

Ready for Electric Vehicles?

Modifying Local Land Use Policies





**ELECTRIC
VEHICLE
CHARGING
STATION**

CONVENIENT
CHARGING OPTIONS

RELIABLE
ELECTRIC TRAVEL

SAVE MONEY WHILE
DRIVING ELECTRIC

Benefits of Electric Vehicles

- Electricity as fuel costs less than gasoline or diesel
- Better acceleration, handling, and safety
- No oil changes
- Lower maintenance costs
- No tailpipe emissions which contain chemicals that create smog and trigger lung diseases such as asthma, emphysema and chronic bronchitis⁴
- Convenient charging in your garage or parking spot
- No gasoline fumes, possible fuel spills, and potential underground leakage at electric vehicle charging stations
- Reduced greenhouse gas emissions. See Appendix C for calculations.

**EV Fuel
Cost Savings**



Photo 1: Electric Vehicle Charging Station
Cover photo: Putting the Charging Station Together

Introduction

This publication is intended for local government officials and planning and zoning staff to provide an introduction to electric vehicles (EVs), and EV charging outlets. It also describes how general zoning ordinances and building codes can be used to support EVs and benefit communities.

Increase in Electric Vehicles

The number of EVs is increasing rapidly in the U.S. and worldwide. In the U.S., EVs have increased from 4,000 in 2010 to 1.3 million in 2020, with no sign of slowing down.¹ By the year 2030, there may be as many as 19 million EVs on the road in the U.S.² While the primary market is light duty EVs, the number of electric heavy trucks, buses and fire trucks is also growing. With this projected growth, it is important for municipalities to plan for EV charging infrastructure as soon as possible.³ When EV charging outlets are installed, it helps reduce range anxiety that prevents people from purchasing EVs. More people are likely to choose EVs as they see increased availability of charging outlets throughout the state.

Increase in EV Charging Outlets

Similarly, EV charging outlets are quickly increasing with about 7.3 million charging outlets worldwide in 2019, of which about 6.5 million were private, light-duty vehicle charging outlets in homes, multi-dwelling buildings and workplaces.⁵ Public EV charging outlets in the U.S. increased from 32,000 in 2015 to 108,000 in 2021.⁶ Figure 1 shows the growth in EV charging outlets in the Midwest.

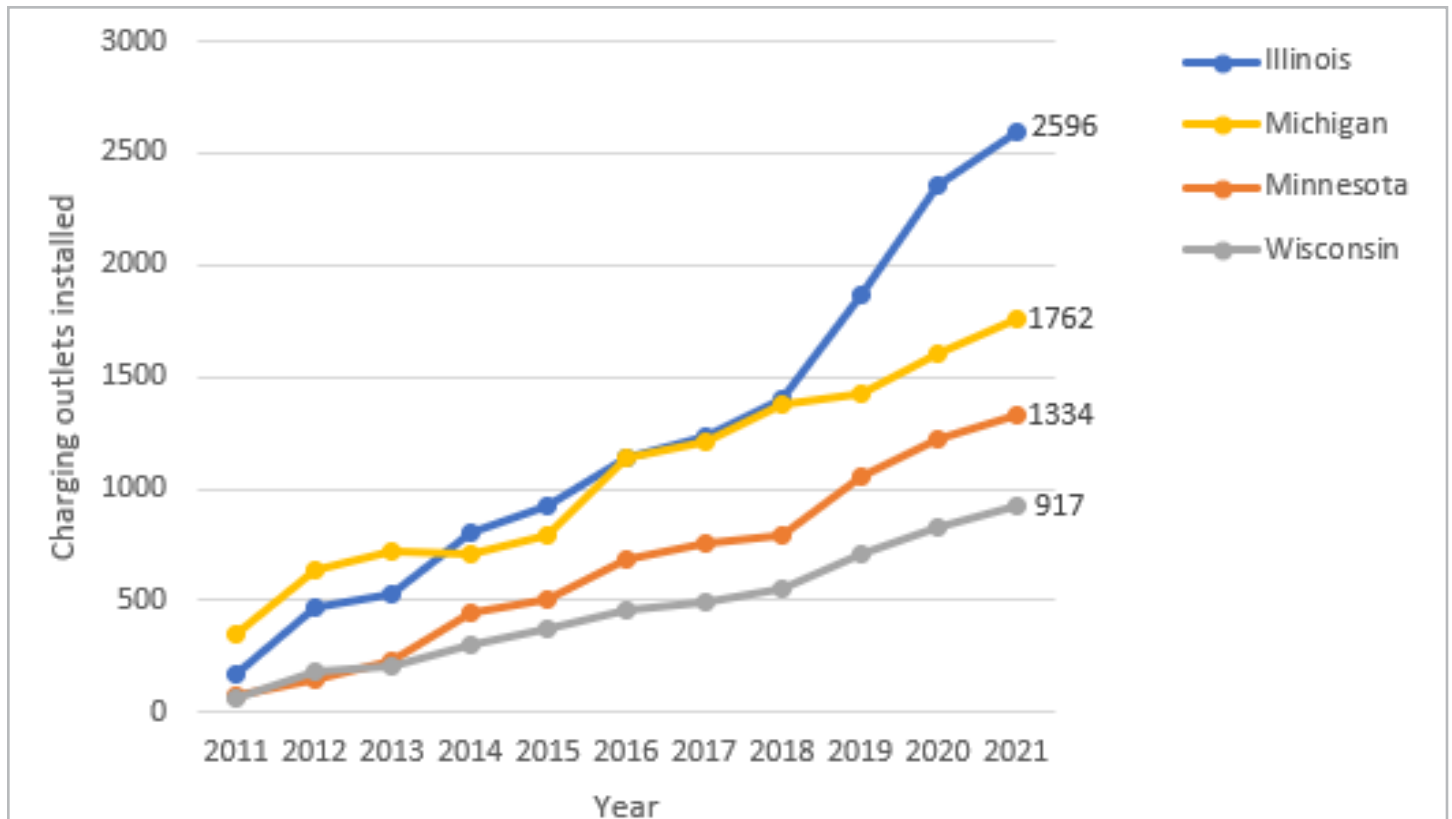


Figure 1: Non-Residential EV Charging Outlets, Public and Private⁹

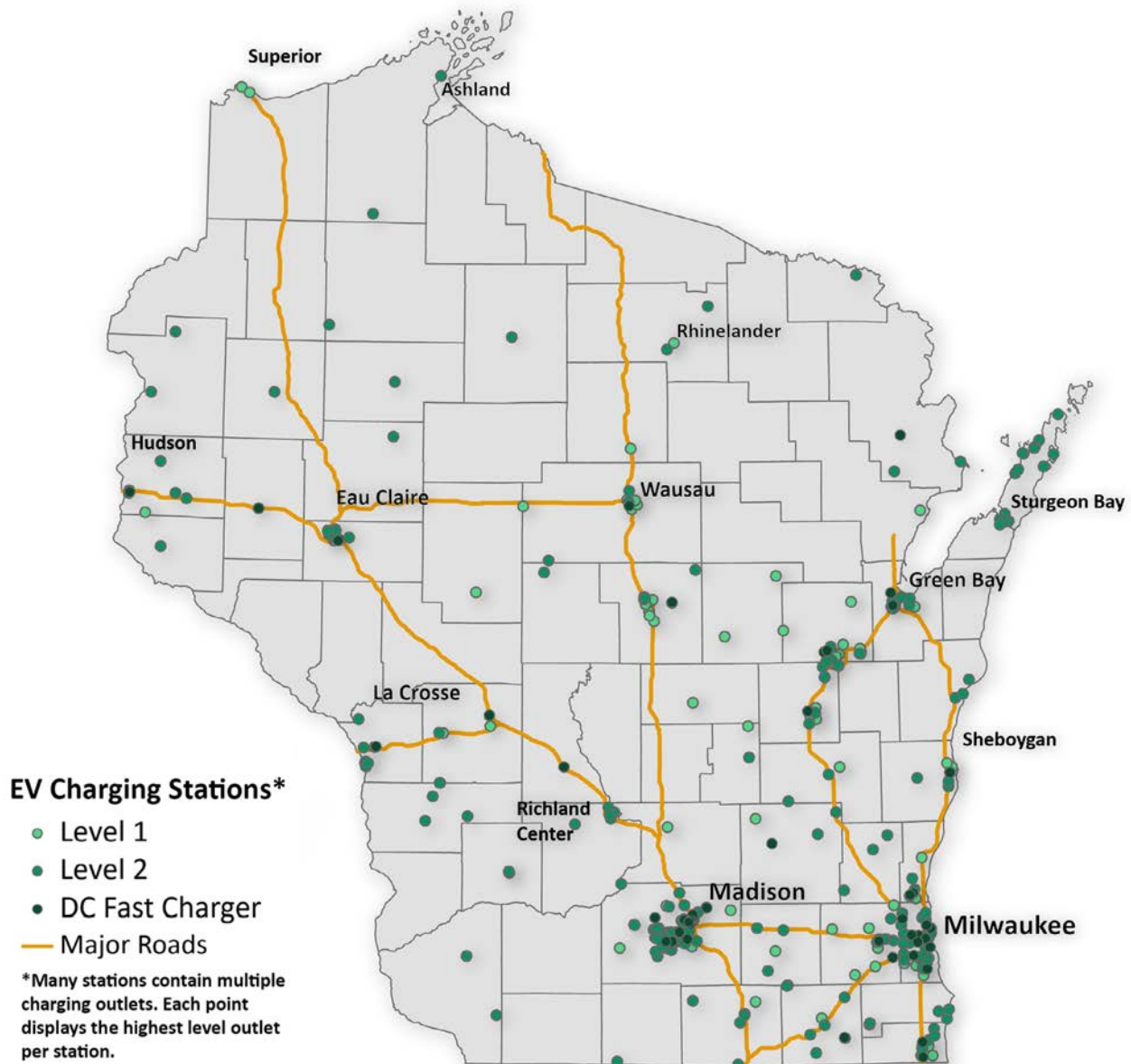
EV Charging Outlet Types

EV charging outlets are not all the same. Table 1 describes the basic differences between three levels of charging outlets.

Table 1: Types of EV Charging Outlets⁷

	Level 1	Level 2	DC Fast Charging Outlet
Volts	120	240 or 208	480+
Miles of Range per Charging Period	2-5 miles per hour	10-20 miles per hour	60-80 miles per 20 minutes
Primary location	Home	Home, Workplace, Public	Public, Highway Corridors, High Tourism Areas

Map 1 shows the EV charging outlets in Wisconsin in September 2021. Not surprisingly, there are more charging outlets in the more population dense part of the state.



(Source: U.S. Dept of Energy Alternative Fuels Data Center)

Map 1: Public EV Charging Stations in Wisconsin (September 2021)

Projecting Future Charging Infrastructure Needs

In 2017, the National Renewable Energy Lab developed multiple scenarios where states would see linear growth in EVs sales to reach between 10% and 30% of sales of light-duty vehicle being EVs in 2030. The middle scenario with 20% of sales being EVs would result in 243,000 EVs in Wisconsin in 2030. Under this scenario, it is estimated that WI would need 7,800 Level 2 charging outlets at workplaces, 5,500 public Level 2 charging outlets, and 450 public DC fast charging outlets.⁸ Table 2 shows progress in Wisconsin toward reaching the projected needed EV charging outlets by 2030.



The Wisconsin Department of Transportation Vehicle Report 28 includes auto counts for each municipality and county total. Calculate the percent of electric vehicles in your area. <https://wisconsin.gov/Pages/about-wisdot/newsroom/statistics/veh-info.aspx>

Table 2: Number of Wisconsin EV Level 2 and DC Fast Charging Outlets⁹

	Public Level 2 Charging Outlets	Public DC Fast Charging Outlets
September 2021	645	140
Percent of projected need met for 2030	12%	31%
Deficit of EV charging outlets	4,855	310
* No data is available for the number of Level 2 workplace charging outlets in place.		

Where to Locate EV Charging Stations?

Many EV drivers use their vehicles mainly for commuting and errands and charge mainly at home or at work, which is very convenient because their vehicles already sit there for many hours at a time. In fact, EV drivers in the U.S. do over 80% of their charging at home and typically use a Level 1 (regular 120-volt outlet) or Level 2 charging outlet.¹⁰ While a homeowner can add an EV charging outlet in their garage or near their parking spot, one-third of households in Wisconsin (nearly 900,000 households) rent their home.¹¹ Currently, many people who rent their homes cannot charge at home or at work. As a result, they buy fewer EVs today even though they want them.¹⁰ A partial solution for renters is to install EV charging outlets on streetlight poles in areas near apartment complexes. For instance, Kansas City, Missouri plans to install 60 charging outlets on streetlight poles by the end of 2021¹², and Los Angeles already has 400 charging outlets on streetlights.¹³ Addressing the need for EV charging outlets at multi-unit dwellings is critical to increasing EV adoption.

EV drivers who do not have access to a charging outlet at their home or work rely on public charging outlets at convenient locations. These locations could include a grocery store or other shopping area where they park regularly; a downtown or other area with restaurants; a school they attend; or at a park where they recreate. Level 2 charging outlets provide around 20-40 miles of charge in two hours; while a fast charging outlet provides 60-80 miles of charge in 20 minutes.¹⁴

EV drivers who drive long distance (more than 200-300 miles, depending on the range of their EV) rely on DC fast charging outlets near their routes, or Level 2 charging outlets at or near their overnight accommodations. Tourism is a big business in Wisconsin with direct tourism spending of \$13.7 billion and overall economic impact of \$22.2 billion.¹⁵

To appeal to EV-driving visitors, visitor bureaus encourage EV charging station installation and provide listings of EV charging locations and EV signage in their areas.¹⁶ In tourist areas, signage at charging stations can provide suggestions about what to do while fueling, including a map showing nearby parks and businesses within a 10-minute walk.



EV stations and charging outlets by level and state. Choose "Total" at the top of the page to view non-residential public and private EV charging outlets.

<https://afdc.energy.gov/stations/states>



Photo 2,3,4 Top to Bottom: Charging in Door County, Wisconsin; Charging Station Connected to Solar Power; On-Street Charging Station

Local governments should coordinate with electric utilities when siting EV charging stations to ensure sufficient grid capacity. Some electric utilities are also collaborating with local governments to fund public EV charging outlets.

When to Install EV Charging Stations?

With more and more people driving electric, it is clear that demand for EV charging, both at residences and at commercial businesses, will increase with time. Owners of new buildings or large additions find it costs far less to install EV charging infrastructure when a building is first constructed than to retrofit the building later.¹⁷ The installation of EV charging infrastructure is four to six times less expensive when included during the initial construction phase as opposed to a retrofit. The additional retrofit costs typically include labor expenses for demolition, trenching and boring, balancing the circuits, and new permitting costs. Denver’s EV infrastructure proposal included the cost estimates for EV-capable and EV-ready parking spaces during new construction and stand-alone retrofit (Table 3).

For local governments in Wisconsin, incorporating EV charging standards in zoning ordinances is one of the easiest and most affordable strategies to support vehicle electrification. Once mandatory EV requirements are set in a local zoning ordinance, the charging infrastructure automatically spreads throughout the community as new buildings and parking areas are built, bringing down the cost of charging outlet installations and allowing public and private investments to stretch further.¹⁸ While local governments in other states use building code standards to prompt EV charging outlet installation in new buildings, this approach is not available in Wisconsin as described in the section, "What Local Land Use Policies Can Help With EV Readiness?"

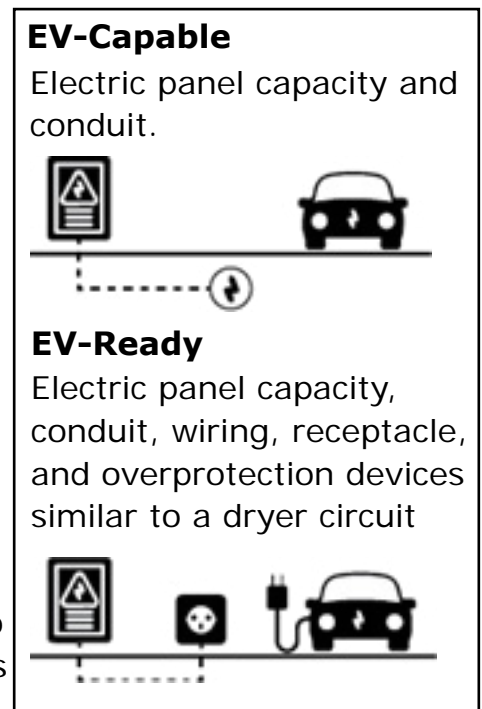


Figure 2: EV Parking Spaces¹⁸

Table 3: Denver's EV-Ready Parking Space Costs for New Construction and Stand-Alone Retrofit

Project Type	During New Construction	During Retrofit	Savings ¹⁹
EV-Capable (panel capacity + raceway)	\$300 per space	\$2,500 per space	\$2,200 per space
EV-Ready (full circuit)	\$1,300 per space	\$6,300 per space	\$5,000 per space

What Local Land Use Policies Can Help With EV Readiness?

More than fifty state and local governments in the United States have enacted zoning ordinance or building code amendments to ensure EV readiness.²⁰ We provide a short explanation of each policy tool, its current status in Wisconsin, and examples.

General Zoning Ordinances

Local governments decide which provisions to include in their general zoning ordinances. Zoning ordinances are useful tools for local governments to indicate where EV charging is allowed or prohibited. Planners and other officials can also use zoning to require EV charging throughout a municipality's zoning districts or in specific areas.²² Zoning ordinances requiring EV-ready construction already exist in many locations including Chicago, Des Moines, Iowa, St. Louis Park, Minnesota, Seattle and Madison.²³ Choose from the menu of EV provisions below to tailor ordinance provisions to fit your community.

- A. Where will EV charging stations be permitted uses? Keep in mind that unlike gas stations, EV stations have no gasoline fumes, no potential for fuel spills or underground fuel leakage.
 1. Allow charging stations as permitted uses in all zoning districts like Des Moines, IA.²³
 2. Allow Level 1 and 2 charging stations as permitted uses in all districts. Allow Level 3 as a permitted use in industrial and highway commercial districts like Chelan, WA.²³
 3. Allow all charging stations as permitted accessory uses in all districts. Allow EV Charging Facilities as a primary land use in most commercial and industrial districts like Madison, WI.²⁴



Photo 5: Charging Stations, Mid-State Technical College, Stevens Point, Wisconsin

B. In the parking section of the ordinance, a certain number of new parking spaces are required to be EV-capable and EV-ready. This example comes from St. Louis Park, Minnesota:

*Multiple-Family Residential Land Uses: all new, expanded and reconstructed parking areas shall provide the electrical capacity necessary to accommodate the future hardwire installation of Level 2 EV Charging Stations for a minimum of 10% of required parking spaces.*²³

Verona, Wisconsin provisions apply to all parking lots:

Any surface or structured parking built after the adoption of the Ordinance, containing greater than or equal to fifty (50) parking spaces, must have a minimum of one (1) electric vehicle charging station installed for every fifty (50) parking spaces, or fraction thereof.

*...Off-street parking spaces with electric vehicle charging stations shall count towards the minimum requirement [of parking spaces].*²⁵

These examples illustrates three common components:

1. Identify zoning districts where EV parking is required. Typically these include residential districts and commercial/office/industrial districts where people park for multiple hours.
2. Set triggers for when new EV parking requirements apply based on total parking area or extent of expansion (e.g., all new, expanded and reconstructed parking areas, additions of 3,000 square feet of parking area; or over 20% expansion of parking area).
3. Set percentage or number of new parking spaces that will be EV-capable and EV-ready (e.g., provide the electrical capacity necessary to accommodate the future hardwire installation of Level 2 EV charging stations for a minimum of 10% of required parking spaces). Table 4 provides another example from the City of Chicago. Note that if you want at least one EV ready spot in all new multi-unit residential buildings, the minimum standard is needed to ensure this happens in smaller buildings. The percentages of EV-capable and EV-ready spaces can be set to increase over time according to projected EV adoption.

*Table 4: City of Chicago Zoning Provisions*²⁶

Project Type	Covered Project	Requirement	Minimum Standard
Residential	New construction multi-family buildings with 5+ dwelling units and has on-site parking	20 percent of parking spaces have the electrical infrastructure for future charging stations or have charging stations installed	At least 1 space (in the situation when fewer than 1:1 spaces to units are built)
Non-residential	A new construction building that provides 30 or more parking spaces (regardless if parking is on-site)	20 percent of parking spaces have the electrical infrastructure for future charging stations or have charging stations installed	

C. Additional EV charging provisions from Section 24.10.040 of the City of Wauwatosa, Wisconsin zoning ordinance²⁷:

Public electric vehicle charging stations must be reserved for parking and charging electric vehicles only. Electric vehicles may be parked in any space designated for public parking, subject to the restrictions that apply to any other vehicle.

Equipment. Vehicle charging equipment must be designed and located so as to not impede pedestrian, bicycle or wheelchair movement or create safety hazards on sidewalks.

Usage Fees. Property owners are not restricted from collecting a service fee for the use of an electric vehicle charging station.

Posted Information. Information must be posted identifying voltage and amperage levels and any type of use, fees, or safety information related to the electric vehicle charging station.

Signage. Public electric vehicle charging stations must be posted with signage indicating that the space is reserved for electric vehicle charging purposes only. For purposes of this provision, "charging" means that an electric vehicle is parked at an electric vehicle charging station and is connected to the battery charging station equipment.

Maintenance. Electric vehicle charging stations must be maintained in all respects, including the functioning of the equipment. A phone number or other current contact information must be provided on the equipment for reporting when it is not functioning or other problems are encountered.



Photo 6: EV Charging Station Sign

D. Examples of definitions to include in your ordinance:

Electric Vehicle: any vehicle that is licensed and registered for operation on public and private highways, roads, and streets, and that operates either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board via a battery for motive purpose. Electric Vehicle includes: (1) a battery electric vehicle; and (2) a plug-in hybrid electric vehicle.

Electric Vehicle Charging Station: A parking space that is served by electric vehicle supply equipment for the purpose of transferring electric energy to a battery or other energy storage device in an electric vehicle.

Electric Vehicle Supply Equipment: The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the electric vehicle connectors, attachment charging outlets, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.

Level 1: Considered slow charging and operates on a 15 to 20 amp breaker on a 120 volt AC circuit.

Level 2: Considered medium charging and operates on a 40 to 100 amp breaker on a 208 or 240 volt AC circuit.

Level 3: Considered “fast” or “rapid” charging and typically operates on a 60 amp or higher breaker on a 480 volt or higher three phase circuit with special grounding equipment. Level 3 stations are primarily for commercial and public applications and are typically characterized by industrial grade electrical outlets that allow for faster recharging of electric vehicles.

EV-Capable Space: A designated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit, and the installation of raceways, both underground and surface mounted, to support the future installation of an EV charging station to serve the parking space.

For further examples of zoning ordinance language for EV charging stations see Appendix B.



Photo 7: Level Two and DC Fast Charging Station, Park Village Shopping Center, Beaver Dam, Wisconsin

State and Local Building Codes

Wisconsin has a Uniform Dwelling and a Commercial Code that municipalities cannot alter in any way. Thus, local governments cannot include EV charging station requirements in their building codes. This is true for the state's Uniform Dwelling Code for one and two-family dwellings, and the state's commercial building code. See Appendix A for more information about current Wisconsin building codes, and how other states and their local governments are using building codes to get EV charging stations installed.

Conclusions

Driving electric has many benefits. The number of EVs and EV charging stations are increasing rapidly. While current EV drivers in the U.S. charge 80% of the time at home, one-third of Wisconsin households rent their home and do not get to decide if EV charging is available where they park. The installation of EV charging infrastructure is four to six times less expensive when included during new construction versus a building retrofit. Therefore, EV charging standards in building codes and zoning ordinances may save people money.

General zoning ordinances are decided by local governments and can be amended to include EV charging provisions tailored to the community. EV charging standards are not included in the current Wisconsin uniform dwelling code or commercial building code. Current Wisconsin laws do not allow communities to voluntarily add EV charging standards to their building codes. When tailoring EV charging standards to fit communities, we can learn from the many states and communities that have already amended their zoning ordinances and building codes to ensure EV readiness.



Photo 8: Tesla Superchargers, Ghidorzi Hotel Group, Hilton Garden Inn, Wausau, Wisconsin

Appendix A

Many states and municipalities use the International Building Code as their base code and may add additional standards to tailor the code to their community.

- International Building Code. The International Building Code (IBC) is updated every three years, and the 2021 code goes into effect in October 2021. The IBC is a set of voluntary guidelines used by many states. The 2021 IBC calls for one EV-ready parking space which means installing panels, outlets, and conduits capable of charging at least one full-size EV in a single-family garage overnight. Multi-family buildings will need two EV-ready parking spaces, along with more that can be easily retrofitted, a standard known as EV-capable. Homeowners will still need to install their own EV charging equipment.²⁸
- State and local building codes. Minnesota and Illinois have adopted the most recent 2018 IBC for residential and commercial buildings. In contrast, Wisconsin has its own residential code, known as the Uniform Dwelling Code (UDC) for one and two-family dwellings based on the 2009 IBC, and a commercial building code based on the 2015 IBC.²⁹ A Wisconsin law passed in 2013 established a uniform statewide commercial building code and prohibits municipalities from adopting or enforcing their own standards, making Wisconsin one of only three states to restrict local control, according to the American Council for an Energy Efficient Economy.³⁰ Similarly, the Wisconsin UDC does not allow municipalities to adopt more stringent standards.³¹ The current Wisconsin building codes do not include standards for EV charging standards, and communities cannot add these standards to their building code. Wisconsin continuously works on updating their building codes, which can become outdated as new technology becomes available.³² Big EV infrastructure questions in these updates are:
 - A. Will Wisconsin adopt a uniform building code that includes current EV infrastructure standards?
 - B. Will Wisconsin change from a one-size-fits-all UDC to allow communities to choose to be more stringent in their building codes, which could include requiring EV ready parking spaces if the state building code does not include them?

Building codes requiring EV-ready construction already exist in New York, Atlanta and Denver. Many of these ordinances require one EV-Capable or EV-Ready parking space per dwelling unit for single-unit dwellings and 2-5% EV-Ready and 20% EV-Capable parking spaces for multi-family dwellings.³³

In its building code, Boulder County, Colorado requires EV charging outlets in all new commercial, industrial, and multi-family residential buildings, as well as with significant additions or alterations.³⁴

Appendix B

Most zoning ordinance examples in this fact sheet came from the Summary of Best Practices in Electric Vehicle Ordinances compiled by the Great Plains Institute. This document is available at https://www.betterenergy.org/wp-content/uploads/2019/06/GPI_EV_Ordinance_Summary_web.pdf



This document summarizes EV and EV charging zoning ordinance language in the US. It is sorted into best practice categories and provides a summary of typical provisions used by cities for each category. Each category includes a table with key points and text examples from actual ordinances, as well as recommendations from model codes for that topic, drawn from one of several model ordinances, or ordinance guidance documents that have been developed to inform cities on developing EV-ready zoning standards. This summary is provided as a reference to communities seeking to develop EV zoning standards or development regulations.

Appendix C

Example calculation of greenhouse gas reduction when people switch from a gas or diesel vehicle to an EV.³⁵

Based on the U.S. Environmental Protection Agency's (EPA) estimation the typical passenger vehicle emits 404 grams of CO₂ equivalent (CO₂e) per VMT. The average Eau Claire resident contributed 4.7 metric tons of CO₂e in 2018 through vehicle travel. This is consistent with the national average resident contribution of 4.6 metric tons of CO₂e (US EPA, 2018). The average EV uses 34 kilowatt-hours (kWh) per 100 miles (US DOE, 2019).

Based on Xcel Energy's 2017 CO₂e emissions intensity factor for the Upper Midwest, if an Eau Claire resident used an EV to drive the 2018 average VMT, the resulting CO₂e emissions would be 1.3 metric tons as shown in the equations below (Xcel Energy, 2018).

$$\begin{aligned} & \text{(Average energy use per EV)} \times \text{(2018 average VMT)} \times \text{(2017 CO}_2\text{ emissions intensity factor)} \\ = & \frac{34 \text{ kWh}}{100 \text{ mi}} \times \frac{10,5000 \text{ VMT}}{\text{avg resident}} \times \frac{0.373 \text{ MT CO}_2\text{e}}{1000 \text{ kWh}} = 1.3 \text{ MT CO}_2\text{e} \end{aligned}$$

Contact your utility to obtain their CO₂e emissions intensity factor in lbs/MWh as they vary by utility.

EVs typically use 25 - 40 kWh per 100 miles.

https://afdc.energy.gov/fuels/electricity_benefits.html



References

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- ⁸WI data on page 52 at <https://www.nrel.gov/docs/fy17osti/69031.pdf>
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