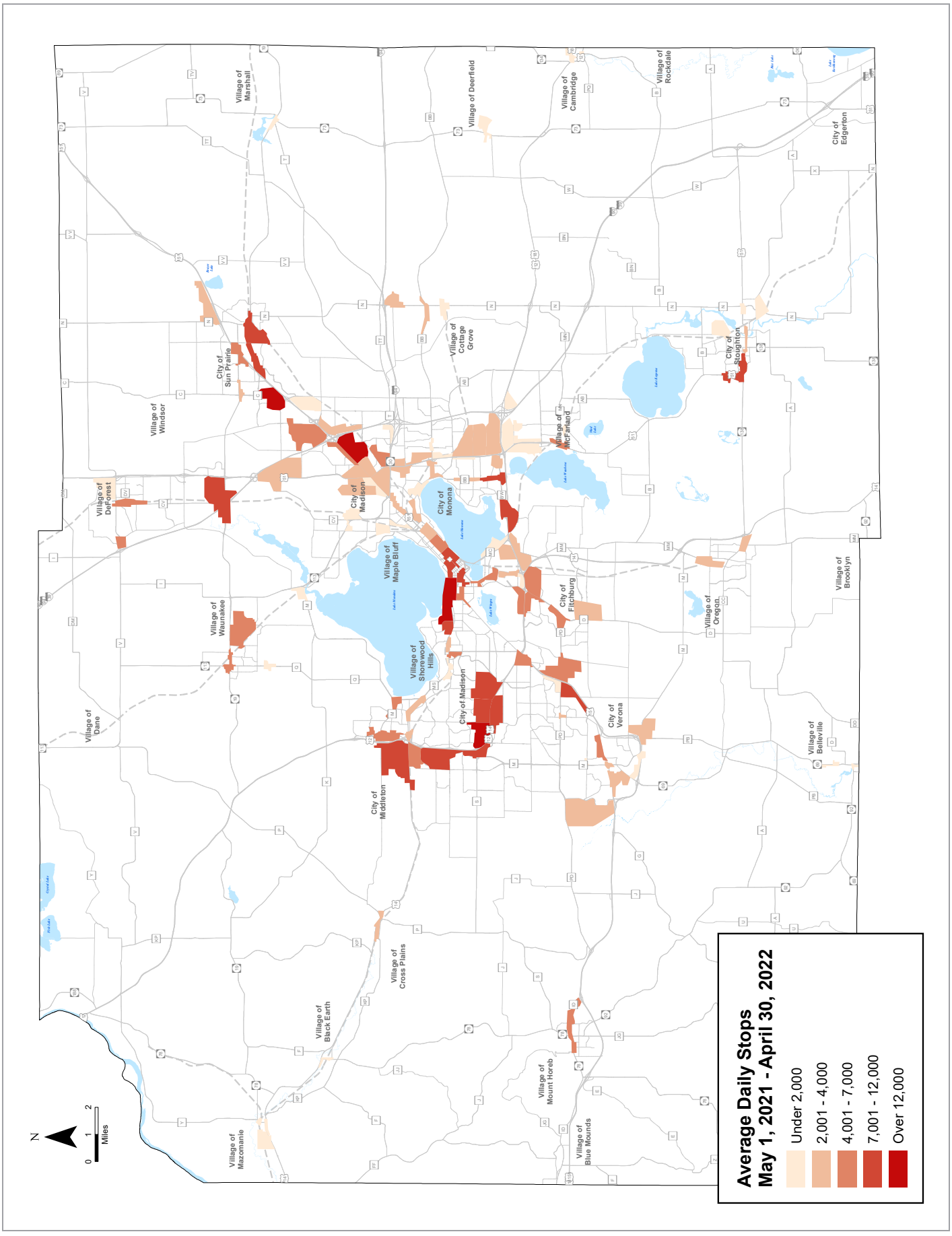


Figure 34: Percentage of Trips over 50 Miles

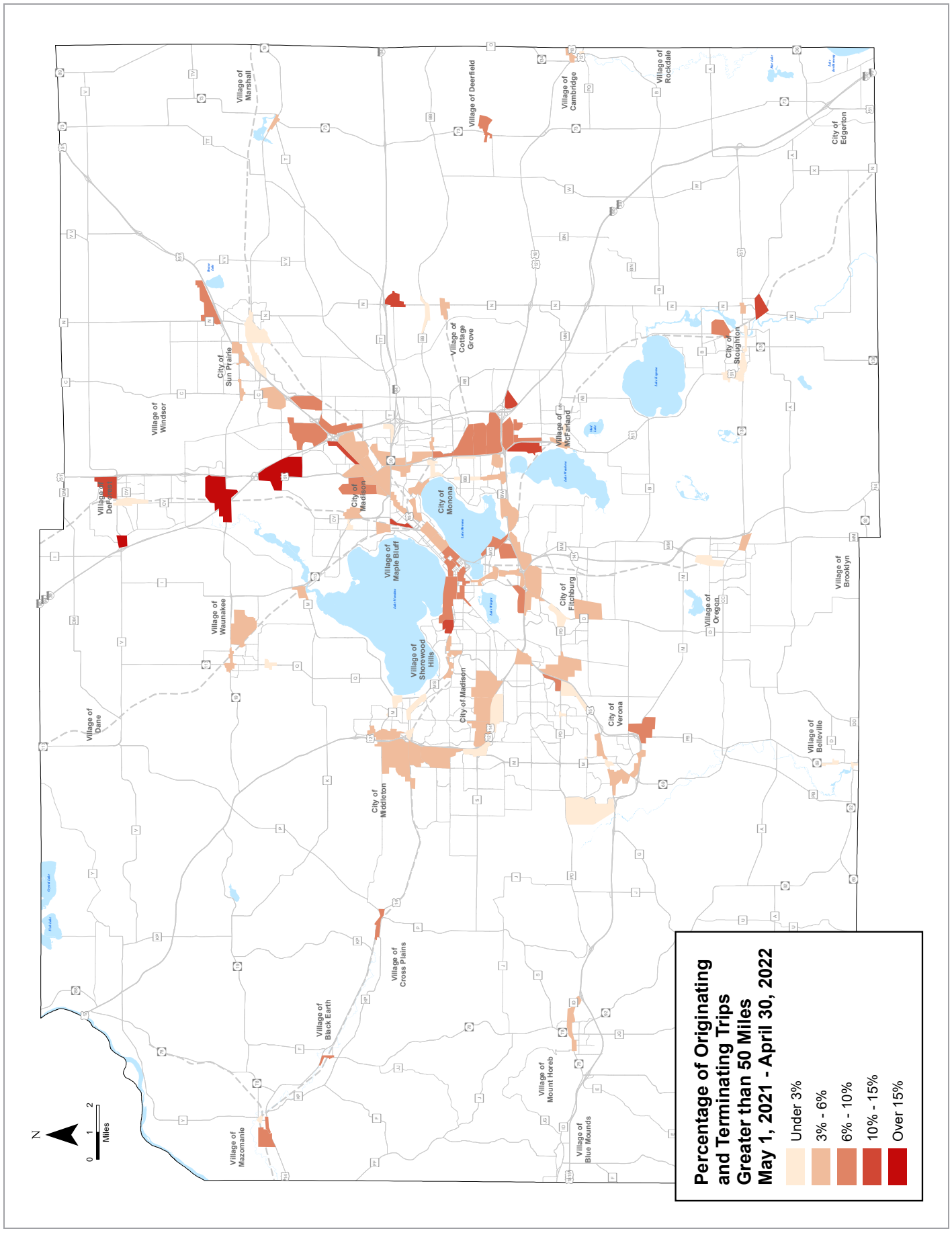


Figure 35: Average Daily Stops, Under 30 Minutes

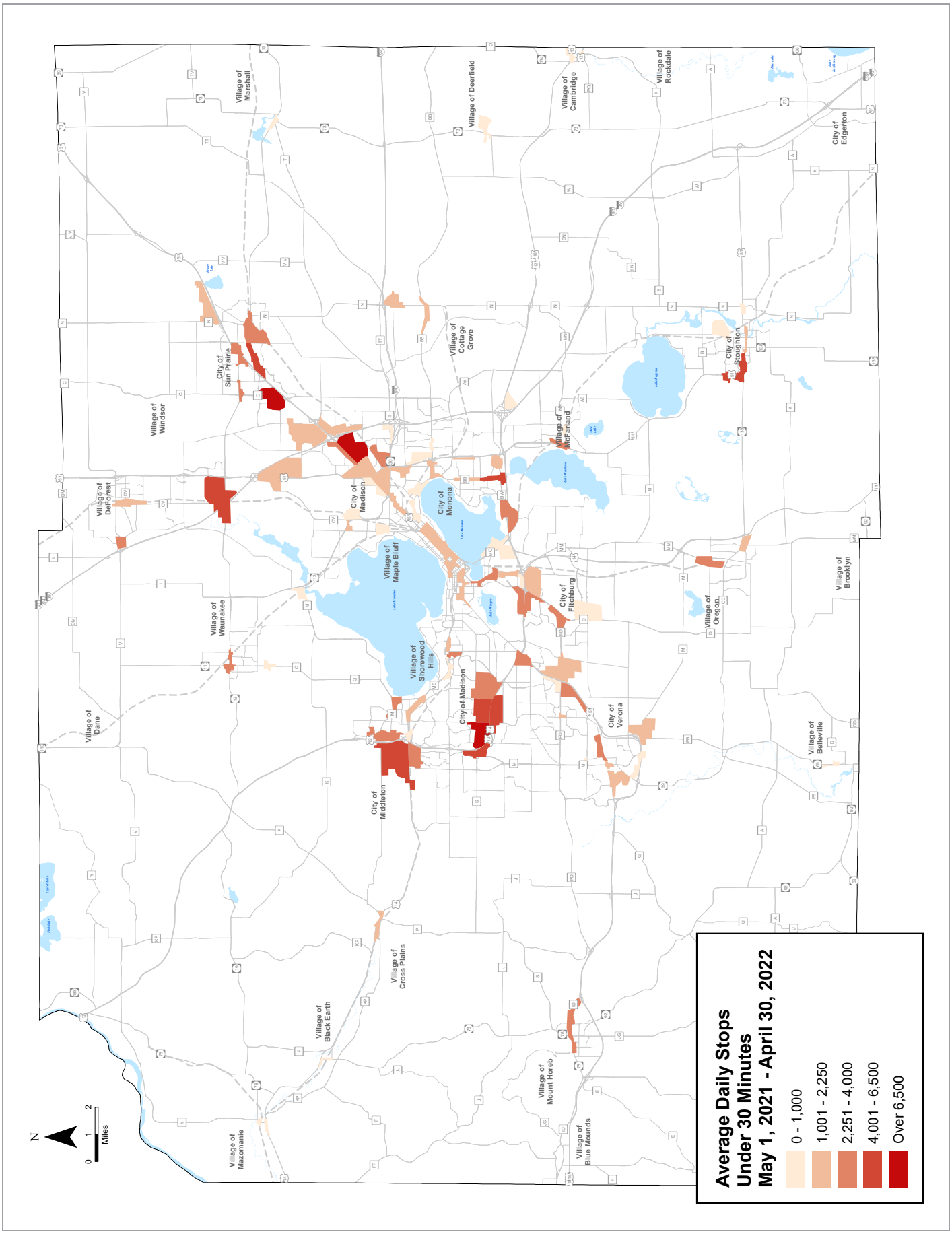


Figure 36: Average Daily Stops, 30-240 Minutes

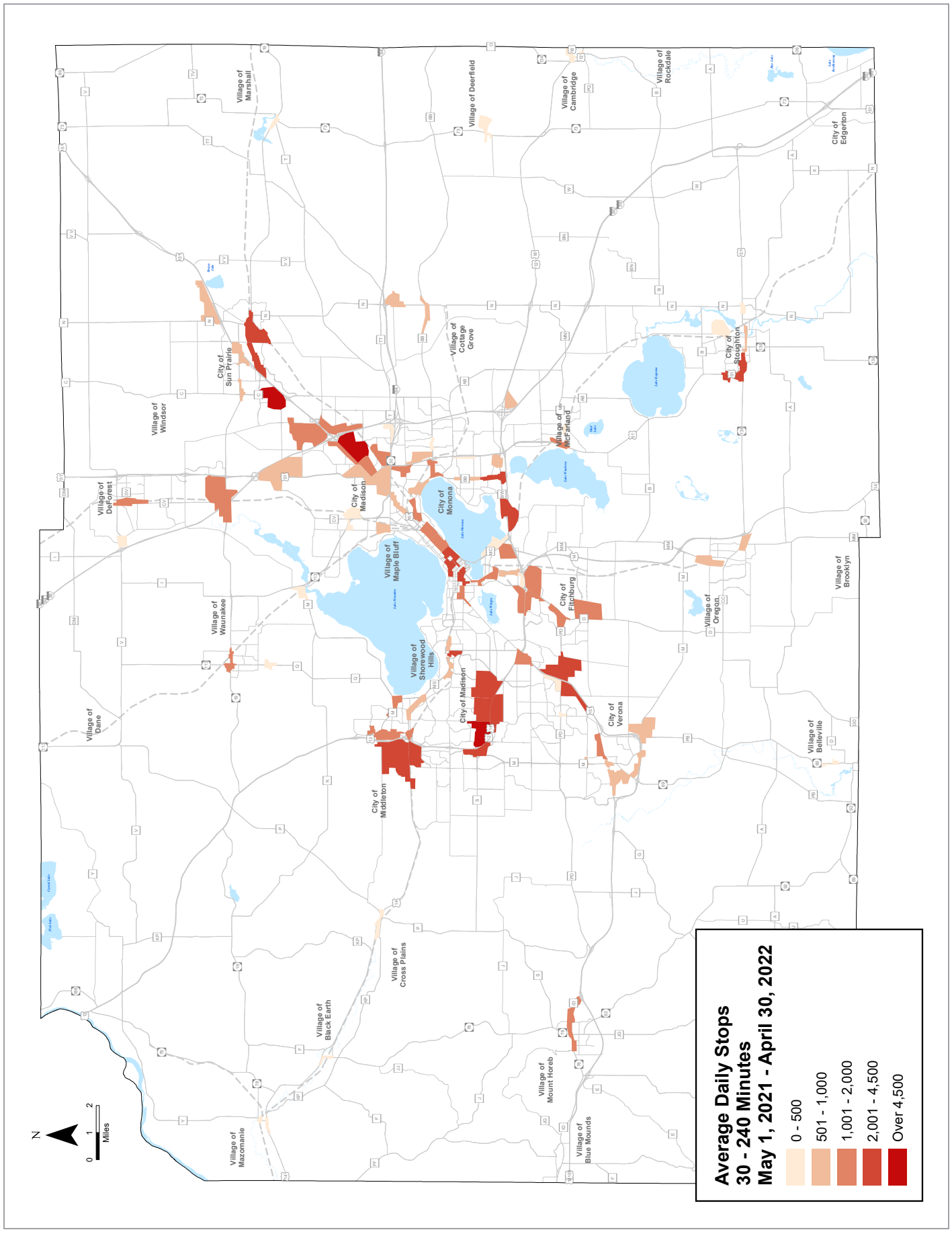


Figure 37: Average Daily Stops, Over 240 Minutes

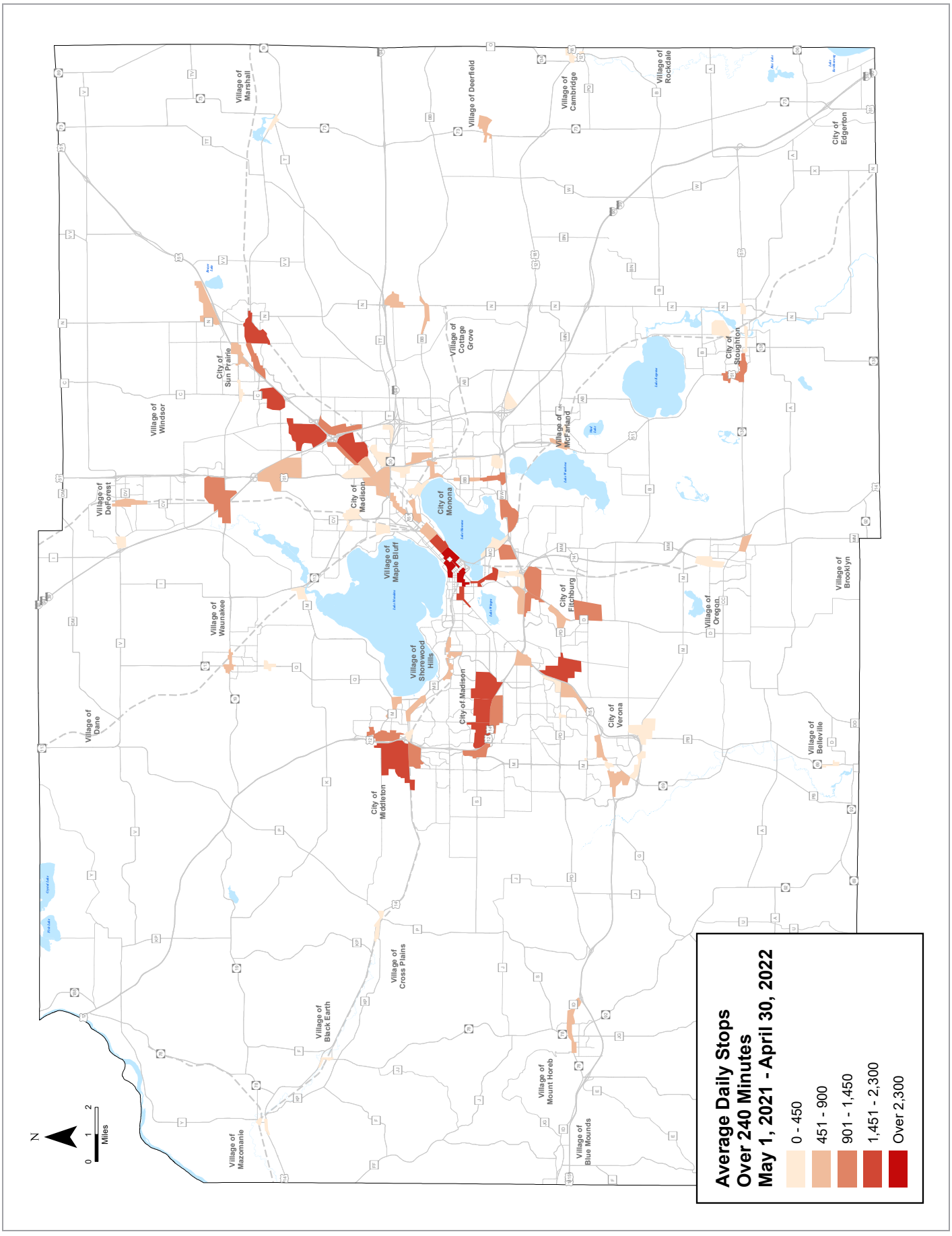


Figure 38: Average Daily Traffic within 1/4 mile of Analysis Zones

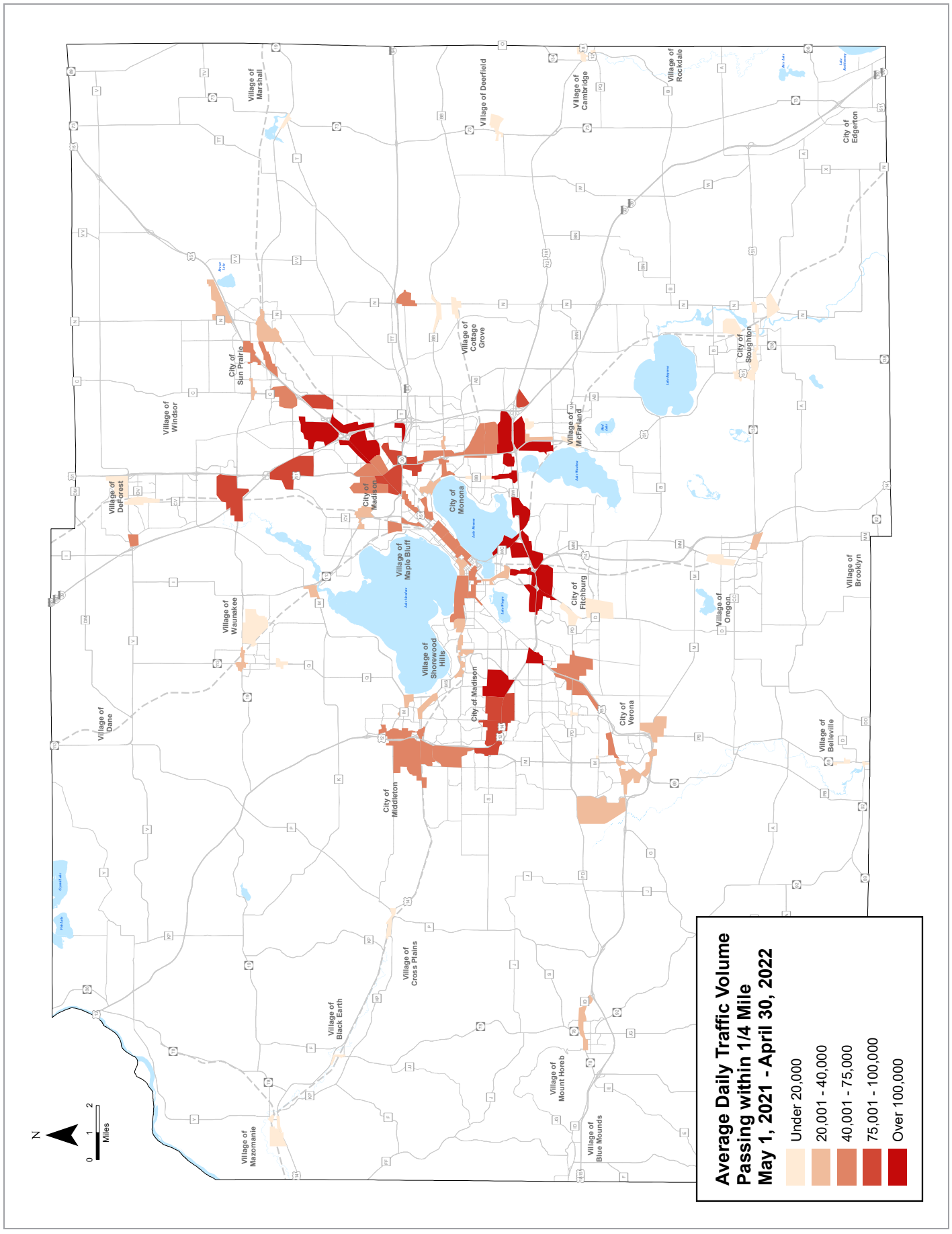


Figure 39: Level 3 Charging Screening Map

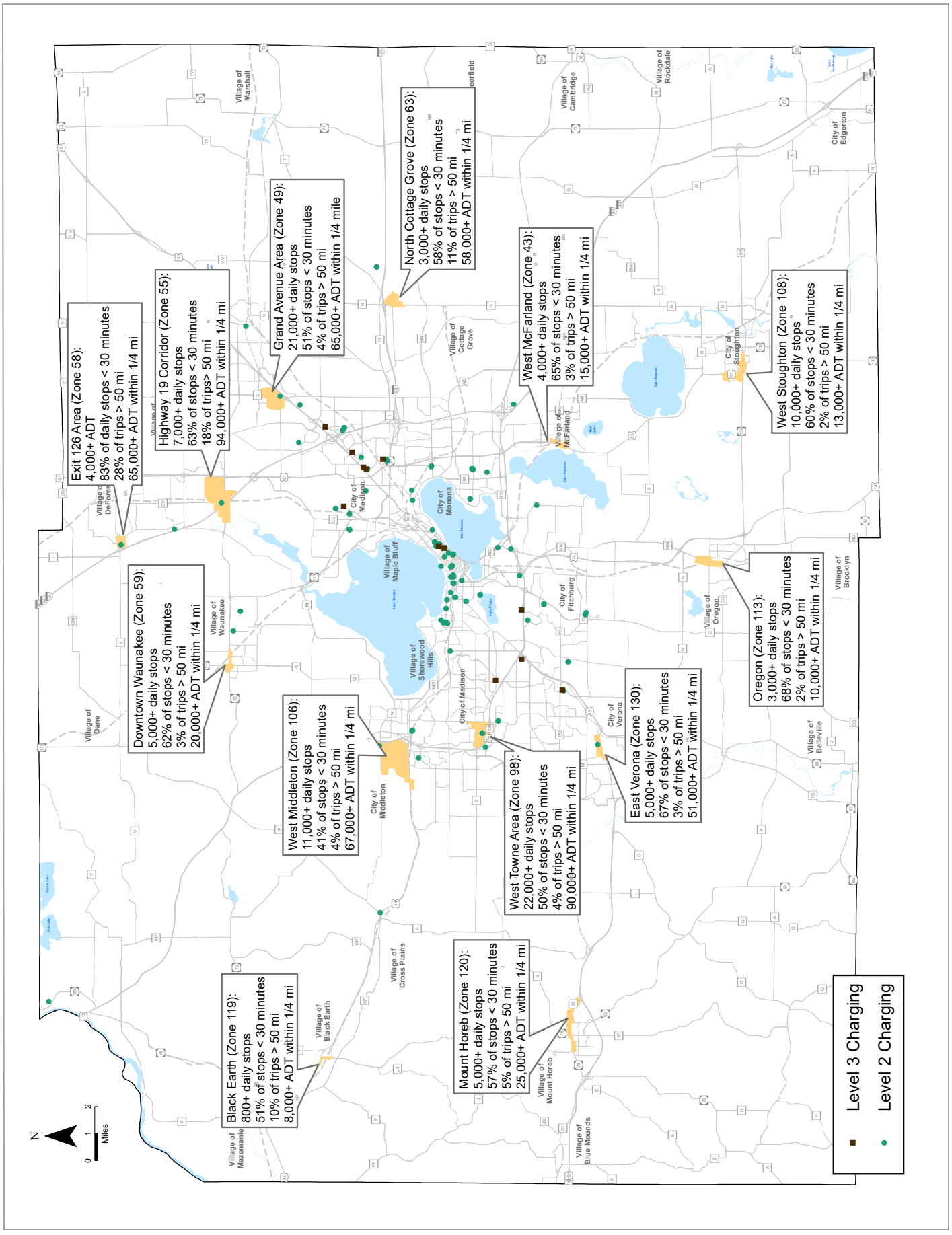


Figure 40: Multifamily Charging Zone with Infrastructure Tax Credit Areas

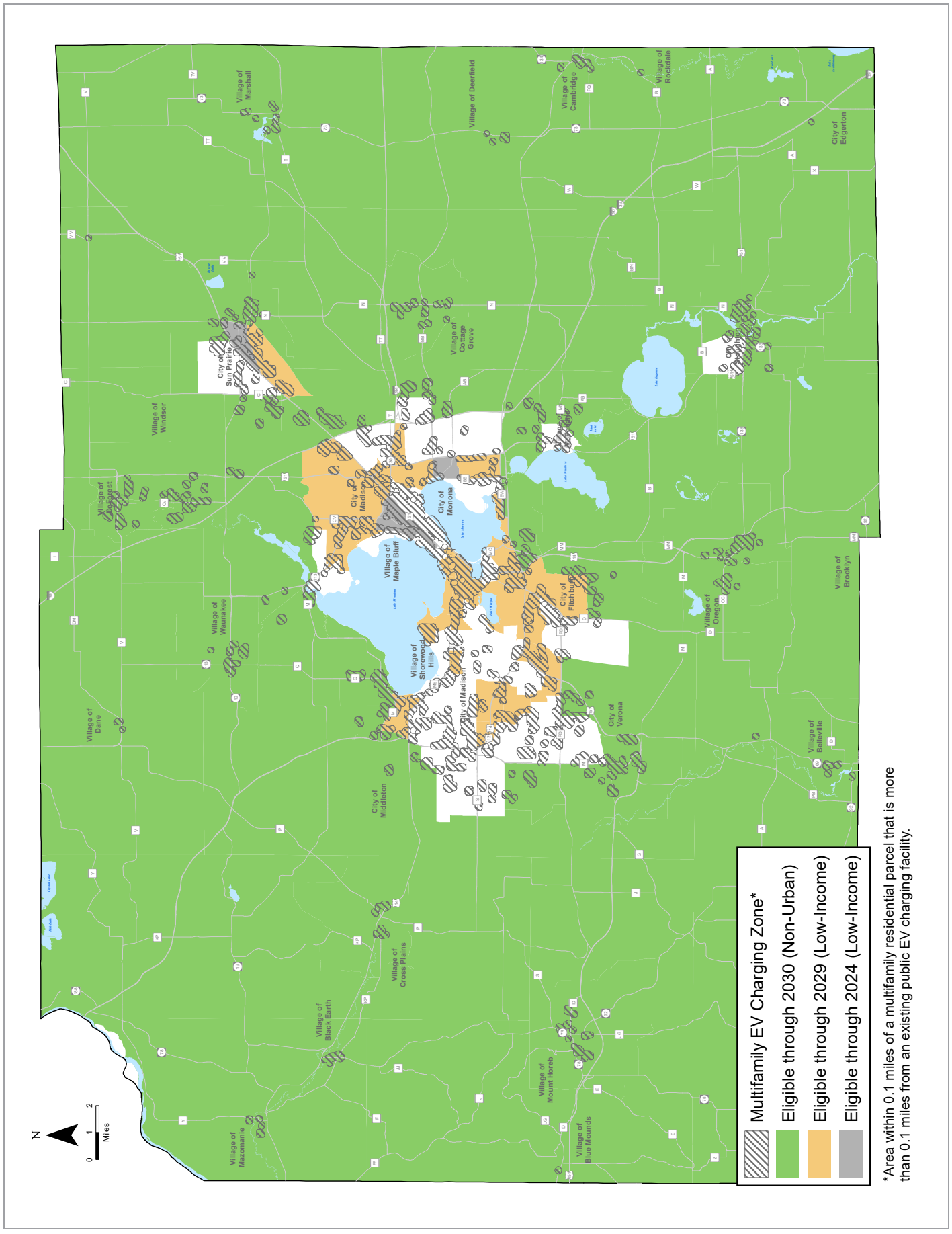


Figure 41: Priority Level 3 Charging Zones with Infrastructure Tax Credit Eligibility Areas

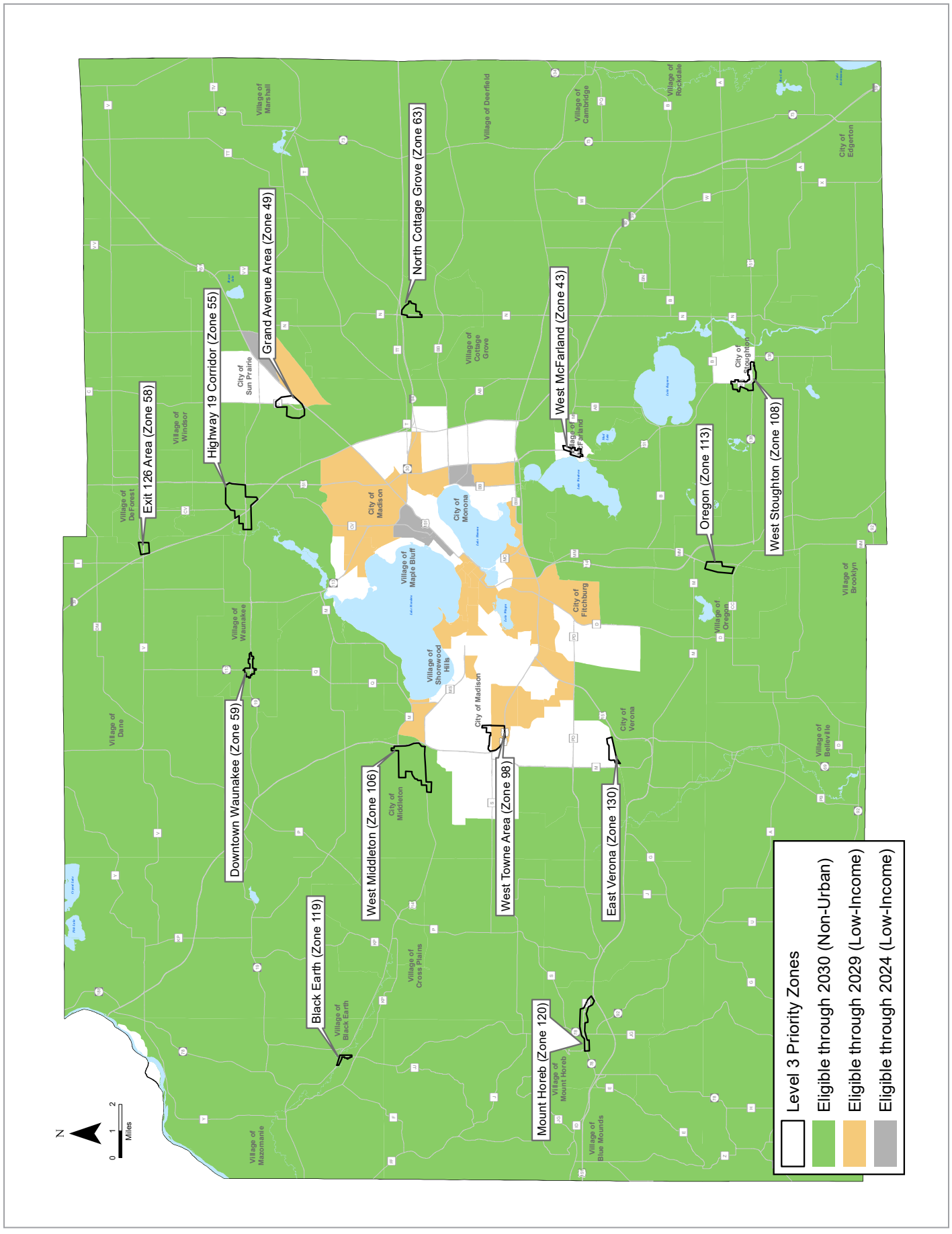


Figure 42: Level 3 Priority Zone Detail

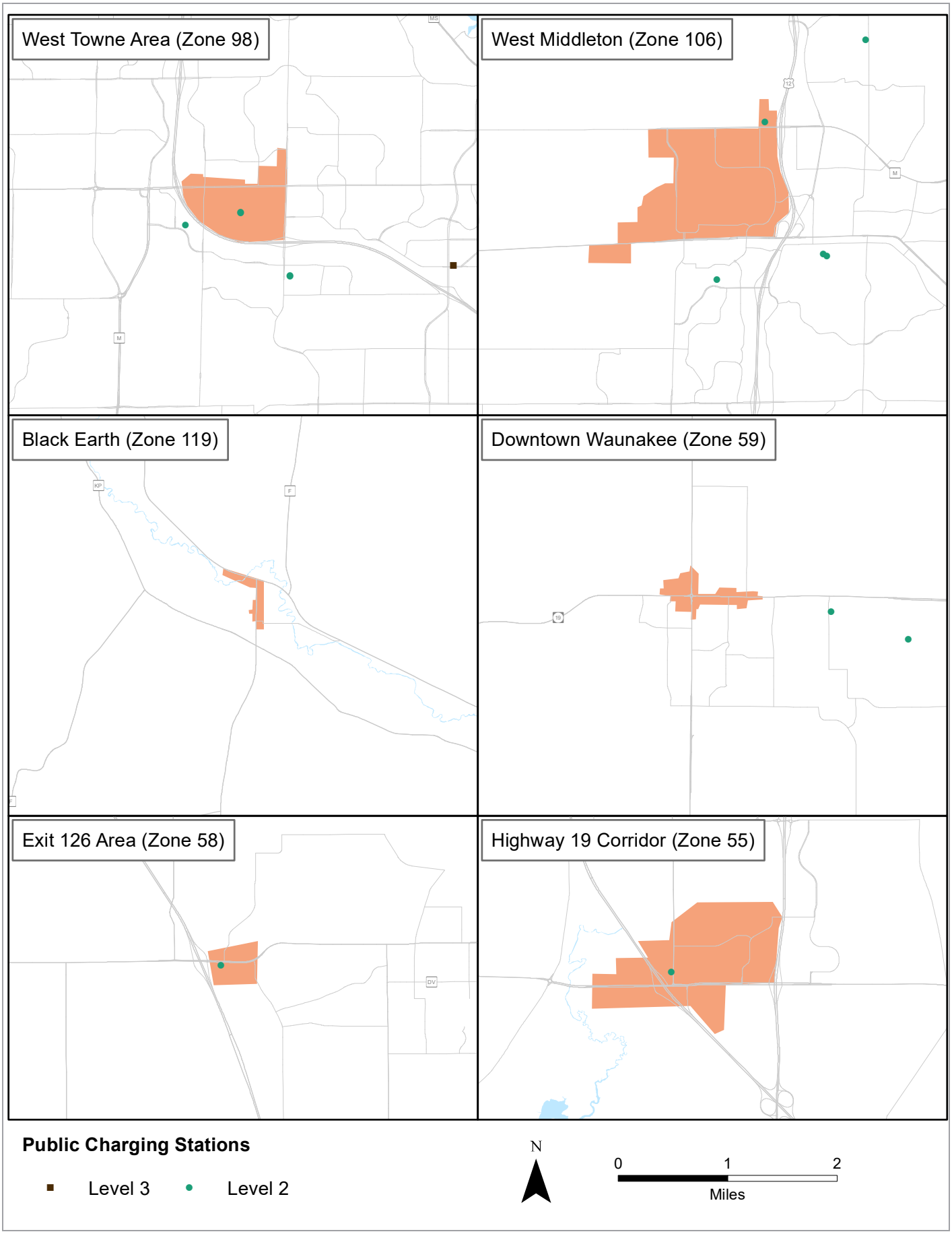


Figure 43: Level 3 Priority Zone Detail (continued)

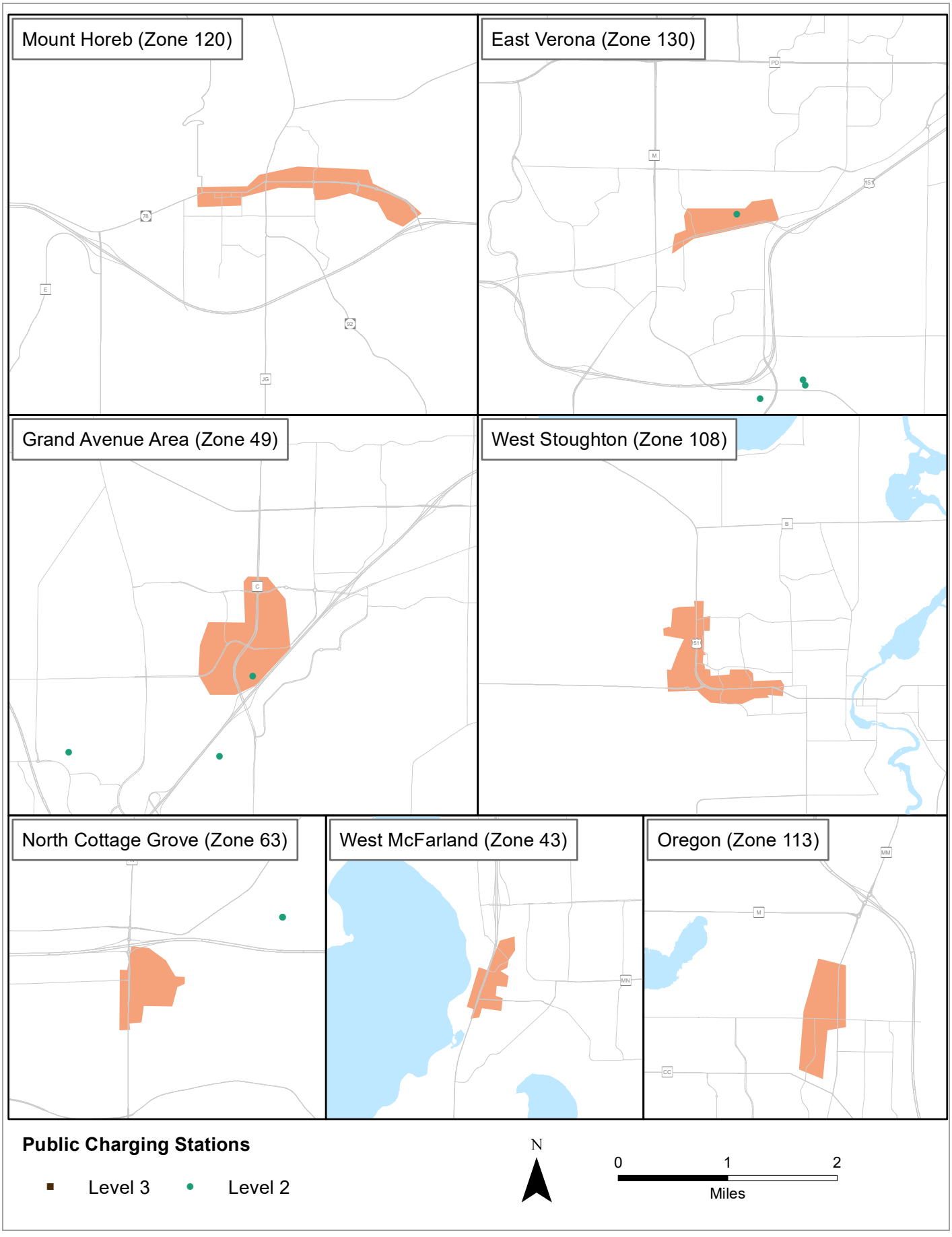


Table 9: Analysis Zone Travel Data, May 1, 2021–April 30, 2022

Zone Number	Estimated Daily Traffic Stopping in Zone	Trip Distance			Dwell Time				Estimated Daily Pass-Thru Traffic within ¼ Mile
		0–20 miles (percent)	20–50 miles (percent)	50+ miles (percent)	0–30 minutes (percent)	30–240 minutes (percent)	240+ minutes (percent)	Median (minutes)	
10	6,233	77%	13%	10%	63%	21%	16%	16.1	124,642
11	23,584	81%	14%	5%	49%	44%	6%	31.0	123,258
12	3,374	84%	10%	6%	51%	34%	16%	29.6	55,381
13	4,208	88%	8%	4%	57%	34%	9%	24.8	81,458
15	2,817	82%	13%	5%	57%	30%	13%	22.3	51,878
16	2,591	84%	12%	5%	40%	31%	30%	63.3	98,314
17	3,510	70%	22%	8%					54,003
19	1,869	87%	9%	5%	44%	29%	27%	49.7	85,547
20	429	91%	7%	2%	54%	37%	10%	24.6	142,041
21	3,862	87%	7%	5%	56%	35%	9%	25.4	83,611
22	2,041	90%	7%	3%					82,182
23	2,219	79%	15%	7%	44%	36%	21%	49.1	62,817
24	3,304	85%	11%	5%	58%	23%	19%	18.8	60,509
25	2,565	86%	10%	4%	30%	44%	26%	76.5	44,505
26	1,273	88%	7%	5%	36%	55%	10%	50.0	25,902
27	3,014	92%	5%	3%	39%	37%	24%	54.2	61,905
28	1,725	87%	8%	6%					64,251
29	1,738	89%	8%	3%	66%	23%	11%	17.8	51,143
30	1,182	89%	7%	4%	53%	28%	20%	29.4	20,093
31	2,429	88%	9%	3%	59%	33%	8%	23.0	133,589
32	3,150	93%	5%	2%	50%	28%	22%	31.8	17,949
33	7,964	87%	9%	4%	59%	29%	12%	21.2	120,825
34	3,601	77%	17%	7%					49,973
35	3,081	72%	18%	10%					49,021
36	3,392	72%	19%	10%					159,360
37	1,690	61%	26%	13%	23%	58%	20%	100.1	93,220
38	1,227	72%	19%	9%					143,094
39	1,604	66%	21%	13%					127,458
40	634	70%	22%	8%					30,969
41	366	76%	15%	9%					13,371
42	8,223	86%	10%	4%	48%	36%	16%	32.7	117,735
43	4,664	91%	7%	3%	65%	22%	13%	12.2	15,645
44	706	89%	8%	3%	40%	35%	25%	64.7	6,883
45	1,364	86%	12%	3%	66%	18%	16%	10.6	8,614
46	3,852	78%	14%	8%	37%	34%	28%	68.0	139,430
47	5,080	74%	18%	8%	37%	33%	30%	67.4	137,456
48	851	68%	25%	7%					79,403
49	21,869	83%	14%	4%	51%	41%	7%	28.9	65,728
51	10,234	89%	9%	2%	61%	26%	13%	20.8	60,871
52	3,746	90%	8%	3%	75%	16%	8%	11.0	27,062
53	4,096	86%	10%	4%	67%	18%	14%	10.6	57,882

Table 10: Analysis Zone Travel Data, May 1, 2021–April 30, 2022 (continued)

Zone Number	Estimated Daily Traffic Stopping in Zone	Trip Distance			Dwell Time				Estimated Daily Pass-Thru Traffic within ¼ Mile
		0–20 miles (percent)	20–50 miles (percent)	50+ miles (percent)	0–30 minutes (percent)	30–240 minutes (percent)	240+ minutes (percent)	Median (minutes)	
54	2,883	74%	18%	8%	41%	30%	29%	54.8	35,320
55	7,932	64%	18%	18%	63%	21%	16%	16.7	94,583
56	893	64%	23%	13%					15,436
57	4,000	89%	9%	2%	51%	30%	19%	29.1	10,081
58	4,197	55%	17%	28%	83%	9%	8%	9.3	65,057
59	5,918	90%	7%	3%	62%	25%	13%	16.6	20,162
60	4,411	82%	14%	4%					19,241
61	1,221	91%	7%	2%	64%	24%	12%	13.2	15,922
62	1,188	86%	9%	4%	61%	21%	18%	15.6	20,944
63	3,558	76%	14%	11%	58%	23%	19%	16.0	58,110
64	2,648	89%	9%	2%	55%	24%	21%	23.6	12,207
65	977	83%	12%	5%					7,192
66	1,141	72%	21%	7%	34%	26%	40%	149.8	4,431
67	1,302	78%	17%	4%	70%	15%	15%	10.5	10,112
68	322	82%	15%	3%	45%	38%	17%	41.7	10,708
69	1,724	87%	9%	4%	42%	43%	15%	53.4	47,553
70	1,353	78%	15%	7%					58,573
71	9,946	82%	8%	9%	20%	38%	42%	161.2	38,559
72	7,579	80%	12%	8%	17%	42%	41%	159.0	61,024
73	4,579	84%	11%	6%	26%	40%	33%	116.3	53,507
74	2,865	88%	8%	3%	36%	38%	26%	62.1	57,834
75	15,912	86%	7%	7%					42,034
76	7,714	79%	13%	8%	20%	35%	44%	185.5	71,766
77	5,181	84%	8%	8%	28%	36%	36%	126.2	52,276
78	5,646	78%	16%	6%	37%	33%	30%	64.7	24,055
79	2,714	89%	8%	3%	63%	24%	14%	15.9	130,405
80	1,389	83%	12%	4%	40%	35%	25%	54.9	135,956
81	1,137	82%	8%	10%	30%	32%	38%	122.8	131,395
82	3,747	77%	14%	10%	26%	38%	36%	138.1	131,586
83	4,253	82%	13%	5%	60%	29%	11%	19.9	128,867
84	3,994	80%	15%	5%	45%	30%	25%	44.9	134,655
85	5,109	84%	12%	4%	51%	27%	22%	28.8	116,695
86	5,150	85%	10%	6%	64%	26%	11%	19.3	125,511
88	7,260	90%	8%	2%	51%	40%	8%	29.0	66,690
89	5,308	88%	9%	3%	50%	33%	17%	30.6	17,082
90	2,827	82%	15%	3%	21%	39%	40%	152.4	12,850
91	2,541	75%	17%	9%	60%	27%	13%	12.2	38,653
92	2,994	82%	12%	5%	44%	31%	25%	47.4	34,521
93	8,350	67%	21%	12%					30,436
94	7,121	86%	9%	4%	46%	46%	9%	36.2	29,808
95	1,724	76%	18%	6%	28%	32%	40%	159.5	34,361

Table 11: Analysis Zone Travel Data, May 1, 2021–April 30, 2022 (continued)

Zone Number	Estimated Daily Traffic Stopping in Zone	Trip Distance			Dwell Time				Estimated Daily Pass-Thru Traffic within ¼ Mile
		0–20 miles (percent)	20–50 miles (percent)	50+ miles (percent)	0–30 minutes (percent)	30–240 minutes (percent)	240+ minutes (percent)	Median (minutes)	
96	7,859	84%	12%	4%	42%	38%	21%	43.9	100,946
97	10,858	85%	11%	4%	49%	36%	15%	31.8	93,598
98	22,726	84%	12%	4%	50%	42%	8%	30.4	90,111
99	10,770	89%	9%	2%	54%	33%	13%	25.9	84,477
100	10,722	89%	9%	3%	58%	33%	9%	23.9	89,031
101	7,595	82%	14%	4%					69,348
102	2,600	88%	9%	3%	48%	32%	21%	36.9	32,699
103	4,719	92%	6%	2%	52%	31%	17%	28.7	25,325
104	6,539	85%	11%	4%	47%	36%	17%	35.6	70,183
105	2,352	89%	8%	3%	34%	50%	16%	56.3	73,464
106	11,519	82%	14%	4%	41%	39%	20%	43.6	67,479
107	5,245	85%	12%	4%	55%	24%	22%	22.6	69,525
108	10,366	87%	11%	2%	60%	28%	12%	20.6	13,163
109	2,498	86%	12%	2%	49%	35%	16%	32.8	15,522
110	965	72%	21%	8%	35%	32%	34%	103.2	4,399
111	573	57%	29%	14%					2,369
112	963	85%	12%	3%	63%	24%	13%	15.2	8,951
113	3,665	89%	9%	2%	68%	21%	11%	12.2	10,786
114	2,675	83%	14%	3%	62%	20%	18%	12.2	28,366
115	2,188	80%	14%	6%	65%	18%	17%	12.4	10,445
116	255	74%	23%	3%	26%	41%	33%	119.6	9,430
117	623	66%	24%	10%	70%	13%	17%	11.2	9,474
118	668	57%	35%	8%					8,211
119	830	63%	27%	10%	51%	36%	13%	29.8	8,581
120	5,427	80%	14%	5%	57%	27%	16%	20.7	25,841
121	2,527	88%	10%	2%					29,715
122	380	90%	8%	2%					5,334
123	808	85%	13%	2%	66%	17%	16%	12.8	4,078
124	1,895	91%	7%	2%	64%	21%	14%	15.3	35,634
125	963	80%	17%	4%	41%	36%	23%	73.4	38,072
126	3,223	55%	22%	23%	47%	27%	26%	43.4	93,461
127	2,882	83%	13%	5%					142,119
128	1,147	89%	9%	2%	43%	46%	12%	43.3	16,964
129	2,040	93%	5%	2%	67%	16%	17%	13.8	19,349
130	5,207	87%	9%	3%	67%	23%	10%	15.9	51,388
131	2,098	92%	7%	1%	61%	26%	13%	20.2	20,396
132	1,043	81%	15%	4%	26%	56%	18%	70.4	30,921
133	2,945	89%	9%	3%	60%	24%	16%	21.4	28,116
134	1,186	85%	9%	7%	64%	26%	11%	14.8	65,214

APPENDIX B

Additional Resources

The resources below are included to provide communities, businesses, and organizations in our region with a starting point for their own EV planning efforts and EV-related grant applications.

EV Compendia

- Alternative Fuels Data Center - https://afdc.energy.gov/
- Atlas EV Hub - www.atlasevhub.com
- Joint Office of Energy and Transportation - https://driveelectric.gov/

State and Regional Plans

- Capital Area Regional Planning Commission (CARPC), Regional Development Framework. https://www.capitalarearpc.org/community-regional-development/regional-development-plan-update/
- Dane County Climate Action Plan. https://daneclimateaction.org/climate-action-plan
- Greater Madison MPO, Connect Greater Madison 2050 Regional Transportation Plan. https://www.greatermadisonmpo.org/planning/RegionalTransportationPlan2050.cfm
- Wisconsin Department of Transportation, Wisconsin Electric Vehicle Infrastructure Plan. https://wisconsindot.gov/Documents/projects/WEVI-plan-final-22-0914.pdf

Environmental Justice and Public Health Data

- Public Health Madison and Dane County. Healthy Dane Community Health Dashboards. http://healthydane.org/?hcn=CommunityDashboard
- Wisconsin Department of Health Services, et al. Asthma in Wisconsin 2020. https://www.dhs.wisconsin.gov/publications/p02412-20.pdf
- Wisconsin Department of Health Services, et al. Wisconsin Asthma Plan 2021-2025. https://www.chawisconsin.org/download/wisconsin-asthma-plan/

EV Infrastructure Information and Guidance

- Best Practices for Designing ADA-Compliant EV Charging Stations, U.S. Department of Energy. https://afdc.energy.gov/fuels/electricity_infrastructure_ada_compliance.html
- Design Recommendations for Accessible Electric Vehicle Charging Stations, U.S. Access Board. https://www.access-board.gov/tad/ev/
- Cybersecurity for Electric Vehicle Charging Infrastructure, U.S. Department of Energy. https://www.osti.gov/servlets/purl/1877784
- Electric Vehicle Charging Station Locations, U.S. Department of Energy Alternative Fuels Data Center. https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC
- National Electric Vehicle Standards and Requirements, Federal Highway Administration. https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements
- The 2030 National Charging Network: Estimating U.S. Light-Duty Demand for Electric Vehicle Charging Infrastructure. National Renewable Energy Laboratory (2023). https://driveelectric.gov/files/2030-charging-network.pdf.

- Nelder, Chris and Emily Rogers. Reducing EV Charging Infrastructure Costs. Rocky Mountain Institute (2019). https://rmi.org/insight/reducing-ev-charging-infrastructure-costs
- Werthmann, Emmett & Kothari, Vishant. Pole-Mounted Electric Vehicle Charging: Preliminary Guidance for a Low-Cost and More Accessible Public Charging Solution for U.S. Cities. World Resources Institute (2021). https://www.wri.org/research/pole-mounted-electric-vehicle-charging-preliminary-guidance

Funding Sources

- Grants.gov website for information on federal grant opportunities - https://www.grants.gov/web/grants/home.html
- Urban Electric Mobility Infrastructure Funding Table - https://www.transportation.gov/urban-e-mobility-toolkit/e-mobility-infrastructure-funding-and-financing/funding-table-dataset
- Federal Funding Programs for Rural EV Infrastructure - https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-funding-and-financing/federal-funding-programs

Housing Data

- Dane County Housing Needs Assessment: 2019 Update. Dane County Housing Initiative in conjunction with UniverCITY Alliance. https://danehousing.countyofdane.com/housingreport
- Dane County Regional Housing Strategy. https://www.danecountyplanning.com/RHS

Screening and Benefit Calculation Tools

- AFLEET Charging and Fueling Infrastructure (CFI) Emissions Tool. https://afleet.es.anl.gov/infrastructure-emissions/
- Climate and Economic Justice Screening Tool. https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5
- EJScreen: Environmental Justice Screening and Mapping Tool. https://www.epa.gov/ejscreen

Energy Utility GHG Reduction Goals

- Alliant Energy's Clean Energy Vision and Goals. https://www.alliantenergy.com/cleanenergy/ourenergyvision/responsibilityreport/cleanenergyvisiongoals
- Madison Gas and Electric Net-Zero Carbon Electricity by 2050 commitment. https://www.mge.com/net-zero-carbon-electricity

Nonprofit Organizations

- RENEW Wisconsin - https://www.renewwisconsin.org/
- Drive Electric Wisconsin - http://www.driveelectricwi.org/
- Wisconsin Clean Cities - https://wicleancities.org/
- Electrification Coalition - https://electrificationcoalition.org/

GREATER MADISON
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