Cracking the Code to EV Readiness in New Buildings

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ABSTRACT

Vehicle electrification is essential to mitigate the increasing impacts of climate change (IPCC 2021), and strategies are being developed to reduce emissions from the transportation sector, the leading source of greenhouse gases in the United States (EPA 2022). While incentives for electric vehicles (EVs) and charging infrastructure have contributed to growth in EV adoption, building codes are effective tools to advance "EV-readiness" by requiring new construction to support convenient EV charging (Wards Intelligence 2021). In addition to promoting more equal access to charging, the EV-ready approach is cost-effective because installing EV charging infrastructure in new buildings is 75% less expensive than retrofitting an existing building (Papke Waters 2019).

This paper presents considerations, guidance, and examples for municipalities and other jurisdictions establishing policies for EV readiness in new buildings. It does so from multiple perspectives, including the U.S. Environmental Protection Agency, the U.S. Green Building Council, and ChargePoint, a leading EV charger manufacturer and network service provider. The paper begins with an introduction to EV readiness in building codes and discusses best practices in infrastructure development such as intelligent load sharing. It then presents an overview of why and how EV readiness was incorporated into the Leadership in Energy and Environmental Design (LEED) rating system. Next, the authors put their research into context by using case studies of municipal codes and a utility program that partners with builders to incentivize EV readiness in new homes. The paper concludes by summarizing key opportunities for advancing transportation electrification through EV-ready building codes.

Introduction

There are now two global trends that call on governments to accelerate the adoption of electric vehicles (EVs). The first is well known and documented: the climate crisis. Today the United States is emitting carbon dioxide (CO_2) emissions that are well in excess of what is necessary to slow the physical impacts of accumulating emissions seen most prominently in steadily rising global temperatures and its numerous effects. The second trend is tied to the current military conflict in Ukraine and highlights the perils of our long-term dependence on fossil fuels: surging prices for oil, gasoline, and natural gas, which are causing economic burdens that fall most heavily on those who can least afford it (Marpillero-Colomina 2021).

The largest source of CO_2 emissions in the United States currently comes from the transportation sector (see Figure 1). The Biden Administration has undertaken a plan to accelerate the use of EVs nationwide. The plan includes policies that stimulate the market

through acquisition of EVs for use in the federal fleet as well as funding for states to build out the national EV charging infrastructure network.

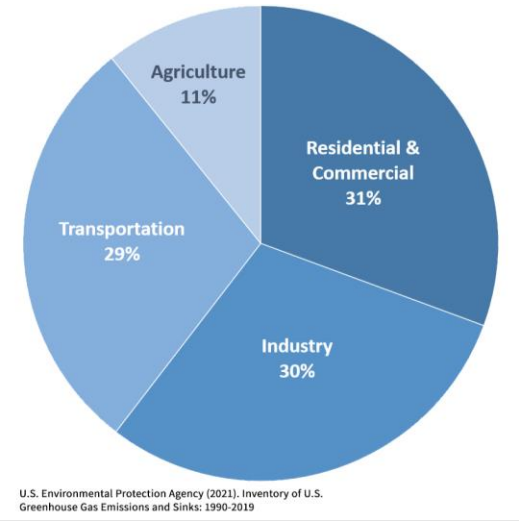

Figure 1. Total U.S. greenhouse gas emissions by sector. *Source*: EPA 2021.

Recognizing the importance of incorporating energy efficiency into a growing nationwide network of EV chargers, the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® program released a labeling specification for EV chargers in 2016. The goal of the effort was to recognize high-quality EV chargers that provided consumers with energy savings. The first product categories were Level 1 (120 volt) and Level 2 (240 volt) chargers and provided users with three main benefits:

- Energy savings, in the standby mode, of approximately 40%, or 30 kilowatt-hours (kWh) per year per unit
- Open standards: encouraging the use of open standards helps the industry develop by fostering interoperability
- Safety certification: following discussions with EPRI and other stakeholders, EPA incorporated requirements for safety certifications for all EV chargers. This is unfortunate but necessary since some online retailers sell EV chargers that are not safety certified and could be dangerous as a result

The Biden Administration has accelerated the transition to decarbonized transportation with significant investments in EVs and EV infrastructure. In August 2021, the Biden Administration announced a federal target for 50% of all vehicle sales to be zero-emission vehicles by 2030 (The White House 2021). The U.S. Congress supported these goals with the passage of the Bipartisan Infrastructure Law, which allocates more than 5 billion dollars over five years to help build out a network of EV charging stations along designated Alternative Fuel Corridors. Increased investment, especially at the federal level, is indicative of the broader shift

to decarbonized transportation with electrification being one of the primary strategies to reduce transportation emissions.

For the purposes of this paper, EV readiness is a general term that encompasses all forms of EV charging infrastructure considerations. The three most common levels of EV readiness in the context of building codes are referred to as EV-Capable, EV-Ready, and EV-Installed, and are further illustrated and described in Figure 2. These terms will be used to identify which strategies and investments municipalities and other decision-making bodies will use to incorporate EV readiness into building codes.

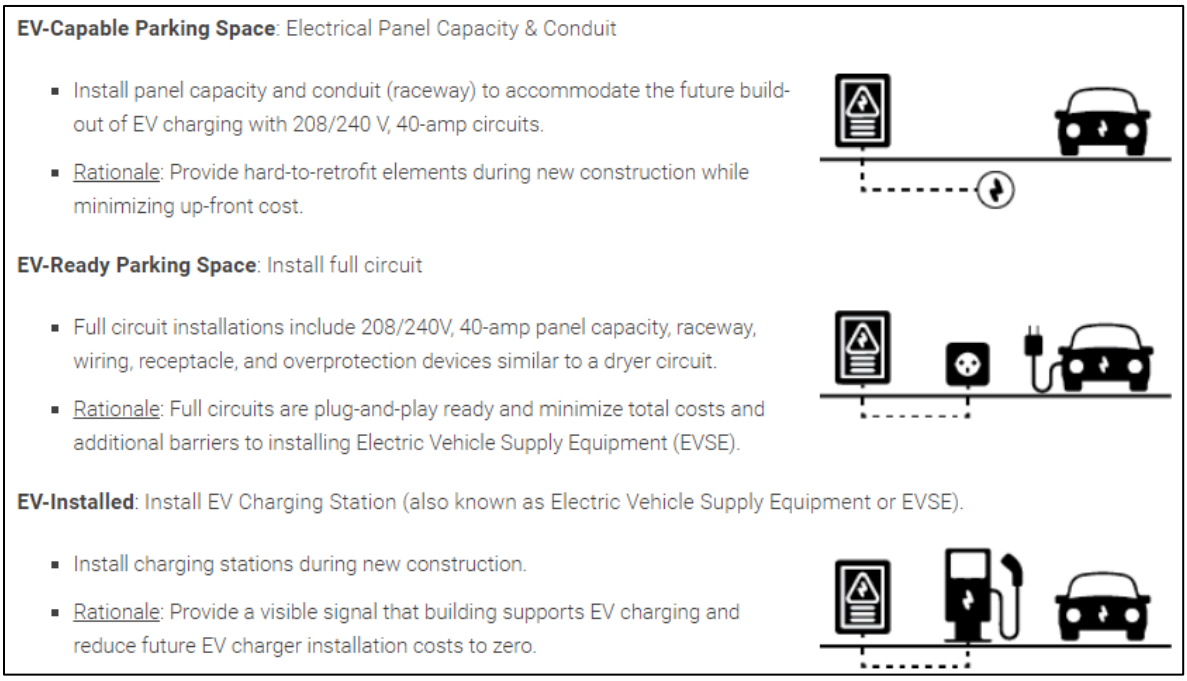

Figure 2. EV-ready building code considerations. *Source*: SWEEP 2022.

EV Readiness in Building Codes

Retrofitting an existing parking spot to install an EV charger will always be more expensive that installing a charger at an "EV-ready" parking spot due to the equipment and labor required. The per-port cost of an EV-Ready space in commercial construction averages $1,500-3,000 in labor and materials, whereas the cost to retrofit a similar legacy parking spot may cost an additional $5,000 (Pike et al. 2019). Other studies have demonstrated that installing EV-Ready parking spaces at the time of construction can make the installation of chargers four times less expensive than retrofitting existing facilities that are not EV-Ready (Minezaki, Kido, and Pike 2019).

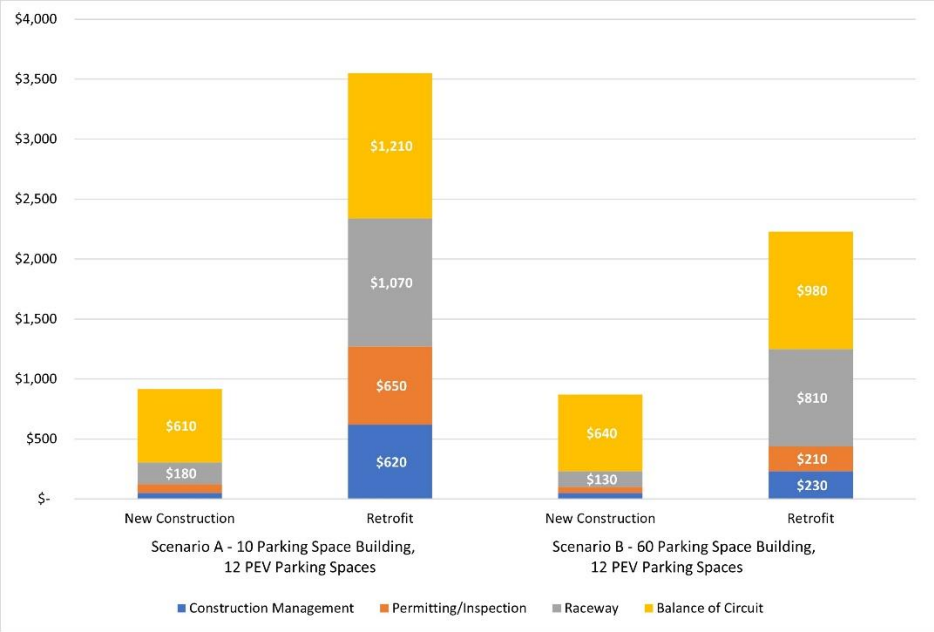

Figure 3. Relative cost per EV charging space of EV charging infrastructure in new construction vs. retrofits (2016 dollars). *Source*: Pike et al. on behalf of the PG&E Codes and Standards program 2016.

Our previous research also provided a range of examples illustrating how new construction offers a very time-limited window for the best opportunity to add infrastructure (Banwell et al. 2020). These avoided costs make it much easier for building operators and tenants to deploy EV charging stations in all building types, even if an Authority Having Jurisdiction (AHJ)[1] only has a relatively small EV-Ready requirement (e.g., >5%). The case for future proofing all types of buildings is clear, particularly as all major automotive manufacturers announce plans to electrify their product lines.

Future proofing and the benefits of cost savings in new buildings, however, can be erased if AHJs perform the traditional simple electric load calculations for EV-Ready parking. These additional costs can be triggered if an AHJ requires there to be sufficient electrical panel capacity to support a given continuous maximum load from a Level 2 charger. For example, the nameplate load for a Level 2 EV charger is typically 40 amperes (A). Simply multiplying the number of parking spaces and EV chargers by 40A can lead to a gross oversizing of the electrical requirements and will saddle developers with additional, and unnecessary, capital costs. Treating EV charging as a static load is an outdated method and can create a barrier to making buildings EV-ready by requiring upgrades such as electrical panel upgrades. This can be even more problematic for AHJs that adopt higher EV-Ready requirements (e.g., <80% of total parking spots).

Recent advances in energy management now make it practical for municipalities, states, and other AHJs to allow for energy management features in EV charging within the EV-ready

[1] From NFPA 731 "3.2.2 Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure."

requirements they adopt. These adjustments will reduce a barrier to EV adoption by lowering the overall cost of making buildings EV-ready. This section will explore how AHJs can allow for more streamlined and less costly compliance with EV-ready requirements.

Introduction to EV Charging Energy Management and Circuit Sharing

EV-ready parking can be realized cost-effectively in new developments by allowing designs to use EV charging energy management systems, which include automatic load management systems or systems to monitor and control EV charging. These systems can facilitate load sharing across branch circuits[2], sharing at the electrical panel level, electrical service monitoring and associated control of EV charging, and other forms of controlling EV charging loads. Figure 4 is a graphical representation of power sharing from one circuit.

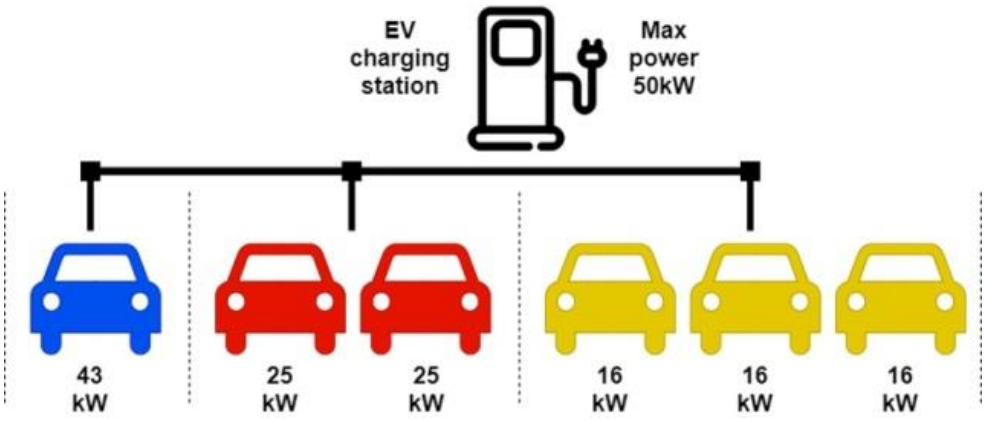

Figure 4. Illustration of power sharing among vehicles. *Source*: Power Electronics News, December 11, 2020

Networked, or "smart," charging stations can share power among co-located stations so that every car can be charged optimally, without ever exceeding the rated electrical capacity for the site. It is becoming more common for charging service providers to offer some sort of energy management option. Ensuring that building operators can safely share power (e.g., from a single branch circuit) will support the installation of numerous EV chargers while allowing building developers to install a smaller, less expensive electrical panel.

There are limits to this technique in that having too many EV chargers on a single circuit would result in insufficient charging capacity, or lengthy charging sessions. The solution is to provide a maximum limit on load sharing across branch circuits so that all drivers receive a reasonable quality of EV charging. The challenge to implementing this solution is that it is a relatively novel approach for electrical engineers and code officials who are more accustomed to designing electrical systems based on standard design formulas. The basic design formula for branch circuits is to sum the maximum loads. What has changed is that "loads" are now flexible

[2] According to Chapter 1 Article 100 of the National Electrical Code, a branch circuit A branch circuit that supplies two or more receptacles or outlets for lighting and appliances. In simpler terms, a branch circuit starts at the main service panel and provides electricity to other locations.

and can be regulated so that they are not all at maximum draw simultaneously. This flexibility means that more loads can be installed on the same branch circuit without exceeding its ratings.

Figure 5 compares the cost (per parking spot) of installing EV charging with power sharing versus without power sharing. The most expensive scenario is listed as "Without Energy Management" and shows the traditional electrical design approach of summing maximum loads, resulting with a cost of $2,500 per parking spot. The least expensive option, "4-Way Sharing on 40A Circuit," shows how power sharing reduces the costs per parking spot by roughly 75%.

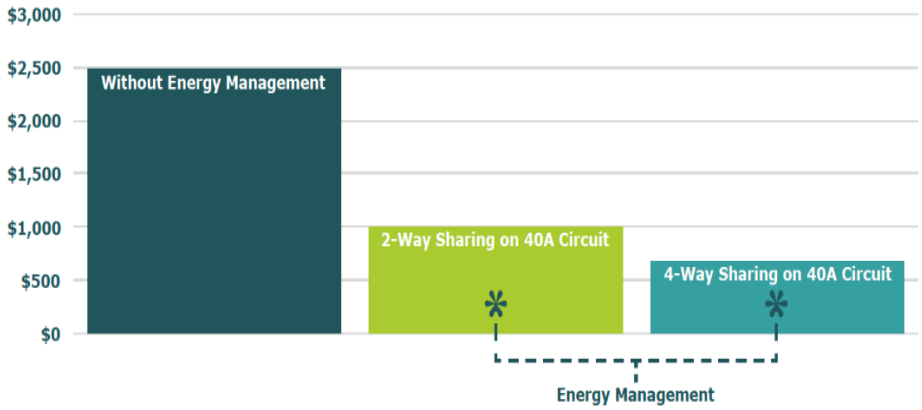

Figure 5. Estimated cost per parking space to provide 100% EV-Ready parking in a new 6-story multifamily building. *Source*: McEwen 2021.

Examples of EV Charging Management Systems in Building Codes

California. In November 2021, the California Building Commission approved updates to the state's green building code, CalGreen, specifically for multifamily buildings and hotels. Building on the requirement that five percent of the total parking spaces must be EV-Installed (California Department of General Services 2022). CalGreen specifically references using networked EV chargers to "reduce the maximum required electrical capacity." The code goes further to say that the on-site electrical system must have enough capacity to provide at least 3.3 kilowatts to each EV charging station served by the smart charging, all simultaneously.

Vancouver, British Columbia. Vancouver requires 100% of parking spots to be EV-Ready for residential buildings and 45% of parking spots for commercial buildings, which could create capital cost barriers to compliance if smart charging and power sharing is not supported. However, Vancouver has been a leader in allowing for designs to leverage management systems in practice, which makes the requirements easier and less costly to comply with. Figure 6, below, shows how using the power sharing approach provides for a significant increase in EV-Ready parking spots over the base case non power sharing approach.

These cost reductions are significant and could be important for the future growth of EV infrastructure, not just in North America, but internationally. Looking at the cost reductions from power sharing (up to 75%) and combining these reductions with the savings from building code/new construction compared to retrofit costs (75%) results in cost savings of more than 90% over the base case (base case: retrofit EV chargers, no power sharing).

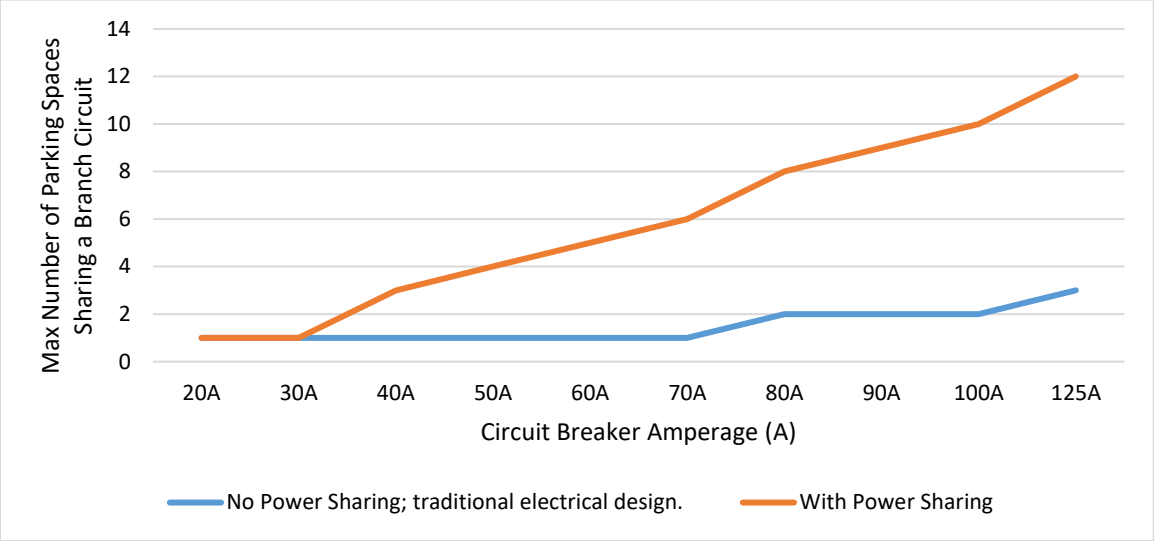

Figure 6: Number of EV-Ready Parking Spaces with Power Sharing. *Source*: ChargePoint and EPA 2022.

Update on National Model Code Adoption of EV-Ready Requirements

Building energy codes are a subset of building codes, adopted and enforced at the state and local levels. While states like California and Washington have their own state energy codes, many adopt the International Energy Conservation Code (IECC), which sets minimum efficiency standards for new construction and is considered the model code. The International Code Council (ICC) is the body responsible for drafting and updating the IECC through a consensus process every three years. This update is underway and to address the important issue of EV ready commercial buildings stakeholders recently submitted comments to the process that included recommendations to adopt power sharing approaches in the upcoming IECC code.

Should EV-ready provisions become part of the IECC, whether in 2024 or later, a significant number of states will adopt the latest version of the code thereby making EV readiness in new buildings a requirement throughout each state's local jurisdictions. In the interim, ICC is making resources available to interested communities and stakeholders, such as "Electric Vehicles and Building Codes: A Strategy for Greenhouse Gas Reductions" (ICC 2021).

EV Readiness in Commercial Buildings

Siting EV charging at commercial buildings, such as retail and workplace, as well as multi-unit dwellings, has become a pressing need to meet charging demand as EV adoption accelerates. Parking spaces can occupy approximately one-third of land across American cities, with an estimated eight parking spaces for every car (Baldwin Hess and Rehler 2021). The International Council on Clean Transportation (ICCT) projects that at least a quarter of new EV owners will be in lower income communities in 2030, which are more likely to be without private at-home charging and more reliant on public and workplace charging (Bauer et al. 2021). The National Renewable Energy Laboratory's "There's No Place Like Home" report highlights that as EV adoption increases, access to at-home charging will decrease (Ge et al. 2021). The

opportunity to shift the focus of siting EV charging at home to multifamily or other commercial buildings will become even more critical to meet demand and ensure equitable distribution of infrastructure as the EV transition accelerates.

Commercial building programs are recognizing the benefits of preparing for EVs and are beginning to include firm requirements. Leadership in Energy and Environmental Design (LEED) is a voluntary program for promoting healthy, efficient, cost-saving high-performance green buildings. Since LEED was launched by the U.S. Green Building Council (USGBC) in 1998, more than 100,000 commercial buildings have registered and over 2.8 million square feet are certified each day. There are LEED projects in all 50 states and 180 countries and territories (USGBC 2022).

Adding EV-Ready to the LEED Rating System for Building Design and Construction

In January 2019, USGBC proposed a revision to LEED requirements for beta testing. This revision introduced an 'Electric Vehicles' credit focused on networked EV charging stations and, for the first time, EV readiness in new construction and major renovation projects.[3] These updated standards in LEED were adopted to keep pace with the emergence of EV charging provisions in a growing number of local building codes and zoning requirements, and because the green building community and experts from the EV industry, supported this change.

Points are awarded to LEED buildings in several different categories. The Electric Vehicles credit is organized within the Location and Transportation credit category in LEED, alongside credits for transportation and land use management strategies like compact development, access to transit, parking supply and management, and bicycle facilities. By meeting the required criteria for EV charging (for either EV-Installed or EV-Ready spaces) a building project may achieve one point toward LEED certification. To recognize and promote higher EV-Ready or EV-Installed parking, a project may achieve an additional point by doubling the credit's percentage thresholds (e.g., at least 20% of on-site parking is EV-Ready).

Feedback and Decisions for Revising the LEED v4.1 EV Credit

The initial release of the Electric Vehicles credit for beta testing led to extensive market feedback from LEED project teams exploring the new requirements. Several key themes emerged in feedback on requirements in the January 2019 version, pointing towards the need to increase the EV requirements in order to keep pace with new and pending local code requirements. As a result, the LEED Steering Committee approved significant revisions to the January 2019 version, including:

- Increased minimum percentage thresholds for both options. Specifically, for Option 1, the minimum number of installed Level 2 EV chargers increased from 2% to 5%. For Option 2, the minimum number of EV-Ready spaces increased from 6% to 10%.
- Removed the V2G requirement from Option 1 and replaced with a requirement to meet the connected functionality criteria from ENERGY STAR's EV charger specification.

[3] See Appendix 1 for LEED v4.1 Electric Vehicles credit requirements (with Nov. 2020 addenda); the Electric Vehicles credit replaced the Green Vehicles credit from LEED v4.

Adoption of the LEED Electric Vehicle credit is high among LEED projects; 1,196 projects chose to substitute the new requirements during the three years it has been available to use. Electric Vehicles is the sixth most frequently adopted LEED credit, alongside credits for building materials/products and indoor environmental quality. Anecdotal feedback from project teams indicates that the new streamlined path for installed EV charging is a significant improvement over the initial proposal.

Barriers to Adoption of EV Requirements for LEED Buildings

Based on the stakeholder engagement process for the LEED v4.1 Electric Vehicle credit, USGBC identified several barriers to adoption, including those summarized here.

- Lack of resources on cost savings of installing EV charging in new construction versus retrofit. Building developers need clear examples and additional documented resources to make the case for installing EV infrastructure in new buildings vs retrofit. Stakeholder feedback indicates that these examples are influential, but not widely circulated.
- Lack of technical guidance on how to make a building EV-ready. Project teams need more comprehensive guidance for evaluating EV charging options, siting, and funding sources.

Next Steps and Future Changes to EV Readiness Requirements in LEED

The barriers to adoption noted above indicate ongoing opportunities for USGBC to partner with other organization to connect project teams with guidance and case studies and, as needed, to develop resources that help explain the value proposition for new building.

The rapid expansion of building codes provisions and other local requirements for EV charging infrastructure in some markets poses a challenge for calibrating the thresholds in LEED, which aims to balance accessibility and a high bar for leadership. More details from projects will help understand the impact of changes to credit requirements and help inform future development.

EV Readiness in Residential Buildings

While the focus of this paper has been purposely placed on commercial building codes, many of the industry drivers, trends, and considerations apply to residential new construction. Figure 7 illustrates the distribution of EV readiness (code) requirements by type over time. Rather than go into detail about the residential space, the paper features one development that is indicative of the movement toward EV readiness as standard practice and connects back to EPA’s ENERGY STAR program.

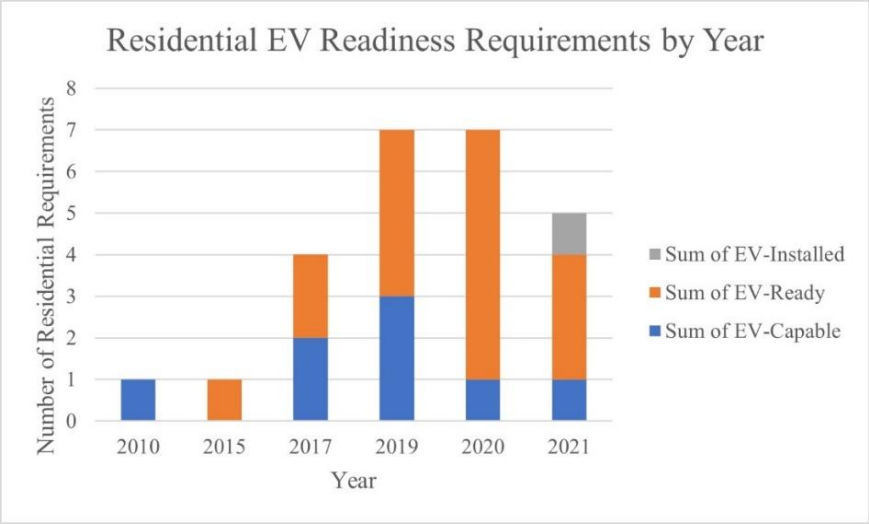

Figure 7. Residential EV readiness requirements by year. *Source*: ICF analysis of SWEEP data, 2022.

The ENERGY STAR Homes program has proposed a new, higher performance companion certification called NextGen Homes. The goal is to help set the stage for the economy-wide transition needed to address the challenge of climate change and provide additional recognition for leading edge homes and builders (EPA 2021). The intent is to look to the future of technology and bring that into a package centering on single-family and multifamily homes.

NextGen Homes Technical Requirements

- Heat pumps are required as the primary heating technology
- Induction electric cooktops are required
- EV charging infrastructure is required.

Regarding the EV charging requirements, in one- and two-family settings with a private driveway or garage, the home must be pre-wired and EV-Ready. Multifamily developments must have between one and five ENERGY STAR certified EV chargers installed, depending on the number of dwelling units, and the property must have conduit installed to make it EV Capable. During the stakeholder process to date, according to EPA, there were numerous comments on this proposal, with the supportive feedback indicating that electrified transportation was the future and the negative comments focused on the cost of pre-wiring a home, particularly in markets where there is currently low demand for EVs (A. Foss, ENERGY STAR HOMES Program, pers. comm., March 22, 2022). EPA will continue to gather stakeholder input with the goal of finalizing the new certification.[4]

[4] Interested parties may follow the process through the ENERGY STAR Residential New Construction website, https://www.energystar.gov/partner_resources/residential_new/stakeholder_feedback.

Program and Project-Level Case Studies

According to the Southwest Energy Efficiency Project (SWEEP), in 2020, EV readiness has already been incorporated into at least 35 municipalities' commercial and/or multifamily building codes with some requirements established as long as a decade ago. Figure 8 shows these requirements for commercial buildings, highlighting the year each was incorporated into code and the percentage of parking spaces involved.

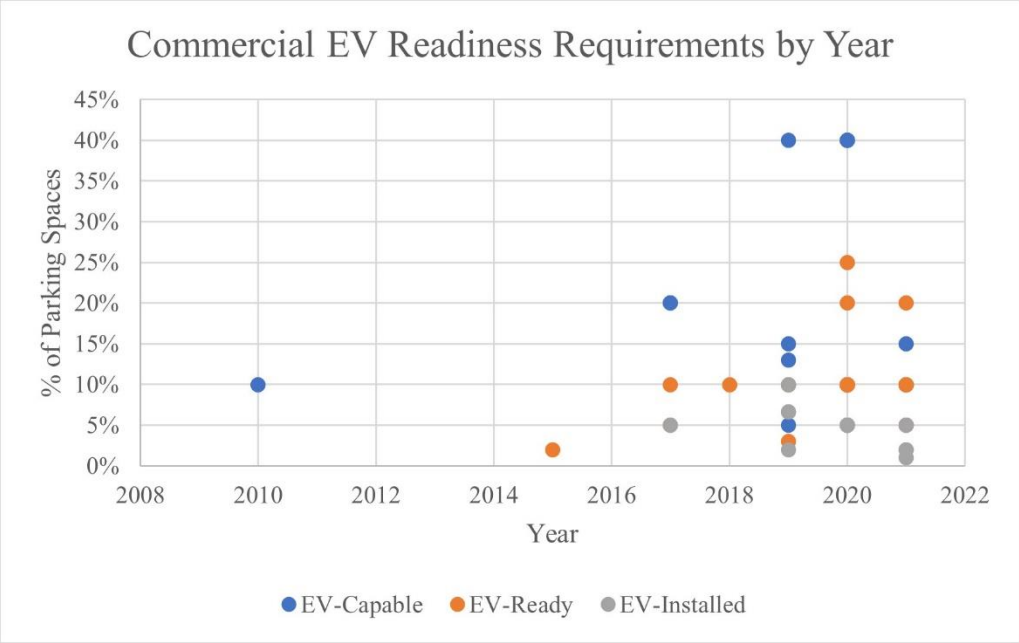

Figure 8. Commercial EV readiness requirements by year. *Source*: ICF analysis of SWEEP data, 2022.

Figure 8 shows that the number of cities and counties requiring some form of EV readiness is growing with time, the codes are becoming more prevalent. In addition, the trend is towards stricter codes, which require "EV Installed" rather than the less stringent "EV Capable" that only requires the installation of conduit for future electrical wiring and EV charger installations.

The following case studies illustrate the diversity of EV readiness programs across the country and share lessons learned for municipalities, utilities, and other entities or jurisdictions that may consider supporting EV readiness requirements in building codes.

Salt River Project, AZ

Through a voluntary program, rather than a code requirement, Salt River Project (SRP), an Arizona electric utility, provides incentives to homebuilders to incorporate energy-efficient technologies through the ENERGY STAR Homes program (SRP 2022). Homes with the label use 25 to 50% less energy and about 20% less water than typical new homes built to meet today's codes. In 2020, SRP expanded the ENERGY STAR Homes program to encourage EV

readiness in new homes. Specifically, SRP provides builders with a $300 incentive to prewire homes for Level 2 EV charging, in addition to marketing support to advertise homes to potential buyers. As of early 2022, SRP's program has equipped more than 250 ENERGY STAR Homes with EV-Ready wiring and equipment.[5]

One of the companies participating in SRP's program is Lennar, a leading builder with a 24-state footprint. Driven by SRP's incentive, effective May 2021. Lennar has committed to making all of the company's new builds in the Phoenix area EV-Ready as part of its "Everything's Included" approach, which offers buyers certain smart home and energy-conscious features at no extra cost. The marketing materials that Lennar provides to its customers include information about the dedicated 40A circuit and NEMA outlet. Lennar has consistently received positive feedback from customers who are pleased to have the option to easily install an EV charging station of their choice.

SRP's program is a good example of a utility partnering with builders to move the market toward EV readiness as a standard feature. The financial incentive from the utility and the resulting satisfaction from the customer combine to make it a win-win for participating homebuilders. As more jurisdictions adopt EV-Ready codes, these builders are well-positioned to leverage what they have learned through voluntary actions and seamlessly comply with local requirements.

City of Atlanta, GA

The City of Atlanta, Georgia was an early mover in this space, incorporating EV charging into their building codes in 2017. The City of Atlanta's Ordinance 17-O-1654 requires new single-family residential buildings to have one EV-Capable space and 20% of parking spaces to be EV-Capable in new multifamily and commercial buildings (City of Atlanta 2017).

The experience in Atlanta has been generally positive. In the early days, 2018, the code inspectors took some time to get accustomed to the new requirements, now the process is very smooth. Stakeholders have only had minimal objections to the code requirements, in part because the cost of compliance is low, since making parking EV-Capable requires relatively inexpensive conduit, rather than expensive electrical wire. One of the other keys to success of the code implementation was the development of a resource guide for stakeholders which answered questions on code compliance and is a resource with tips on how to successfully build EV-Ready parking (J. Seydel, Director of Sustainability, City of Atlanta, pers. comm., March 28, 2022).

City of Fort Collins, CO

In 2018, the City of Fort Collins finalized an Electric Vehicle Readiness Roadmap, which identified building codes as a policy tool to drive EV readiness, among other strategies and actions. Then in 2019, Fort Collins amended their Municipal Code to include EV-Ready requirements for EV charging stations (City of Fort Collins 2019). Single-family residential buildings are required to have one EV-Capable parking space while 10% of multifamily parking spots must be EV-Capable.

[5] SRP's ENERGY STAR Homes program implementation team tracking via email correspondence.

In a presentation given to the City Council in March 2022, City staff cited several reasons to adopt stronger EV building requirements, such as accelerating EV adoption, the immediate cost savings EV readiness would provide to vehicle owners, and that EV infrastructure costs are lowest at the time of construction. The City also undertook a broad community engagement effort to understand local concerns regarding the National Electric Code (NEC) definitions and requirements to provide clarity around proposed requirements and potential costs in the code amendment.

In April 2022, the City adopted stronger EV building codes that extended to a variety of building types. The new codes require all new buildings to provide EV spaces and several tiers differentiate requirements for a range of residential and commercial building types.

City of Frisco, CO

Frisco started work on its EV code requirement in 2018 as part of a countywide effort. The city worked with regional towns, ski resorts, and stakeholders to craft a code as part of a climate action plan. With IECC requirements as a baseline, work groups consisting of builders, architects, engineers, city officials and environmental organizations met over several months to agree on the direction and details of the code language. The resulting code covers both commercial and residential buildings and relies in part on the U.S. Department of Energy's (DOE) "Zero Energy Ready" guidance, as well as research on similar efforts in nearby cities such as Fort Collins, Denver and Boulder (DOE 2022).

To date the EV building code has been used for several hundred homes and dozens of commercial projects in Frisco and Summit County. According to City staff, the program has been successful, and while training was required, code officials and home energy raters have come up to speed and are comfortable with program implementation (R. Weinman, Building Official, City of Frisco, pers. comm., April 5, 2022).

Best Practices for the Inclusion of EV Readiness in Building Codes

With dozens of municipalities introducing EV readiness requirements in building codes over the past ten years, the case to include EV readiness in new construction continues to gain momentum due to demonstrated cost savings and customer satisfaction. As municipalities learn more about strategies to include EV readiness in buildings, a few recommendations have emerged, detailed below.

EV-Ready requirements are observed to balance cost-effective builder investments and customer satisfaction more effectively than EV-Capable and EV-Installed requirements. For municipalities looking to incorporate EV readiness requirements into their building codes and ordinances, EV-Ready requirements, in which electrical panel capacity and raceway with conduit to terminate in a junction box or 240-volt charging outlet is installed, are recommended. According to SWEEP's preliminary overview of EV readiness in building codes, EV-Ready

requirements are the most common form of EV readiness incorporated into municipal codes in comparison to EV-Installed and even less stringent EV-Capable requirements (SWEEP 2022).

Building codes that incorporate EV readiness should include energy management strategies. Treating EV charging as a static load can create a barrier to making buildings EV-ready by requiring electrical panel upgrades. Technological advances in energy management now make it practical for municipalities, states, and other AHJs to future-proof building codes by integrating energy management features in EV charging within the EV-ready requirements they adopt. Allowing this change will reduce a barrier to EV adoption by lowering the overall cost of making buildings EV-ready. Existing building codes that include consideration of energy management strategies, such as CalGreen and Vancouver, can act as resources.

Conclusions

This paper has shown that taking two steps: installing EV infrastructure with new buildings and allowing for energy management/power sharing among EV chargers can lead to more than a 90% reduction in cost per parking spot when compared to the base case. This cost reduction can bring significant benefits to building owners by removing a primary cost objection to the upfront installation of EV chargers and at the same time allow for more EV ready parking in buildings. Since the EV industry is new, there is time to learn from these best practices and apply them to future code requirements, as well as adopt revised codes that allow smart energy management/power sharing in cities and counties where it is currently prohibited. Doing so will allow for faster growth of EV infrastructure and a more rapid transition from fossil fuels to electric transportation.

Cities like Atlanta, Fort Collins, Frisco, and others have led the way in EV ready buildings by adopting code requirements. Based on their experiences, some keys to success are having a consultive process during code development, publishing technical guides, and training code officials. Leading building programs like LEED have shown that EV charging can be implemented nationally, and that the requirement is popular among developers. ENERGY STAR, in its NextGen homes program is looking to the future and will require EV infrastructure in each home. The NextGen program requirements also call out the requirement that all EV chargers need to be ENERGY STAR certified, which brings additional energy savings to homeowners.

The research and industry knowledge detailed in this paper illustrates how municipalities have an opportunity to support EV deployment by including EV readiness in local building codes while reaping the benefits of associated cost savings, energy efficiencies, and broad stakeholder support. And with over a decade of experience, interested decisionmakers have access to a wealth of existing case studies, lessons learned, programs, and model codes. As a growing group of stakeholders continue to invest in EVs and EV infrastructure to grow the EV market and charging demand, municipalities have an increasing opportunity to adopt cost-effective and energy efficient EV-ready requirements.

The EV charging industry is changing quickly, with new hardware and software being developed by manufacturers every year. These changes will allow for more use of smart charging/energy management and will make it easier for municipalities and programs to adopt requirements. The number of programs using building codes as a tool for accelerating the EV

transition is growing, and the early adopters have shown that code changes are not only possible, they are popular. In the future it is likely that the growth in code requirements for EV charging in new buildings will grow, providing citizens with widespread, accessible, and cost-effective EV charging.

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