International Parking & Mobility Institute

EV Readiness Resource Guide

April 2024

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“The adoption of electric vehicles for both patrons and fleets in parking, transportation, and mobility represents a sea change in our industry,” said **Shawn Conrad, CAE, CEO of the International Parking & Mobility Institute (IPMI).** “The NEVI program, along with the multitude of federal, state, and local incentives, will help support this massive initiative nationwide towards smarter cities, greener infrastructure, and greater mobility options. The International Parking & Mobility Institute has launched this effort in electrification and EV readiness for our members and the industry at large. We look forward to advancing EV adoption throughout our membership to the benefit of our members, our communities, and the nation.”

Introduction

State of the Market and Industry

Electric vehicles (EVs) and charging infrastructure are poised to transform the parking, transportation, and mobility industry. The launch of the National Electric Vehicle Infrastructure (NEVI) Formula Program, along with complementary federal, state, and local funding, policies, and programs, represents a generational opportunity for the parking and mobility industry to play a pivotal role to plan, deploy, and maintain required charging infrastructure to advance the adoption of EVs and related infrastructure across the nation.

IPMI released its inaugural landmark EV Readiness survey in 2023 to capture critical benchmarks and data on the state of the industry’s readiness to prepare for electric vehicles and charging needs to support national initiatives. Developed by the IPMI Board of Directors, its new EV Readiness Cohort along with the support of hundreds of IPMI expert volunteers, the 2023 IPMI Electric Vehicle Readiness Survey captured insights and benchmarks on the current state of EV readiness, Electric Vehicle Supply Equipment (EVSE), and EV fleet deployment industry-wide, as well as anticipated demand and related impacts to the industry.

About the EV Readiness Cohort

The IPMI EV Readiness Cohort specializes in planning, research, and innovation industry-wide to create partnerships and resources that enable IPMI members to prepare for and accommodate anticipated needs and requirements to support EVs across all segments of the industry. The small expert working group develops targeted and impactful resources of benefit to IPMI members relative to the challenge and opportunities around electrification.

About IPMI

The International Parking & Mobility Institute (IPMI) is the world's largest association of professionals in parking, transportation, and mobility — professionals who keep all of us moving. IPMI works to advance the parking and mobility profession through professional development, research and data collection, advocacy, and outreach.

IPMI is a proud member and active supporter of the CHARGE Coalition, as well as an Strategic Partner to the United States Green Building Council, Green Business Certification Institute, and the Parksmart Program, the only rating system of its kind to certify high-performing, sustainable parking structures alongside the suite of LEED rating systems.

Survey Responses

Nearly 300 industry organizations representing several market segments responded, providing a solid foundation to better understand and explore our industry's EV readiness as a whole and by specific market sector. Respondents offered a variety of programs and services, with the greatest majority providing off-street parking facilities and on-street programs.

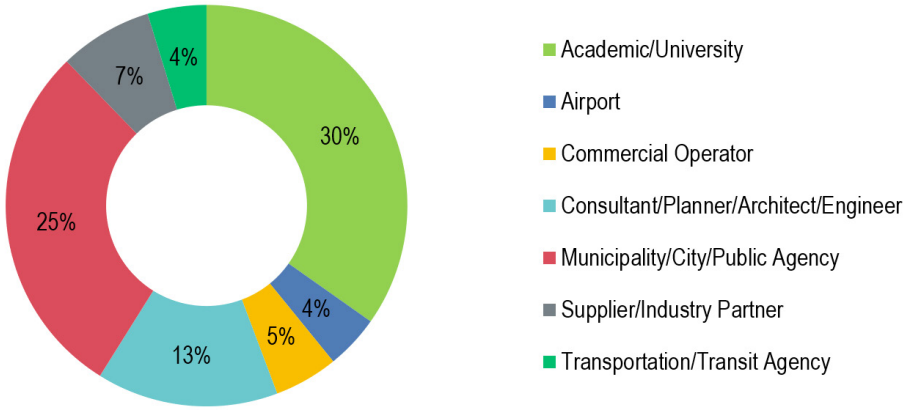


Figure 1: Survey Respondents by Market Segment

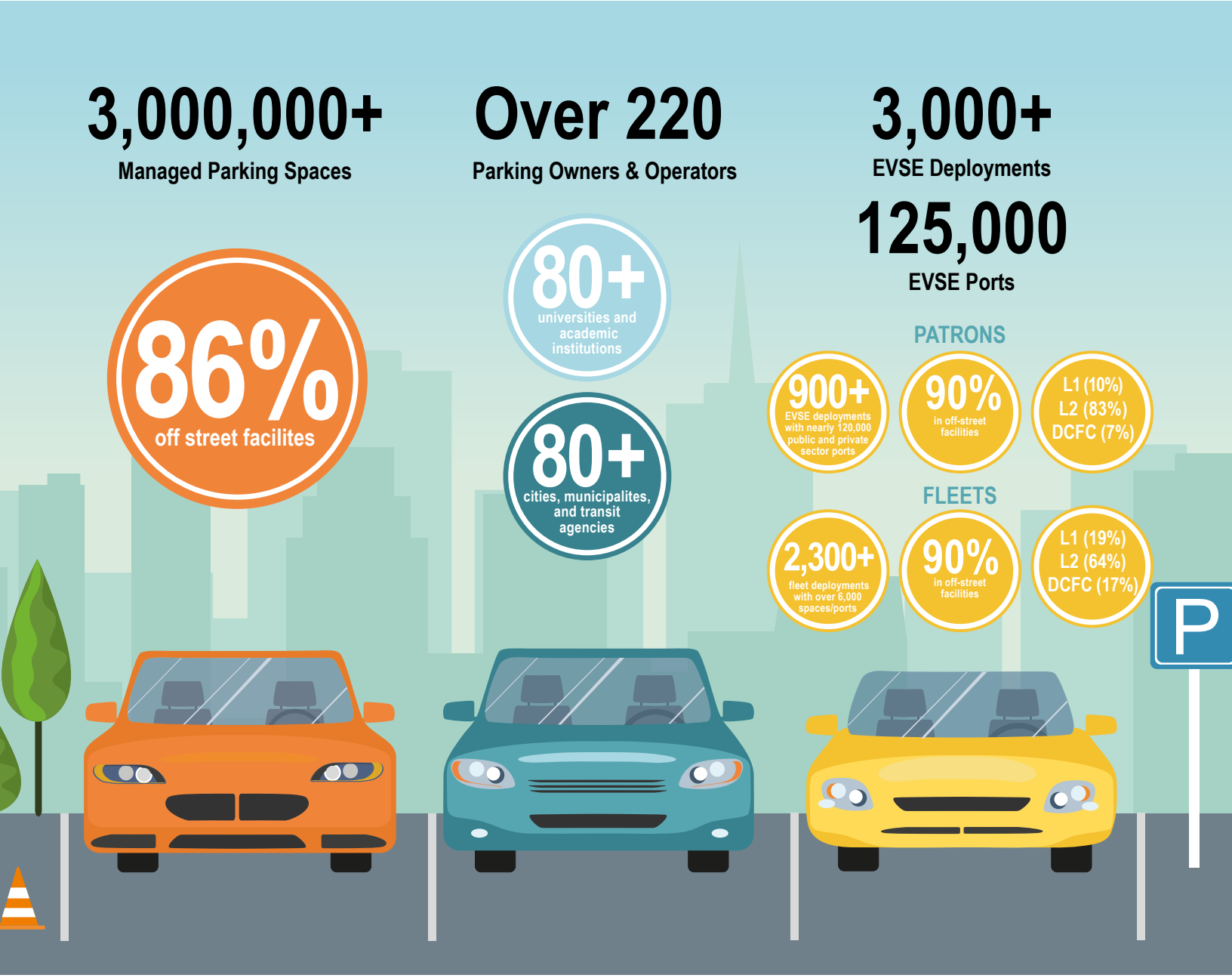


Figure 2: Survey Overview Highlights

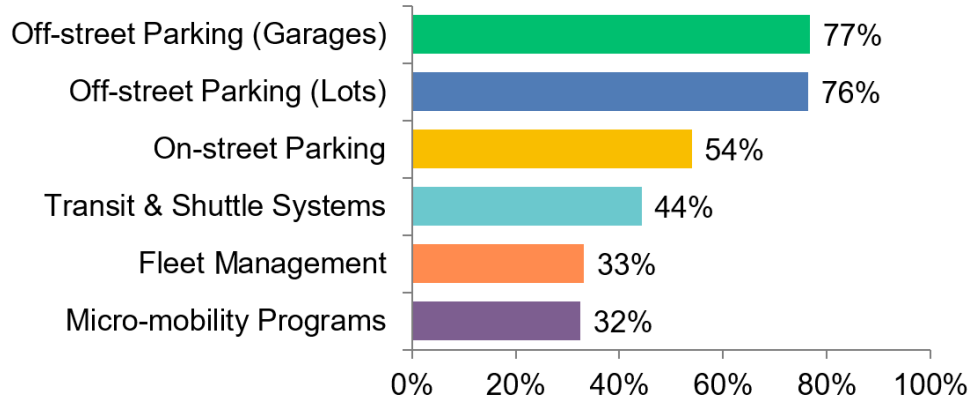


Figure 3: Programs & Services Offered by Respondents

Industry EV Readiness

The survey captured current levels of EV Readiness based on specific data sets, asking detailed questions to explore challenges and barriers to greater expansion of amenities that support effective implementation. The following responses define how various sectors of the parking and mobility industry perceive their readiness levels.

A significant majority (85%) evaluated current policies and programs as supportive of Electric Vehicle Supply Equipment (EVSE) expansion, either directly or indirectly. A majority (61%) determined their EV readiness to be at least adequate, if not well prepared.

Private sector respondents were more positive in both supportiveness and preparedness than their public sector counterparts. Commercial operators ranked their readiness at almost 90%, from adequately prepared to fully prepared, with airports in stark contrast at 70% ranking their operations as minimally prepared.

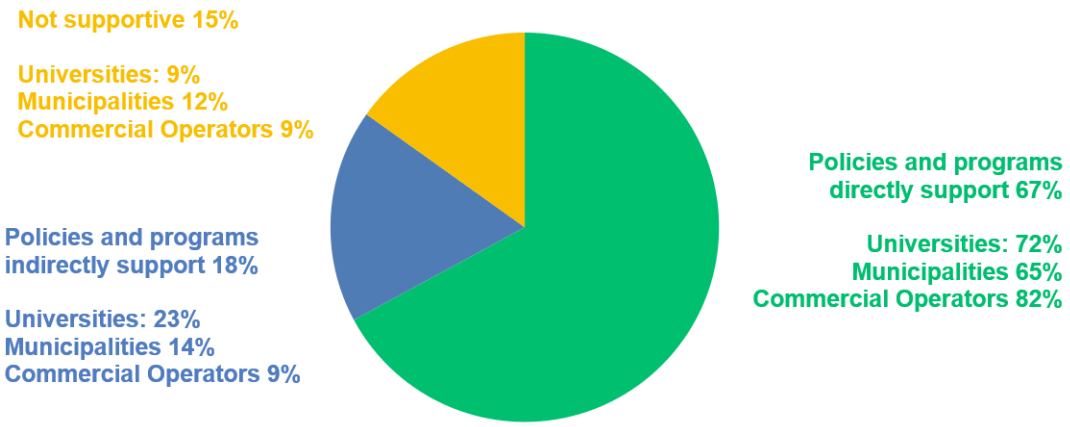


Figure 4: Policies & Programs Ranked by Supportiveness for Transportation Electrification

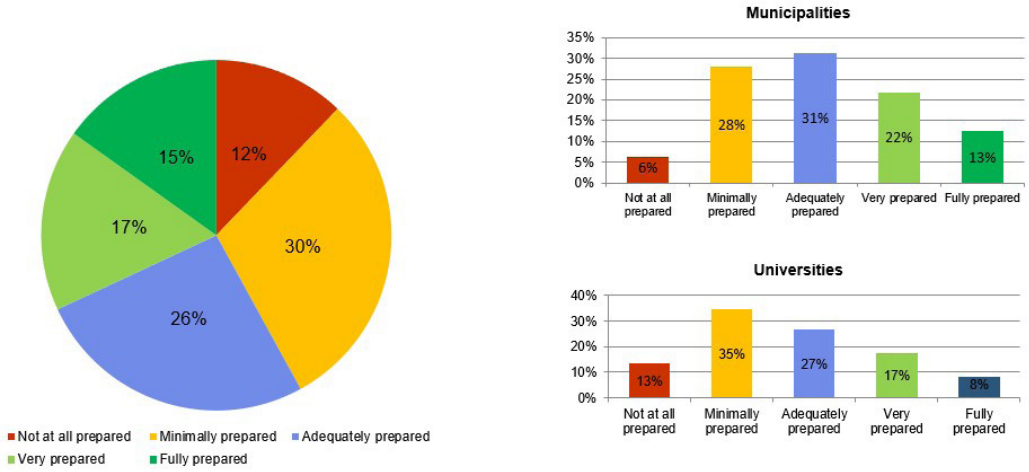


Figure 5: Evaluation of EV Readiness for All Segments

Key Considerations

Wherever your organization is on the journey to electrification, there are key considerations that should be kept in mind prior to planning new or enhanced EVSE deployment. The following considerations may be used to develop your own organization's roadmap to implementing EVSE for patrons and fleets alike.

Program Goals

The first step in an organization's electrification journey is to establish program goals to set the foundation for implementing EVSE. As your organization develops transportation electrification program goals, consider whether relevant policies and plans are either in place or under development that will impact the planning process. These relevant policies and plans may be planned reductions in greenhouse gas emissions, zero-emission fleet aspirations, and expanding EV charging infrastructure in disadvantaged communities.

Conduct a full policy review to determine both current applicable federal, state, and local requirements and recommendations. Include aspirational or desired policies and programs that may not yet exist, but that could be implemented to foster your program goals. Many states have existing guidance documents, particularly in reference NEVI plans, that should be referenced. All fifty (50) states now have approved NEVI plans with stated goals for an expanded EV charging network [1].

As your organization develops transportation electrification program goals, consider whether relevant policies and plans are either in place or under development that will impact the planning process.

Following the policy review, determine proposed timeframes and critical milestones to achieve your desired program goals:

- Are there opportunities to phase the implementation of EVSE?
- Are there programs that may fall under the purview of your organization, such as the development of grant or rebate programs?
- If you are a regulatory agency, determine what codes, rules, and regulations foster adoption and implementation – or create barriers and additional challenges – to advance community electrification efforts.

[1] Historic Step: All Fifty States Plus D.C. and Puerto Rico Greenlit to Move EV Charging Networks Forward, Covering 75,000 Miles of Highway | US Department of Transportation

Planning and Stakeholders

As program goals are developed, examine the key stakeholders and team members who will need to be involved throughout the process. Explore key performance indicators (KPIs) that will allow the capture and tracking of data sets to gauge success and prepare to gather necessary resources to support your goals.

Establishing program goals should be conducted in partnership with key stakeholders, related agencies, and the broader community to be as holistic and inclusive as possible.

We have provided a brief overview of the potential stakeholders and team members that may be involved in the planning and deployment of EVSE.

Figure 6: Potential Stakeholders and Teams

Focus Areas

Transportation electrification may take many forms in the industry. For parking practitioners and operators specifically, it is critically important to determine where to place your focus and resources as early as possible. There are three primary focus areas in the planning process for your EV readiness:

1. EVSE for Patrons (publicly available).
2. EVSE for Fleets (internal or contracted to identified stakeholders).
3. Fleet Electrification and/or Zero-Emission Conversion.

Simply put, determine what resources are readily available, and what may need to be secured or enhanced to meet your goals.

There are nuances within each of these areas. For patron EVSE, there are many potential locations including off-street lots and garages, public on-street spaces, and other private parking areas. For EVSE for fleets, partnership opportunities with related agencies are of significant import. For fleet electrification and/or zero-emission fleet conversion, there are several fleet types for consideration that involve specific needs analysis and planning. This could include electrifying a municipal light-duty fleet, converting a campus transit fleet, or converting an airport shuttle system. Determine your focus area early in the electrification journey, keeping in mind your program goals and any known constraints or opportunities.

Organizational Preparedness

Once your agency has established broad program goals and determined an electrification focus area, it is time to assess your organizational preparedness. Considerations include leadership roles and dedicated staff time to manage stakeholders, partners, and project teams, secure financial resources (including but not limited to federal, state, and local grants). Identify stakeholders and partners (both public and private) early in the process and develop a coordinated staffing and financial plan well in advance of setting permitting, design, and construction timelines.

Simply put, determine what resources are readily available, and what may need to be secured or enhanced to meet your goals:

- Do you have sufficient staff resources, or the ability to outsource resources, to perform the entire process, from planning, budgeting, procurement, deployment, operations and management, and maintenance?
- Do staff (or outsourced contractors) have the necessary background knowledge and technical acumen to be successful?
- Are there specific hiring needs, technical experts, and/or training resources you need to support the entire process?
- From a financial perspective, is there any expectation that portions of existing budget allocations shift to support your agency's electrification journey?
- Do grant dollars need to be secured, and are there partner agency funding opportunities available to move your program goals forward?

Utility Assessment

When identifying partners that will contribute to success in your program, your power utility should be at the top of the list. Utilities top the list for several key activities:

- Work with your power utility to calculate available power capacity at current levels, as well as increases required to install or add EVSE capacity.
- Collaborate with your utility to explore options to expand capacity throughout all proposed program phases.
- Explore available (and potential future) funding options. These include incentives and rebates, make-ready programs (where your utility shares or assumes the cost for power infrastructure upgrades), and power rate schedules that incentivize charging at different times of day and limit what are called peak demand charges to lower the risk of increasing power charges.

With over 3,000 electric distribution companies, or power utilities nationally, developing a productive partnership early in the planning process will be a key component to your program's success.

Market Demands

Understanding current and anticipated demand for EVSE in your geographic market and industry sector will be necessary to plan and phase your deployments. Technology advances, policy directives, and funding opportunities are increasing the pace and rate of change in the market so rapidly that it may be difficult to keep pace. These elements, as well as specific local information, should be considered when documenting current market demand for transportation electrification in your community:

- How many EVs are on the road today in your community?
- What is the current availability of EVs in your area?
- Is there fleet diversity or are you in a market where only certain types of EVs are available to the public?
- For fleets, do your current vendors offer EV options for purchase or lease?
- From a funding perspective, what local, state, and federal programs are available to purchase EVs or install EV charging infrastructure?
- How many EV charging stations are currently available in your community, and what is the current utilization of those charging stations?

After you establish current demand, calculate future market demand to better understand what investments need to be made to meet future demand. To forecast future demand, document and collect EV charging and fleet goals in your community. Reference your program goals and related policies to establish future demand for your agency, but also establish a peer set of agencies.

These peer agencies could be like-sized entities or entities with similar policy guidance. Agencies across the country are in similar stages of developing their electrification programs and learning from those entities to quantify future EV market demand for your agency and your community can support your program's long-term success.

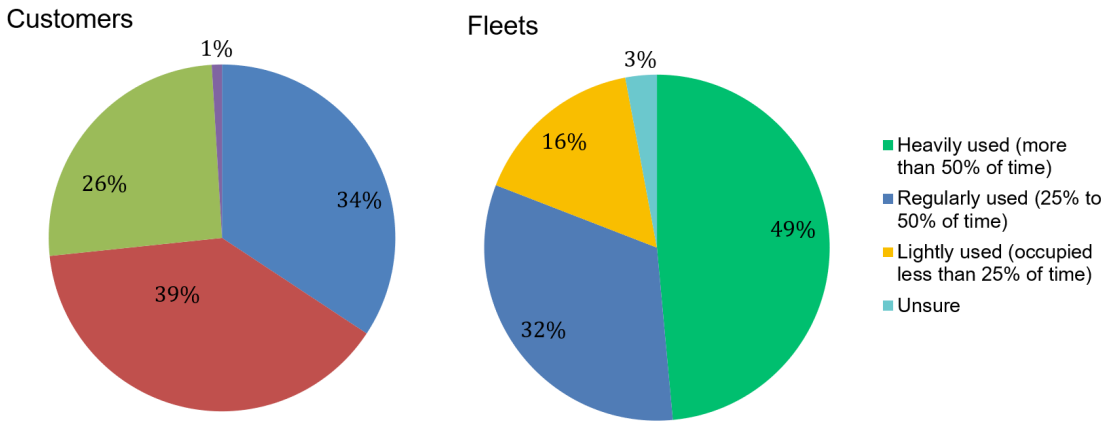


Figure 7: EVSE Usage by Patrons and Fleets

Charging Locations

There are several key considerations when deciding where to install EVSE; regardless of your focus area, location considerations will be key to program success or failure. Consider your program goals, as well as current and future demand assessments.

First, existing power capacity limitations identified during the utility assessment will drive where initial charging stations may be installed. Along with capacity considerations, physical site considerations include Americans with Disabilities Act Accessibility Guidelines (ADAAG) and requirements, zoning and fire codes, parking stall design limitations, and structural considerations. Please note that ADA, fire, and zoning code requirements are constantly changing and vary by location; these must be met when planning any EVSE deployment.

Programmatic considerations to determine optimal EVSE locations add complexity to planning. These programmatic considerations are specific to your program goals and focus areas, as well as your overall operations. Consider a specific scenario in the green box the right.

When developing programmatic considerations, be sure to note partner agency assets and where EVSE may be deployed to meet multiple partner agency goals and objectives.

Program Goal:

Expand EVSE availability to support the rapid adoption of EVs for residents.

Focus Area:
Publicly available EVSE

Programmatic Considerations:

- Determine overall service or operational area.
- Map current publicly available EVSE locations.
- Determine gaps in publicly available EVSE
- Assess current facilities with available power capacity, including partner agency resources and assets.
- Evaluate where gaps and assets overlap.
- Develop list of potential locations in overlap areas and target locations (off-street assets, residential developments, shopping centers, etc.).

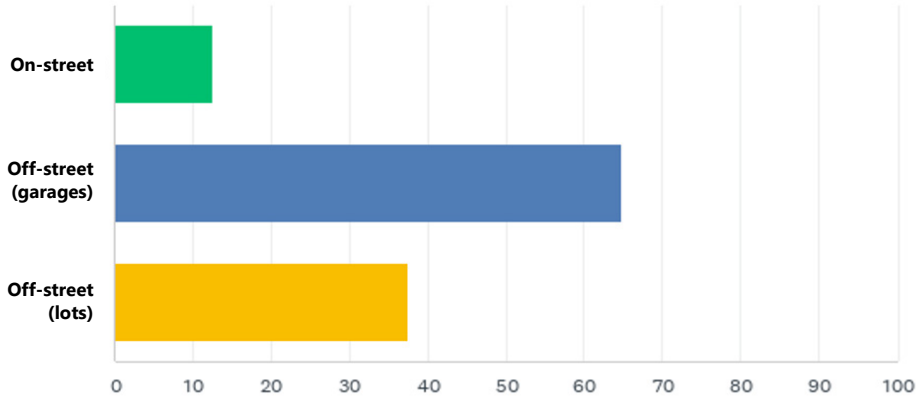


Figure 8: EVSE Deployment by Primary Location for Patrons

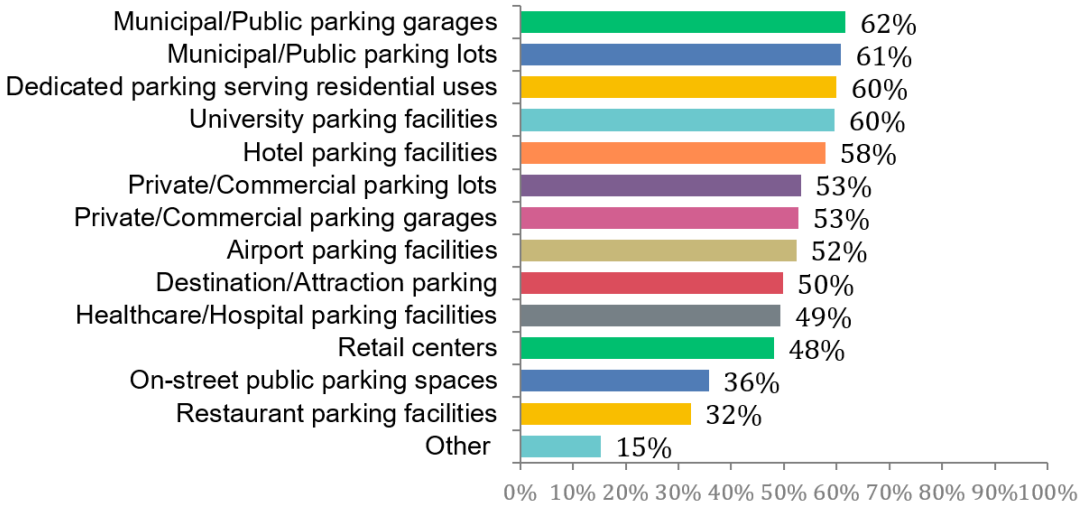


Figure 9: Recommended EVSE Locations from EV Readiness Survey

Charging Types

Your agency has determined charging locations to meet program goals and focus areas. The next step is to determine the type of charging infrastructure to install to meet current and future demand. Please note that EVSE technology is changing rapidly and continuously improving.

Your patron's parking demand profile (or user profile) should determine charger type and level of service (LOS) installed at your selected location. The parking demand profile defines a typical user based on destination, dwell time, frequency, and hour of day. Create several user profiles based on your typical patrons.

For a summary and helpful graphic of levels and power output, please visit the Alternative Fuels Data Center.

These profiles influence EVSE charger type as well as destination/location primarily based on matching typical dwell (parking) and charging times:

- DC Fast Charging (DCFC): quickest charge for short-term parkers (30 to 60 minutes).
- Level 2: slower charge for longer dwell times (two to six hours).
- Level 1: charging for the longest dwell times (overnight or all-day parking).

Regardless, selected equipment should have the utmost flexibility to integrate with other parking technologies (both deployment and proposed), load management software systems to better regulate power provided to the chargers, and other asset management systems.

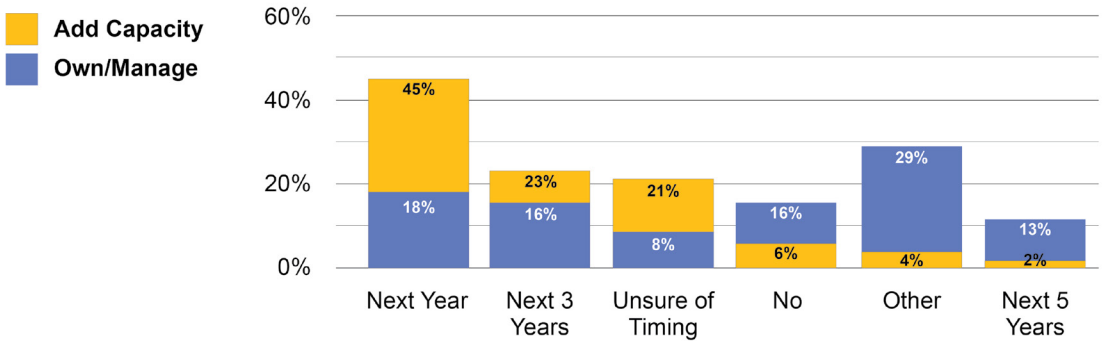


Figure 10: Plans to Increase EVSE Capacity for Patrons

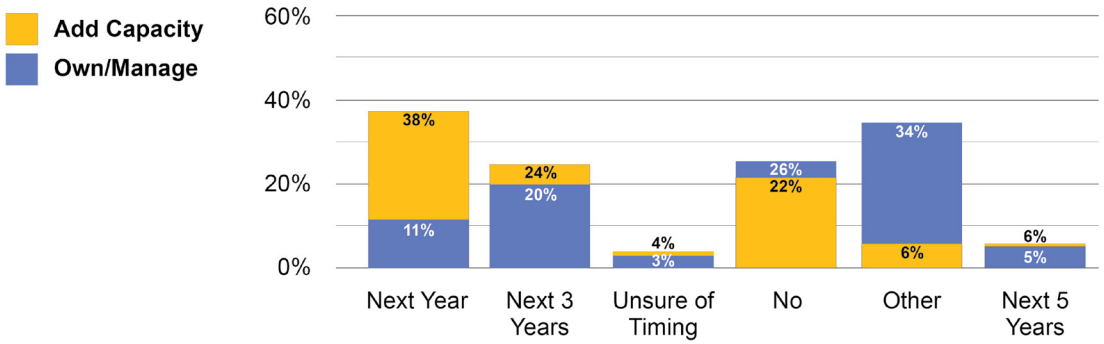


Figure 11: Plans to Increase EVSE Capacity for Fleets

Operations and Maintenance

Implementing a robust electrification program requires your agency to implement a comprehensive operations and maintenance plan. As with any other type of equipment, failure to proactively operate and maintain your charging equipment and electric fleet will lead to increased downtime, system unreliability, and decreased customer service.

Consider the required resources to operate and maintain the program and requisite infrastructure:

- Do you have agency staff to maintain EVSE on a proactive and as-needed basis, or do you have contracts in place with third-party vendors to proactively maintain equipment?
- Does your fleet management staff have the tools to be successful in maintaining an electric fleet?
- Do your financial projections include provisions for ongoing and needed equipment upkeep, spare parts inventory, and maintenance reserve funds?
- If you are partnering with related agencies to implement EVSE, are agreements in place that allow agency staff and financial resources to properly operate and maintain equipment across all programs and deployments?
- If your agency secured grants to implement your electrification program, note funding provisions and reporting requirements to determine allowable expenses as well as uptime provisions and any required KPIs, benchmarking, and reporting.

Your customers, whether internal or external, will appreciate the due diligence taken to ensure your EV charging infrastructure and electric fleet are operating at optimal and reliable levels.

Do your homework to better understand current and planned EV charging management strategies locally and amongst peers.

Management

The EV market is maturing and is hitting an adoption inflexion point. Historically, both within and outside the parking industry, EVSE has been offered to patrons as an amenity, and generally has been provided free to users. As EV adoption increases, parking practitioners and operators should plan to “charge to charge” and include EVSE as integral to business planning and revenue projections. Further, many grants require applicants to determine how EVSE will be managed upon award, and some place restrictions on fees and how and when an agency can recoup costs. To determine the most appropriate EVSE management policies and procedures, consider whether your business plan goals (both short- and long-term) include offering EVSE as an amenity, covering operational costs, and/or creating program revenue.

Do your homework to better understand current and planned EV charging management strategies locally and amongst peers. Understand if there are limitations to how you can manage EVSE as well as your budget. Limitations may include hardware choices (specific charger types), software-related requirements, and/or provisions that disallow or limit how your agency can manage EVSE. Consider how EV pricing policies and operations integrate with broader pricing policies at your facilities, integration with technology and applications, and how to create a seamless charging and payment experience for each user profile.

Gary Means, CAPP, IPMI Board Chair shared his perspective on our role as an organization to shape the industry's guidelines on deploying additional EV capacity:

> "IPMI initiated the EV Readiness Survey to collect critical data to help our members assess their readiness to deploy charging capacity for patrons and the greater communities that we serve. We are dedicated to driving the industry forward to create greater mobility choices, including support for electric vehicles. Results will be used to develop research and resources that help professionals prepare for anticipated demand, as well as enhanced services for fleets.

Implementation

Your agency has thoroughly planned and conducted its due diligence to implement a robust electrification program to serve its constituents. Now is the time to implement the program to meet broader policy goals and objectives. As you work towards execution and launch, there are several key important factors to keep top of mind.

Electrification plans often must be phased over several years due to budget, staffing, resources, power availability, supply-chain, and other constraints. Outline an ideal or optimal phasing plan and how the initial phase can be as impactful as possible to meet your program goals.

Multiple elements must work in tandem electrification plans to achieve successful outcomes. Plan for upgrades to power infrastructure, purchase of EVSE and fleet vehicles, and proper and proactive maintenance of EVSE and fleet vehicles if applicable:

- Explore and document procurement options, including internal expectations and external partnerships, as well as possible funding limitations and provisions.
- Maintain as much flexibility as possible in your plan and consider new or alternate procurement methods. Determine if it is possible to leverage partner procurement methods or existing contracts and/or utilize national cooperative contracts.
- Explore whether a third-party vendor is appropriate to provide a turnkey EV solutions, or a part of a solution, including but not limited to maintenance and operations.
- Develop performance criteria, or KPI's, to regularly evaluate program success and whether program goals are being met both internally and externally. Develop annual evaluation criteria to inform program changes and continued investment.


EV Charging

Barriers and Challenges to Implementing EVSE for Patrons and Fleets

The survey identified the primary challenges to implementing or expanding EV programming for both patrons and fleets. The following illustration ranks overall barriers industry-wide and by individual market segment.

Thematically, there were distinct similarities between both response sets: costs and funding, site constraints, and utility coordination top the lists for both patrons and fleets. Uncertainties related to dedicated funding, facility renovation and retrofits, and finding the right partners to support EVSE expansion ranked as the most challenging.

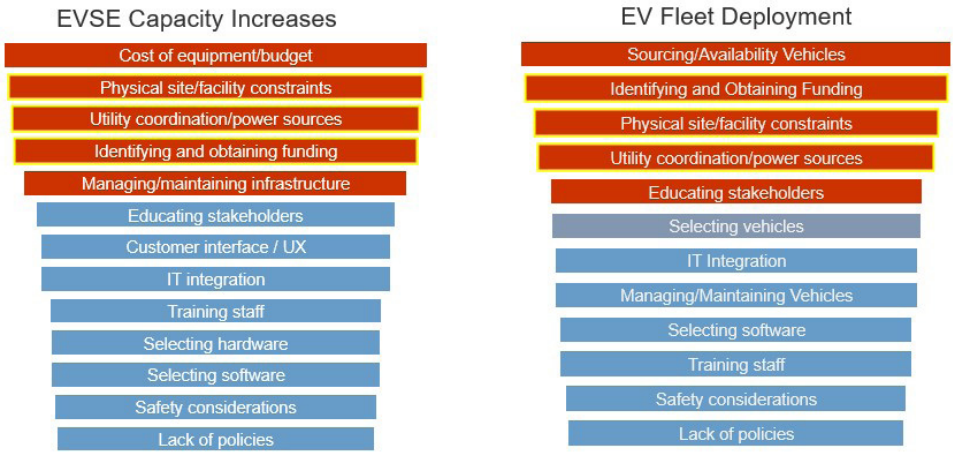


Figure 12: Primary Barriers to EVSE Implementation for Patrons and Fleets

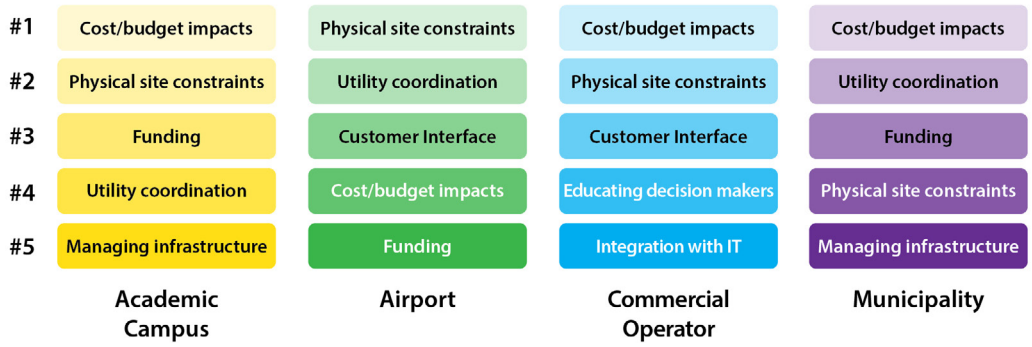


Figure 13: Market-Specific Barriers to EVSE Implementation

Funding Resources and Charging for EVSE Use

Finally, the survey examined trends related to financial investments and the ability to generate revenue through EVSE deployments. Respondents could choose as many resources as they felt were available, but it is telling that program budgets (80%) are the highest (and seemingly primary) source to fund EVSE expansion. Even with federal, state, and local funding available, many are having to offset shortages for expansion or are limited to their own funds when planning for, or retroactively reacting to, demand for EV infrastructure.

A majority provide EVSE usage for free; however, more programs are introducing some level of charging fee (either standalone or included in the parking fee) to operate EVSE for customers. As the debate continues regarding the real and perceived value of providing free charging to promote EV adoption, our industry will be challenged in several specific ways. Each owner or operator must determine when and how to charge for use, if they can recapture deployment and ongoing costs, and encourage regulations and policies to shift to an operational structure that creates programs that can recapture investments and create return on investment (ROI) to sustain EVSE infrastructure over the long-term.

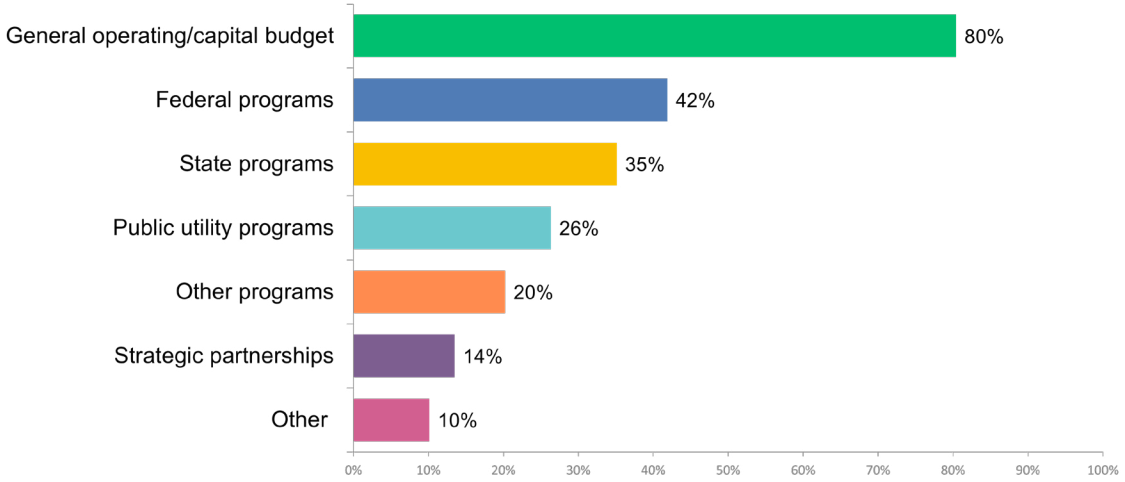


Figure 14: Typical EVSE Funding Sources

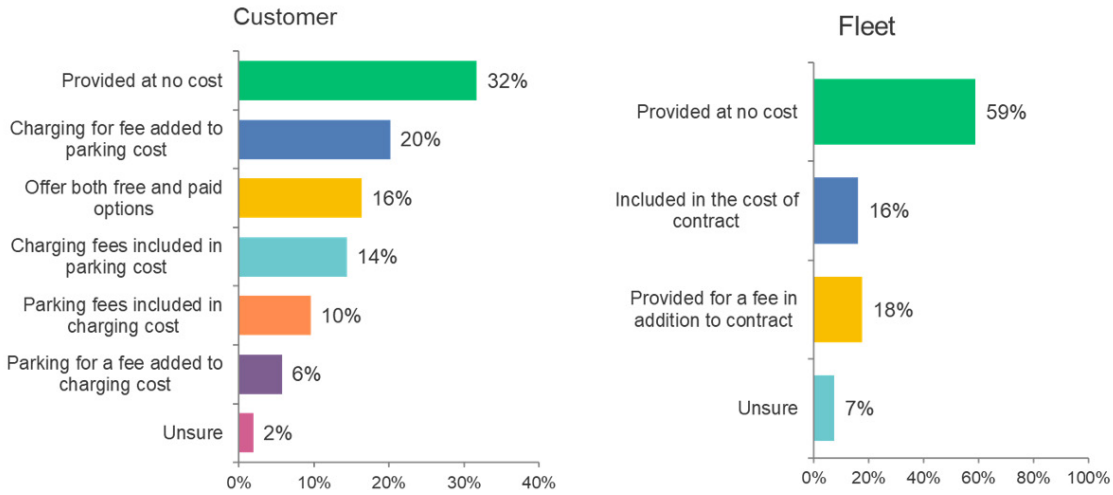


Figure 15: EVSE Pricing and Payment Options

Market Segment Approaches, Commonalities, and Differing Needs

Airports

Airport landside transportation and parking operations serve a diverse set of user groups. These user groups include short and long-term customer parkers, employee parkers, valet operations, cell phone lot customers, ride share and passenger loading and unloading operators, rental car companies, and shuttle operations. These users have different parking and transportation needs, and therefore different electric vehicle charging needs. As with other industry segments, airports need to match user parking needs with charging infrastructure needs to accommodate an electric transportation future.

Landside transportation and parking operations are typically revenue generating and self-sufficient operations with excess revenue being reinvested back into the landside and overall airport operation. Investments in electric vehicle charging infrastructure and electric vehicles, namely ground transportation shuttle operations, must be able to demonstrate a return on investment (ROI) for the landside operation. Up front capital costs along with any long-term operational savings from these investments should be considered before airports begin their electrification journey.

As airports look to meet increased electrification demands, Level 1 and Level 2 chargers should suffice to meet customer charging needs due to longer customer lengths of stay. However, DC Fast chargers should be prioritized in cell phone waiting lots and rideshare pick up and drop off zones. When installing new EV charging infrastructure, there is a significant challenge in ensuring there is sufficient electrical infrastructure available in commercial areas to support necessary EV charging expansions. As electric vehicles may vary in weight depending on models compared to traditional ICE vehicles, airports (and all operators) must confirm that existing facilities support potentially heavier loading and ensure that this is factored into the design of any future structures.

Ground transportation shuttles operate nearly 24/7 with limited downtime. Charging infrastructure must be sufficient and efficient to limit any downtime charging the vehicle. The market currently offers limited electric fleet vehicle replacement for passenger shuttles that are economical and provide similar passenger capacities. Limited electric shuttle market availability will continue to be an impediment for airports to electrify their ground transportation fleets.

Lastly, during peak travel and parking demand periods enforcement becomes challenging given that customers driving internal combustion engine (ICE) vehicles are likely to utilize EV charging spaces when capacity is strained.

Cities and Municipalities

The public realm takes many different forms. Government agencies, particularly cites and municipalities, have unique operational and financial roles managing the public realm. Therefore, city and municipality roles comparative to other sectors are much more complex. At the core, municipalities have the objective to provide EV support across the infrastructure, property, and services they are responsible for managing as a public amenity. Unlike other sectors, cities and municipalities must plan for all segments of EV users, from trucks and commercial vehicles, to on- and off-street EV charging, to support of transit services and municipal-owned fleets, making the complexity of such services unique in terms of scale, scope, and pricing, as well as funding for both construction and maintenance.

The greatest challenge for cities and municipalities is balancing the provision and types of charging infrastructure. Siting is also a major consideration in terms of utilities, larger curb, and parking infrastructure. As a public service, the ability to differentiate between public provision or private entity can prove challenging. This makes public-private partnerships on public property a challenge in terms of investment, ownership, and revenue. Balancing residential demands with those of commercial and retail areas is also a challenge. Certain types of infrastructure may not align with desired parking limits or demands. For example, overnight residential charging limits overall availability and turnover, while Level 3 quick charging may not align with desired curb demands. Cities and municipalities must balance regulatory and political mandates. Local laws and state policies may not align with financial and operational capabilities, or such changes may require administrative rule changes in a municipality.

Utility coordination and load studies are the most critical element of any EVSE, especially in built urban environments. Accessibility to power and costs associated with such connections can potentially undermine or greatly inflate costs associated with deployments. Budget is a concern in locations where the electrical infrastructure needs upgrading. Grants are available but pursuit of grants isn't something on most municipalities' radar. Load management may be an option in a longer-term parking situation (office employees parked for 8+ hours) but does not help in a short term situation such as for retail customers. Lastly, development of technology is a challenge. A state-of-the-art system can become obsolete quickly in the current environment (think Ford and Chevy adopting Tesla's charging technology after a city installs a large amount of Level 3 chargers with CSS plugs).

Development of an EV charging roadmap is critical to success. Incremental and meaningful investments and policies allow a program to develop and flourish, while providing for future expansion and opportunities. For example, building raceways and infrastructure into developments and

Photo: Joshua Prezant/University of Miami

sites allows for less future capital expenditures, while allowing EVSE infrastructure to grow organically as opposed to being over allocated. Cities should look to maximize current infrastructure with new technology that expands current infrastructure through SMART systems that add capacity without adding significant additional cost for EV Charging. Government agencies should also look to establish charging redundancy and reciprocity with local colleges and cities to assist with grid interruption and emergency management events. Lastly, cities should monitor and take advantage of new special EV charging rates passed by its local public utility for dedicated EV charging during peak cost charging periods. This will allow simultaneous increased electricity volume at the same or less cost.

Colleges and Universities

Although college and university campuses often operate with a very similar set of conditions as cities and municipalities they are often a subset of larger communities. They may rely on the public agencies for utility services, have the larger communities using their internal campus services, and not have access to the same grant opportunities as cities and municipalities. Higher education facility's objectives are to provide EV support across their properties, and services they are responsible for managing as a public amenity. Similar to cities and municipalities, Universities must plan for all segments of EV users, from heavy-duty commercial vehicles including transit busses, to on- and off-street campus-owned service vehicles, and the vehicles used by the campus faculty, staff, students, and visitors who may elect to drive to the campuses. Most higher education facilities are funding both the construction and ongoing maintenance and the EVSE and the electric infrastructure.

The greatest challenge for colleges and universities is finding the balance of EVSE types that align with the long-term needs of the campus.

The greatest challenge for colleges and universities is finding the balance of EVSE types that align with the long-term needs of the campus. Although the compact nature of campuses compared to cities reduces some of the siting difficulties cities experience, campus community members desire charging resources near their specific destinations.

The balance of EVSE types on campuses is further complicated as those responsible for EVSE operations need to find the right distribution balance to serve their on-campus residential facilities. Certain types of infrastructure may not align with desired parking restrictions or demands. As an example, charging limits that were created to drive turnover may demand residents to leave their housing facilities during late night/early morning hours to relocate their vehicles. This is where the balance of political mandates and commuter/resident needs are further complicated by some campus community members' personal safety views. Local and state laws may not align with financial and operational capabilities, or such changes may require administrative rule changes for a campus.

Similar to cities, utility coordination and load studies are the most critical element of any EVSE. Accessibility to power and costs associated with such connections can potentially undermine or greatly inflate costs associated with deployments. Budget is a concern in locations where the electrical infrastructure needs upgrading. Often higher education campuses do not qualify for grant funding to support EVSE installations like cities and municipalities. Load management may be an option in a longer-term parking situation (office employees parked for 8+ hours) but does not help in short-term uses from students and campus visitors.

Photo by Denise Applewhite, Office of Communications

Parking permit programs on campuses may create alternative EVSE use fee collection opportunities that make 20 amp low-power charging options more viable. Low-power solutions such as California's Level II Low-Power receptacles (208/240 volt, 20 amp) can help campuses prevent investment losses related to changes driven by developing technologies. Customer-owned chargers with J-1772, SAE J3400 (Tesla), and CCS connectors can all be purchased with the same style of 208/240 volt, 20 amp receptacle plugs.

Having a well-defined understanding of a campus community's commuting habits will be critical in developing a successful EV charging roadmap. A proper balance of EVSE types and commuting distances of the campus' commuters, along with, appropriate EV charging policies, fees, and enforcement can result in an EV charging program that is maintainable. An unbalanced program can result in charger overuse from fees being too low or lack of enforcement or the opposite, no use, from high fees and over-enforcement. Incremental and meaningful investments should be driven by defined policies based on need for the program to develop and grow. Campuses will benefit from providing large raceways and infrastructure between new utility projects, campus building projects, and transportation and parking facilities. Campuses with existing successful systems report taking every opportunity to invest in access to power for future projects and not over-expanding EVSE installations. Maximizing current infrastructure with low-power options and SMART systems that add capacity without adding significant additional cost for power upgrades will allow campuses to grow their programs as their demand increases. Colleges and universities should also look to establish charging redundancy and reciprocity with their local cities and municipalities where applicable.

Colleges and universities should monitor and take advantage of any special EV charging rates available through their power provider. This relationship should also be explored by campuses that are looking to control peak demand fees from high amperage EV charging during peak rate power periods.

Commercial Operations

The primary objective of most commercial real estate owners is to offer a cost-neutral charging solution to their tenant base. With the national average age of U.S. commercial buildings at about 53 years old, the construction cost of civil and electrical work to retrofit garages remains the single biggest challenge in modernizing existing urban infrastructure to support electric vehicles. Concurrently, real estate owners are being pressured to provide EV charging to their tenants. Statistically, while 80% of EV owners do charge at home (source: U.S. Energy Information Administration), there is a cohort of people who prefer to charge at work or dwell in an environment where accessibility to chargers might be limited as more people transition to electric vehicles (e.g. apartments, multiunit dwellings, etc.). Those who prefer to charge at work are often ones who have not upgraded to Level 2 home chargers but prefer Level 2 charging over the Level 1 trickle-charge experience at home (1.1 kW). In a recent Boston Consulting Group (BCG) global survey of EV owners in the U.S., respondents said having EVSE conveniently located next to my workplace came in fourth behind reliability, price, and speed of charge. For most, workplace charging remains the second most common destination, and therefore the availability of chargers remains an important initiative for most of our clients.

> **LOAD MANAGEMENT**
>
> Level 2 speeds dominate EVSE conversations, however those charging speeds are not necessarily what parking consumers need in a workplace environment (typically working 6-8 hours). With the average daily number of miles being driven at 37 miles (source: Department of Transportation (DOT), last modified in May 2022) and people subscribing to keep battery state around the 80-90% mark for the long-term health of the vehicle's battery pack, the total power needed per customer can often be delivered at a reduced kWh rate – enough to "top off," as most do.

Parking practitioners can leverage historical data collected by PARCS and data collected through License Plate Recognition (LPR) and other new technology to more easily predict demand to determine the size/scale of projects (i.e. the number of chargers needed) that make sense for the tenant community. Too often EVSEs, consultants, and electricians more often quote more power than called for on the assumption the location's needs will dramatically grow. This leads to overinflated costs in the name of futureproofing, or the mistaken belief that full power is always needed for all chargers. To date, commercial operators have not seen widespread evidence of large-scale power demand in portfolios. Instead, load management systems have been utilized to absorb any power deficiencies in the power budget.

REVENUE MANAGEMENT

Charging behaviors observed in commercial properties include most customers "topping off" and are fully charged within two to three hours and customers tending to not move their vehicles when charging is done. Pricing, including the psychology of pricing, is the means to affect behavior and change, and is a powerful way to optimize existing charging infrastructure without incurring additional costs. Parking and charging behavior change can influence the rate of charging through tiered plans, induce turnover on each charging station through fees, etc.

The nationwide average for one kWh of electricity for a residential building is just under 15 cents ($0.1496), but at many commercial garages lower rates have been negotiated, providing an opportunity to manage EV charging stations to generate profits based on the variance.

FINANCE MECHANISM

The majority of commercial properties do not qualify for federal, state, or local incentives for a number of reasons, mainly because it's not a true public amenity since chargers exist behind paid parking. There have been several firms entering the market in recent years who invest and develop net zero sustainable infrastructure on behalf of private capital. Funding for projects is beginning to shift towards private third-party entities and accelerated public-private partnerships.

ENERGY STORAGE

Mitigation of time-variable pricing, where electricity rates vary at different times of day (and often seasonally), is something that should be planned for. Commercial properties should study the use of co-located energy storage, a still relatively nascent concept in the parking operator world, to pull power during overnight off-peak hours or the two "shoulder" periods.

Multi-Family and Commercial Real Estate Developers

Studies on EV charging have shown drivers prefer to charge at home due to convenience and lower cost, but will occasionally use public and workplace charging to supplement their vehicle's needs.[3] EV drivers who live in multifamily properties expect not only traditional amenities but also access to EV charging stations.

The electric revolution brings with it opportunities and challenges for multifamily and commercial real estate developers. Several opportunities include:

- Adding EV charging infrastructure can be a property differentiator for prospective tenants, particularly in multi-family properties. As more EVs hit the road, having EV charging infrastructure on property will move from a "nice to have" amenity to a "must have" property differentiator.
- Patrons will visit your businesses more often and for longer periods of time if EV charging infrastructure is readily available onsite. Level 2 charging equipment provides a meaningful charge to a vehicle in 2-3 hours, and customers will spend that time visiting your site and spending their dollars.
- Installing EV charging infrastructure on your property can help meet broader sustainability goals and add Leadership in Energy and Environmental Design (LEED) and Parksmart Certification points to your project. Prospective tenants and visitors value sustainability and will prioritize visiting your site or choosing to live at your multi-family property as they value green infrastructure.

These opportunities are paired with many challenges to implementing EV charging infrastructure on your property, especially as the market continues to rapidly change. These challenges include:

- EV charging can be costly. Smart planning can minimize those expenses and result in a valuable investment for your property. Installing EV charging as part of new property developments is the most economical option, at one-fourth to one-sixth the cost of retrofitting an existing property[4].
- For retrofits in particular, evaluating how much power capacity is available and adding power capacity can be challenging and time consuming. It's important to start this process early with the support of a licensed engineer and in coordination with your local public utility.
- EV charging technology is rapidly changing. To start, understand your user demand profile and select a charging type based on how long a vehicle will be parked in your facility. Work with your selected EV charging vendor to try and futureproof your investments as vehicle battery and charging plug standards rapidly change.
- Funding opportunities are abundant at the federal, state, and local level however most of these opportunities require charging stations be available to the public 24/7. This can prove challenging to multifamily and commercial developers who manage secure facilities that only allow access to residents and tenants.

Transportation and Transit

Transportation and transit agencies have a unique design in relation to electrification and EV charging. These users have the most defined vehicle routing systems associated with their use. Unlike "variable-demand" based sectors, the design and architecture of such EV infrastructure is dependent on the profile of trips and range profiles of vehicles. Because of the predictability with routing and system design, transportation and transit agencies can design the overall electrified system to meet the current and future needs of their system.

Because of the defined "home base" charging locations and the nature of system use and design, the charging architecture implemented may be more flexible in design and utilization. For example, transit vehicles can easily charge overnight when use is less prevalent. Similar considerations can be made for EV fleets in the shipping and industry sectors. EV infrastructure and design can also be more flexible, with grid and large charging farms better able to serve charging and power needs.

One of the biggest current barriers to successful implementation in the transportation and transit sectors is the sourcing and purchase of vehicles and infrastructure. Large investments in both elements are currently challenging given the demand for EV vehicles and infrastructure. Once supply-chain issues are overcome, the general expense of electrified vehicles in the fleet category can be very expensive, especially vehicles like buses and shuttles. Overcoming these initial capital costs is prohibitive and requires effective planning to manage investments.

Users should explore several power and flexible charging infrastructure to ensure that the capital outlay provides the return on investment and effective use of resources. An example of effective investment includes installing solar canopies at bus depots and commercial distribution hubs. These canopies can provide increased capacity and lower costs to charge EV vehicles within the system. In addition, the EVSE investment also allows for back-up power off the main grid supporting more efficient use of power generated.

Most states have programs available for fleets to adopt zero-emission vehicles technologies. Users should refer to state or municipal programs to determine if there are ways to supplement the implementation of EVSE solutions. There are also often state and federal funds available for decarbonization efforts for facilities, providing opportunities to integrate EVSE infrastructure into larger facility planning and upgrades.

Recommended Best Practices

Depending on your site's complexity, location, and scale, the EVSE implementation process can take anywhere from 2 to 18 months from the planning to installation phase. To accelerate the process, prospective EVSE owners should following these five steps:

1. Evaluate your business opportunity.
2. Prepare your team.
3. Assess and finalize your strategy.
4. Develop your design.
5. Implement and maintain your charging stations.

Evaluate your business opportunity

Start with developing a business plan that considers money-oriented, people-oriented, and environment-oriented considerations. Money-oriented considerations include projecting revenue increases by attracting and retaining customers and identifying, applying for, and securing funding local, state, and federal grant opportunities. Consider re-sell value of your property when you add either EV capable, ready, or installed infrastructure. People-oriented considerations include thinking about equity for tenants who do not have access to reliable charging opportunities and providing public charging opportunities nearby to drivers who do not have access to home or workplace charging. Environment-oriented considerations include meeting sustainability business targets and lowering emissions in your community. As you develop your business opportunity, develop a customer needs assessment to cater your plan to your customer base.

Prepare your team

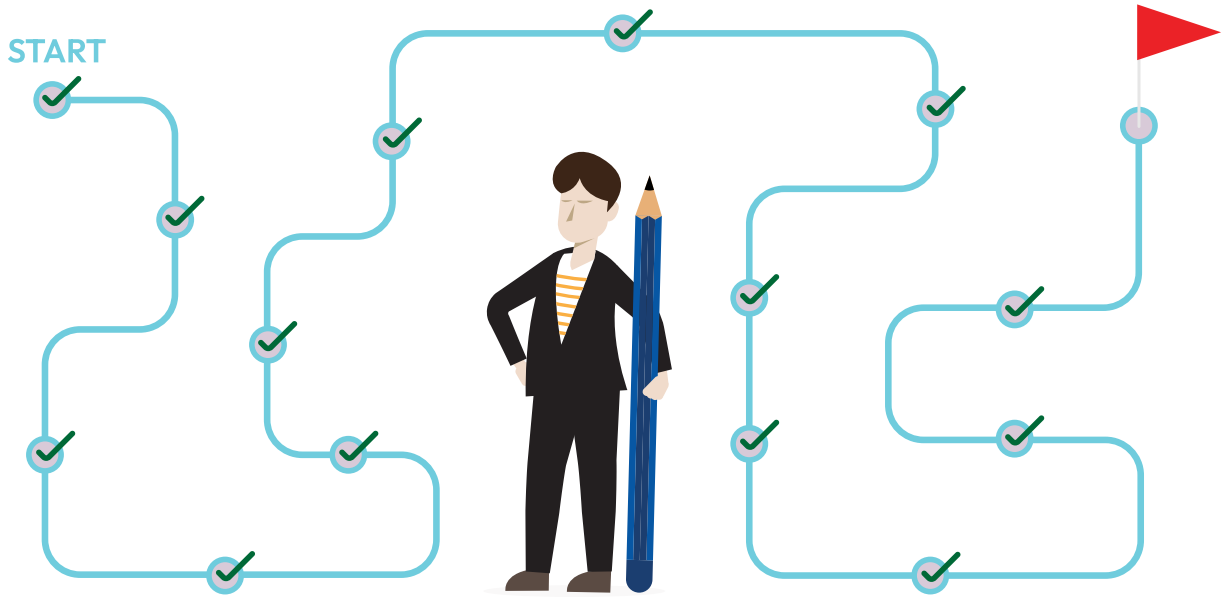
Internal and external partners should be prepared to implement EV charging infrastructure. Internal partners include your property manager, operations and maintenance team, and customer base. External partners include consultants and engineers, your local utility provider, EV charging vendors and software providers, contractors and electricians, and operations and maintenance staff is outsourced. Connect with your local clean fuels coalition organization for ways to connect with external partners and educate yourself on funding and operational support opportunities.

Assess and finalize your strategy

Working with consultants/engineers, EV manufacturers/software suppliers, and others external partners will help you evaluate options with specialist expertise to develop a well-researched, well-rounded strategy. Your plan strategies should include management approaches, EV equipment considerations, and battery-supported charging infrastructure. As you develop a management approach, consider how to capitalize on available funding opportunities by locating the EV charging infrastructure in non-designated parking areas available for public use. Depending on the local market conditions, consider either charging a fee for charging or rolling the cost of charging into other tenant costs. EV charging types should match your property user demands. For example, if your tenants cater to customers who park for 30 minutes or less, consider DC Fast Level 3 charging. For customers who park for 2-3 hours, consider Level 2 charging. And for multi-family properties where residents park overnight, consider a mix of Level 1 and Level 2 charging. At properties where the local power utility has constraints in supporting increased power needs, consider battery storage on-site to power EV charging stations during high demand times and rely on the local power grid during off-peak times to charge vehicles.

Develop your design

Once you plan is in place, you need to develop a design for EV charging on your property. A site assessment and preliminary design should be the first step in the process. This step will help you determine the number of spaces to be made EV installed or EV ready, identify potential locations on your site, verify local building codes, and consider ADA requirements. A utility assessment should be conducted in tandem with the preliminary design to determine current electrical capacity and available capacity on circuits serving your property. Consider where optimal EV charging infrastructure locations are as compared to power sources to



mitigate long conduit runs to sites. A final design should be developed to help ensure infrastructure is laid out properly to promote safety, efficiency, longevity, and flexibility for future growth. Future proofing considerations include designing conduits to stub in locations for future charging infrastructure, adding associated upstream equipment capacity (panelboards, switchboards, transformers, etc.) and pulling new wire where possible.

Implement and maintain your charging stations

Working with your identified internal and external partners when you are ready to begin construction, choose an operations and maintenance team, and develop a communications, awareness, and monitoring program. Construction considerations should include selecting a licensed, insured, and bonded contractor, planning accordingly for equipment purchase lead times, finalizing utility requirements and upgrades, planning for temporary parking disruptions during construction, and installing EV infrastructure as designed. When choosing an operations and maintenance team consider whether your property management company will oversee this responsibility or whether the work will be outsourced to a vendor. Regardless of the option you decide, ensure staff is properly trained and spare parts are ordered and on-hand as part of the initial equipment order. Once the EV chargers are installed and commissioned, develop resident, tenant, and customer communications to bring awareness to the chargers. Communicate through public channels such as PlugShare to bring awareness to the EV charging equipment. Include information in regular tenant communications and ask tenants to communicate with customers on social media, online, and in print.

[1]Bloomberg — More Than Half of US Car Sales Will Be Electric by 2030

[3]Idaho National Laboratory (INL) — Plugged In: How Americans Charge Their Electric Vehicles — Findings from the largest plug-in electric vehicle infrastructure demonstration in the world

[4]U.S. EPA's State and Local Energy — An Introduction to Electric Vehicle-Ready Buildings

EV Readiness Resource Guide

CASE STUDIES

International Parking & Mobility Institute

CASE STUDY 1

Trailblazing for the Nation: Hawaii leads the Country's Build Out of Federally Funded NEVI Program

ALOHA CHARGE
A National Car Charging Company.

Market Segment:	
Governmental:	State
Location:	Honolulu, HI
Facility Type:	Multiple locations throughout the state including off-street lots and garages
Funding Sources:	Federal programs, incentives, and/or grants

Best Practices

This project was tied directly to the U.S. NEVI formula program which did a tremendous amount of research and heavy lifting prior to releasing the program and funds.

The project team selected experienced partners with in-depth technical knowledge as well as hardware from reliable and proven manufacturers.

Program Goals

- Strategically install charging infrastructure to equitably accelerate EV adoption in Hawaii and make EV charging more accessible to all Hawaiians.
- Establish interconnected network to facilitate data collection, access, and reliability at the state level.
- Reduce the state's dependency on fossil fuels and reduce the carbon emissions associated with internal combustion engine (ICE) vehicles by making EV charging more dependable (part of the U.S. strategy to reduce emissions to net zero by 2050).

Program Summary

Hawaii has long been dependent on petroleum and is aggressively working towards a goal of being net zero by 2040. With vehicles producing 35% of all US emissions (source: Union of Concerned Scientists), electric vehicles and fueling infrastructure plays a significant role in Hawaii achieving their aggressive climate actions goals.

HDOT is using the initial round of NEVI funding to procure eight Tritium NEVI systems, totaling 32 PKM150 (150kW) chargers and 16 power units. Chargers were procured for HDOT by Sustainability Partners from the National Car Charging subsidiary Aloha Charge and will be equipped with software developed by EV Connect. These DC fast chargers are expected to be the first federally funded and installed under NEVI.

During this first phase, HDOT will install charging facilities approximately every 50 miles along the designated Alternative Fuel Corridors (AFC). While locations on all the islands have been identified, the final selections have yet to be announced pending final discussions with community

stakeholders. During plan development, HDOT made equity and access a priority, and identified all disadvantaged communities along the AFCs using census data and the Climate and Economic Justice Screening Tool (CEJST).

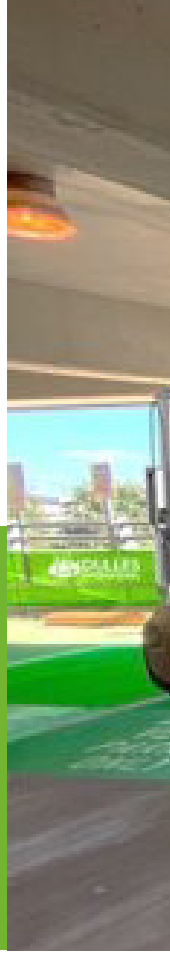
Assuming the schedule continues as planned and barring any unexpected events (tropical storms, fires, etc.), these charging systems will be the first operating NEVI-funded stations in the U.S. with the first location opening before the end of 2023. Currently, there are approximately 19,000 registered EVs and 5,200 plug-in hybrids in Hawaii (source: Hawai'i Energy Office) and those numbers are growing rapidly. Hawaii ranks 4th in the country in EV adoption behind California, Oregon and Washington with 15% market share (source: Insideevs). This project will make significant strides in meeting the state's growing electric fueling needs.

Organization: National Car Charging
Contact: Margaret-Ann Leavitt, Chief Marketing Officer

Timeline

In 2022, the Federal Highway Administration (FHA) approved Hawaii's Electric Vehicle Infrastructure Deployment Plan, granting the state access to $2.6 million of National Electric Vehicle Infrastructure (NEVI) Formula Program funding. The funding was part of the Bipartisan Infrastructure Investment and Jobs Act (IIJA) passed in the fall of 2021. The Act was designed to provide $5B over five years to develop EV charging infrastructure across U.S. highways, including Hawaii's almost 1000 miles of roadway. It's estimated the state will receive $17.6M in funding throughout the duration of the NEVI Program. To expedite installation, the State of Hawaii Department of Transportation (HDOT) used its existing contract with Sustainability Partners, a public benefit company mandated to form reliable and enduring partnerships with public institutions for the advancement of their critical infrastructure. Identifying locations took additional time to meet federal guidelines, gain adequate power access and required stakeholder input.

International Parking & Mobility Institute



CASE STUDY 2

City of Aspen Leads Climate Action Through Electrified Transportation

NATIONAL CARCHARGING™
EV Charging Infrastructure Experts

Market Segment:	
Governmental:	City/Municipality
Location:	Aspen, Colorado
Facility Type:	Multiple - off street, garages & lots
Funding Sources:	General operating/capital budget; state programs, incentives, and/or grants; and public utility programs, incentives, and/or grants.

Best Practices

Building a comprehensive strategy that ties into a larger sustainability program helped guide the planning and execution of the EV infrastructure in Aspen. With the established plans, the community and stakeholders were already on board which allowed the city to focus on the project at hand.

Program Goals

The City of Aspen looks to the transportation sector as an essential way to achieve its science-based climate targets to reduce emissions by 63% by 2030, and 100% by 2050.

- As a first choice, the city is supporting infra-structure that allows residents, visitors, and the workforce to travel via public, active, and shared transportation.
- The City's goal is to provide equitable access to EV charging infrastructure, installing 35 to 45 publicly available ports by 2026.
- EV charging station locations are planned for affordable housing, early care, and nearby public transportation.

Program Summary

The City of Aspen envisions a future with drastically-reduced greenhouse gas (GHG) emissions and much-improved air quality. Eleven percent of Aspen's community GHG are attributable to on-road vehicular transportation (according to the 2020 community-wide GHG inventory). Aspen City Council formally adopted the 2017 Electric Vehicle Readiness Plan, which aims to increase the adoption rate of zero-emission electric vehicles by installing public electric vehicle (EV) charging, EV education and incentives, and leading by example with the City's own fleet and operations.

EV readiness is a key strategy to advance Aspen's Climate Action Plan and reduce GHG emissions. With ample public transportation options and infrastructure supporting active travel, the city encourages walking, biking, taking public transit, and carpooling before using a personal vehicle. However, when driving a car is required, EVs are the best option to support Aspen's environmental sustainability. This is especially true when EVs are charged on a low-carbon electric grid, such as the

100% renewably sourced Aspen Electric. The City of Aspen's hope is to support increased sustainability with access to public EV charging stations and local EV education and incentives.

Currently, there are three DC fast-charging (DCFC) stations and six Level 2 Charging Stations. DCFC users are charged $0.45/ kWh; users of Level 2 charging stations are subject to a $0.25/ kWh charge. Parking fees and posted parking hours apply to all charging stations. 100% electric vehicles may apply for a permit to park for free in residential areas. In addition to these public stations, electrifying the city fleet is a priority work area over the next two years. The City of Aspen's police department is a national leader in its purchase of six Tesla Model Ys and a Ford F-150 Lightning for use in police work.

Timeline

City installations are part of an ongoing initiative since 2017, and the city is aggressively working to meet program goals. Each site had different configurations, and most were installed on a six-month project timeline. The only significant program barrier was procurement with supply chain challenges related to COVID.

Organization: National Car Charging
Contact: Margaret-Ann L Leavitt, Chief Marketing Officer

International Parking & Mobility Institute

CASE STUDY 3

CU Boulder Promotes ZEV Lifestyle through Transportation Infrastructure and On-Campus Electric Buses

University of Colorado Boulder

Market Segment:	Academic/University
Location:	Boulder, Colorado
Facility Type:	Off-street Surface Facilities
Funding Sources:	Federal programs, incentives, and/or grants

Best Practices

The success with the CU Boulder EV infrastructure program was and is deeply rooted in having a clear vision and well thought out deployment strategy that started small and grew with time and experience.

While the University was breaking new ground by adding buses, their experience in building out their parking lot and small vehicle EV infrastructure paved the way and established a strong foundation for the bus project.

Program Goals

- Take a leadership role in climate action and establish the foundation for a zero-emissions future.
- Build scalable EV infrastructure for parking, fleet vehicles and campus buses throughout the CU Boulder Campus, while reducing fleet expenses.

Program Summary

Boulder is famous for its value of environmental preservation, education, and quality of life, and is truly a hotbed of change and innovation. This innovative spirit is deeply embedded in the fabric of the University and it's long been part of the school's vision: *The University of Colorado will be a premier, accessible and transformative public university that provides a quality and affordable education with outstanding teaching, learning, research, service and health care.*

The EV program at CU Boulder is part of a larger sustainability program that includes both micro- and macro mobility along with other green initiatives that include solar and building efficiency among others. CU Boulder, whose passion for the environment can be traced back to 1970 when the nation's first student-led environmental center was established, has long promoted the use of alternative modes of transportation and the use of new fuel vehicles to reduce greenhouse gas emissions from travel to and through its campuses.

CU Boulder has been growing their EV infrastructure since the 1990s; however, it has taken a leap forward

over the past decade, with a focus on expanding charging infrastructure for the campus bus fleet. The project started in 2020 with the award of the first of two U.S. Environmental Protection Agency (EPA) Diesel Emissions Reduction Act (DERA) grants totaling $1.7 million. The issued grants covered 45% of the cost to purchase the buses and charging equipment.

The forty-foot New Flyer's buses were designed to take on the school's existing Buff Bus routes. Like most EVs, the buses feature fewer moving parts, and will require less maintenance and fuel, overall reducing the University fleet budget significantly. Each bus has a dedicated ChargePoint charger with the added capability for one bus to pull from both at the same time for faster charging. Each bus has a range of more than 200 miles and can run on one overnight charge for a full day on a Buff Bus route.

The third and fourth electric buses are expected to join the fleet by summer 2023. They will have larger batteries, extending the distance each can travel on a single charge. As part of the DERA grant requirements, the diesel buses were retired and destroyed. The replaced buses were 28 years old with each having traveled over 700,000 miles.

Timeline

The build-out of campus EV infrastructure began decades ago and expands as demand from students, faculty and staff grows. Each installation project runs approximately six to nine months. The electric bus project started in 2020 when the University was awarded the first of two U.S. EPA Diesel Emissions Reduction Act (DERA) grants, and buses went online in November 2022 with the installation of charging infrastructure. The timeline was extended because of COVID and supply chain issues that aren't anticipated in the future.

In addition to the financial benefits, the University's sustainability and resilience program manager Ed von Bleichert is thrilled for the long-term climate impact: "*The positive environmental impact of the buses will be immense. By taking two diesel vehicles off the road, we are reducing the end-of-pipe emissions by roughly 150 tons of carbon dioxide, and we will save more than 13,000 gallons of diesel. Electric vehicles have their own emissions, to be sure, but we will only see more benefits as the technology improves.*"

Organization: National Car Charging
Contact: Margaret-Ann L Leavitt, Chief Marketing Officer

International Parking & Mobility Institute

CASE STUDY 4

EV Spot Network Connects EVSE to Car-sharing and Mobility Programs in Minneapolis, MN

Minneapolis
City of Lakes

Market Segment:	
Governmental:	City/Municipality
Location:	Minneapolis, Minnesota
Facility Type:	On-street facilities
Funding Sources:	General operating/capital budget; and federal programs, incentives, and/or grants

Best Practices

The program is integrated with mobility hub planning with the partners, and plans include local and hyper-local considerations to support greater sustainability and transportation equity in diverse communities.

Connecting EVSE to car-sharing infrastructure and other mobility programs enhances sustainability outcomes, including reducing GHG emissions and creating shared infrastructure for communities.

Program Goals

- Establish a comprehensive network of electric vehicle charging hubs across the Twin Cities region.
- Provide widespread access to electric vehicles through the Evie car-sharing service.

Program Summary

The EV Spot Network is a partnership between Minneapolis and St. Paul which consists of 70 charging hubs within a 40-square mile service area of the Twin Cities. Most EV Spot locations will be within a ten-minute walk for residents/users in the service area. The charging hubs include signs, electrical service cabinets, and charging stations – generally two to three charging stations to power vehicles in four to six parking spaces.

Car-sharing thrives in areas with a dense population and reliable transit options. However, the partners acknowledged that equitable access to car-sharing and efficient transit services has not always been a reality. The goal is to enhance accessibility in Saint Paul and Minneapolis by introducing car-sharing to neighborhoods that have previously not had this resource to ensure that more individuals can benefit.

The Twin Cities Electric Vehicle Mobility Network

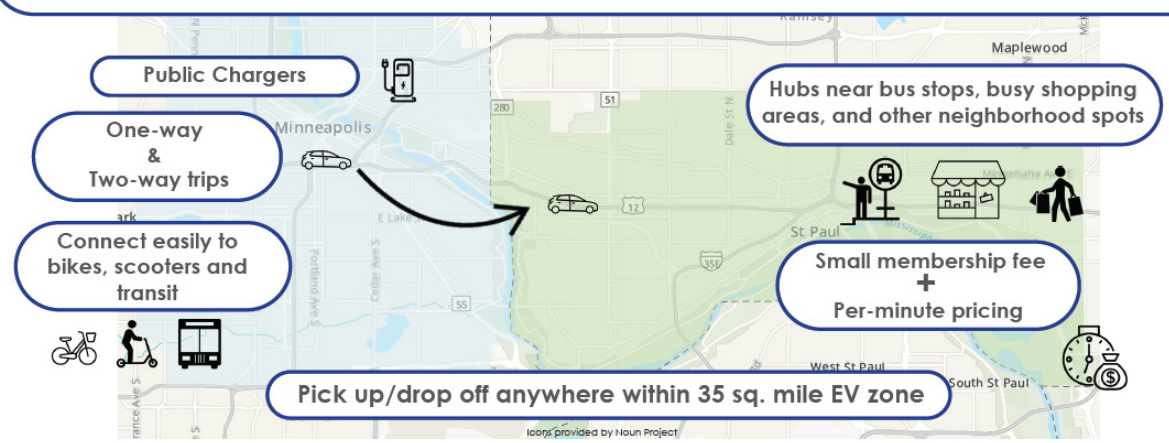
Through a unique partnership, car-sharing in the Twin Cities will be more convenient, affordable, and accessible than ever before. This means communities that experience excess auto emissions will see cleaner air and people who are car-less will have more options. There will also be charging available for privately owned electric vehicles.

What's Included in the new EV network?

Electric Vehicle Carshare Fleet + Public Curbside Charging Hubs

What is Car Sharing?

Car-sharing provides the benefits of car access without the burden of car ownership. By becoming a member of a car-sharing network, you have access to cars throughout a service area for short-term rental.



Visit hourcar.org to explore current service. More info at www.stpaul.gov/EV Email at charginghubs@ci.stpaul.mn.us

Within each neighborhood in the service area, the program sought to make hubs conveniently and centrally located, accounting for a host of factors to place hubs in proximity to affordable housing, multi-family housing units, local businesses, schools, libraries, and recreation centers, while also locating them close to public transit networks and bike-friendly streets.

In Minneapolis, siting is coordinated with the mobility hubs pilot program. There are many logistic factors as well, including where there is space available and other city planning activities. Finally, the program considered hyper-local information, such as unmarked loading zones and other local curbside activities that we would find alternative solutions for as part of this project.

Two of the spaces are reserved for the electric vehicle carshare service called Evie and operated by HOURCAR, and two to four are for public charging of personal electric vehicles. A handful of hub locations near freeway access or regional destinations have five electric vehicle parking spaces to also provide a fast EV Spot charger.

Timeline

Installation of the chargers began in late 2021. The full build out is expected to be complete in late 2023.

Organization: City of Minneapolis
Contact: Dillon Fried, Mobility Manager

CASE STUDY 5

Suburban University EV Charging Re-imagined: University of California, Riverside Drives Decision-Making with Commuter Data

Market Segment:	Academic/University
Location:	Riverside, CA
Facility Type:	Off-street (lots)
Funding Sources:	General operating/capital budget

Best Practices

Utilizing a data-driven approach, the university compiled data from various sources that informed programming, including EV planning and operations.

The university's research found that most drivers did not need to charge on campus, but were doing so to reduce personal commuting costs. Reductions in time availability for free charging reduced dwell time, enabling greater turnover and efficiency.

Challenges included addressing concerns from individuals who do not own or operate an electric vehicle or do not perceive community value from the program.

Proximity to affordable housing and the suburban location provides an ideal environment for easy EV ownership as well as reduced demand for school/workplace charging.

Program Goals

- Reduce ongoing operating costs of EV charging program and identify cost-relative charging solutions.
- Eliminate the need for EV drivers to monitor their vehicles.

Program Summary

If you build it, they will come and charge their vehicles. But do they need to?

The University of California at Riverside campus started offering electric vehicle charging in 2013. The expected slow utilization early in the program blossomed into a high demand for Level II charger access. For years the campus' chargers had a utilization rate above 90%. This was believed to be tied to the program's allowance for registered campus community members to receive the first four hours of an EV occupied a charging cable space for free.

As the program worked towards a self-sustaining model where income was collected from all vehicles using chargers to fund the annual maintenance costs, utilization dropped in half. Registered participation continues to grow, adding 100 or more users per year with no significant growth in utilization.

The campus was able to gather data on Level II charger users from the system tracking software and other sources. The average EV driver had a round-trip commute of 5.6 miles, and the average commuting vehicle charged on a 240volt/40amp Level II charger in one hour and 24 minutes. When users received four hours at no cost, average dwell time was three hours and 45 minutes. When the free period was reduced to two hours, dwell time dropped to one hour and 54 minutes.

With the data and testimonials from users, the campus was able to develop the following facts related to this specific campus and its location in the region:

- At this campus, most EV users do not need to charge their vehicles at work. They do so because it lowers the cost of ownership.
- At the program's inception, EV drivers were never paying to charge their vehicles because they could charge for free on campus utilizing funding from the large parking community.
- When asked to pay the operational costs of public charging, most EV drivers will not use the system unless it is required to complete a planned trip.

In 2020 with the construction of the Parksmart Gold PS1 parking structure, the UC Riverside team installed 95 Level I (120volt/20amp) receptacles, initiating the campus low-cost EV charging program. This option lowered the per-space charging equipment costs from $10,000 to $500, allowing the campus to charge a low monthly fee that averaged what a Level II user paid for two days of charging on campus. Users enjoy the benefit of charging their vehicles without needing to relocate them during their work or classes while paying a fraction of the cost.

The campus' proximity to affordable housing and its specific location in a suburban city provides an ideal environment for easy EV ownership as well as reduced demand for school/workplace charging. Although simpler to implement, this experience demonstrated that percentage-based EV charging equipment requirements without regard for commute distances may have charging equipment installed long before it is needed. It also does not take into account available power capacity, or the ability to meet the community's needs with lower power solutions.

Organization: University California Riverside, Transportation Services
Contact: Andrew Stewart, Associate Director, Field Operations

Timeline

System launched September 2013. Changes to programming occurred between 2013 and 2019. In 2020, the construction of the Gold PS1 Parking Structure enhanced charging resources on campus. All campus plans for EV charging have been overshadowed by state building code requirements for EV charging equipment at a growth rate 10 times planned growth.

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CASE STUDY 6

Reagan National Airport EV Charging Infrastructure Program

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

Market Segment:	Airport
Location:	Arlington, Virginia
Facility Type:	Off-street (garages)
Funding Sources:	General operating/capital budget; Public utility programs, incentives, and/or grants; Strategic partnerships (automaker, public-private partnership, etc.)

Best Practices

DOT data and objective industry 2030 projections utilized the quadratic approach to anticipate market share through 2023. This data and analysis formed the basis for the EV charging programs, goals, and operations.

Partnership with the utility company allowed the airport to enhance its operations, with special emphasis on managing power capacity.

Research and usage reports support different levels of EVSE; the airport carefully examined distinctions and advantages of Level 1 and 2 charging ports.

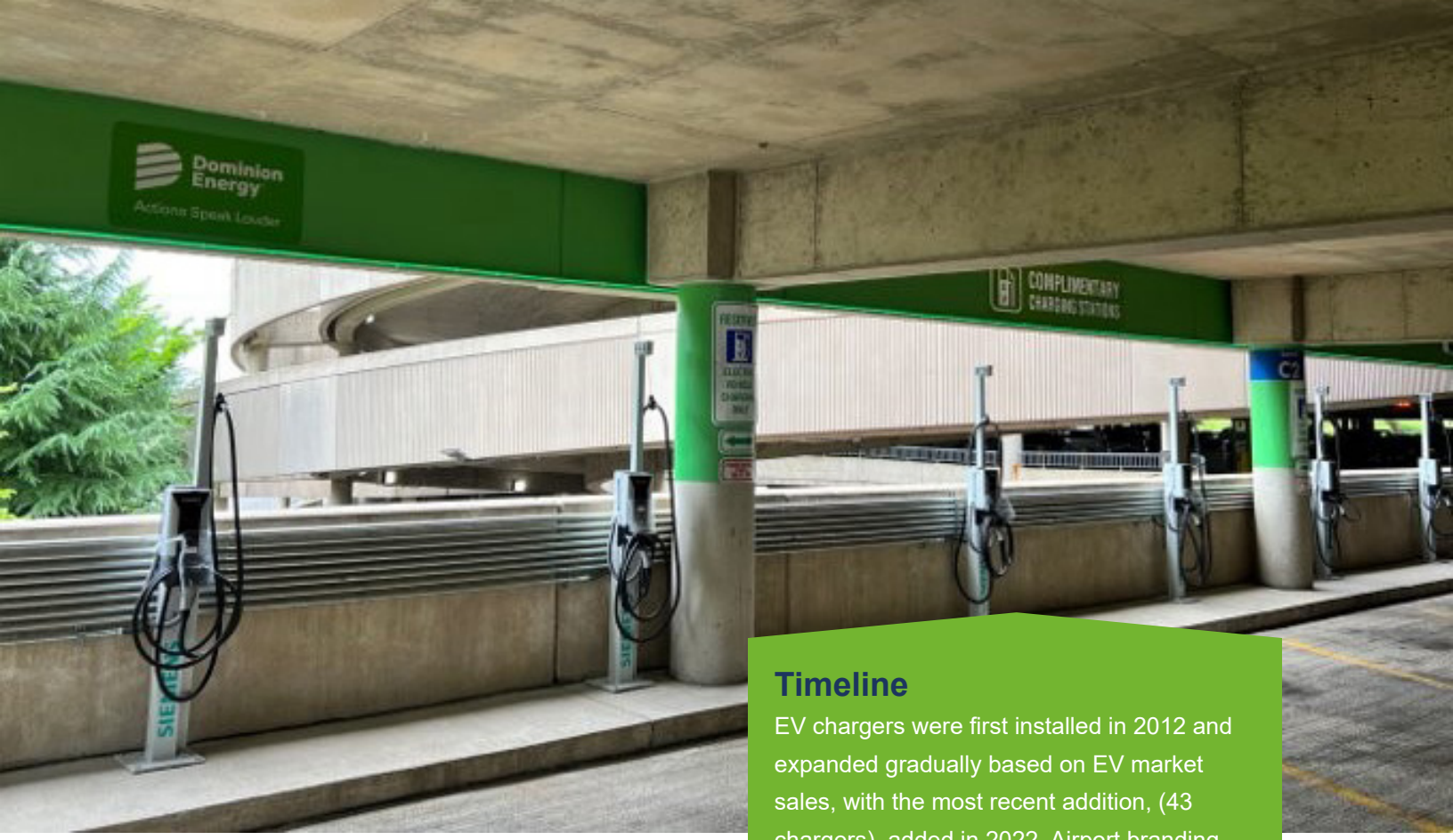
Program Goals

- Recommend all chargers (Levels 1-2) eventually include connectivity and the ability to charge for access in the future.
- Use existing funding from approved projects to procure materials (transformers, breaker panels, wire, chargers, etc.), needed to add additional chargers.
- Enhance EV charging zones with additional amenities, including painting, green LED lighting, and signage improvements.

Program Summary

Based on EV demand, physical counts of plug-in hybrid and electric vehicles in our garages, MWAA conducted a ten-year outlook to identify challenges, infrastructure needed, and overall demand in the immediate area and across other parking areas. Demand projections are intended to be used as a guideline and adjusted throughout based on actual market conditions and any shifts in future projected demand and/or customer behavior.

Specific to this case, the DMV area was found to hold the second largest number of EV registrations behind California, currently at 7% of all registered vehicles, supporting demand to increase EV offerings within the



Timeline

EV chargers were first installed in 2012 and expanded gradually based on EV market sales, with the most recent addition, (43 chargers), added in 2022. Airport branding and LED lighting added to enhance EV zones and improve wayfinding.

Airport garages. In the first quarter of 2022 alone, EV sales grew by an average of 60%, compared to the same period of the previous year. Data continues to support an increase of EV sales nationwide and, due to passenger demographics, airport demand is likely to be above and beyond local and national levels.

Part of MWAA's ten-year outlook included in 2020, expanding partnership with Dominion Energy, an American power and energy company headquartered in Richmond, VA. Under this new project MWAA and Dominion Energy specifically focused on EV charging stations. Dominion Energy now sponsors an additional (30) chargers for Reagan National Airport as well as (30) charging stations at MWAA's sister airport, Washington Dulles International Airport.

Program challenges included the cost of equipment and budget impacts, integrating EVSE with current IT infrastructure and programs, managing and maintaining EVSE infrastructure, as well as utility coordination and power supply and physical site/facility constraints. Specifically, electrical infrastructure is limited to both Parking Garages with power capacity at its max for Parking 1 and data logging required to determine remaining capacity for Parking 2. Surface lots and expanded capacity will depend on a long-term planning approach to manage electrical demand, supply, and future resources.

Current data supports an average length of stay of 3.5 days parked in a parking garage at an Airport. Recent enhancements to infrastructure has allowed for Level 2 charging stations, however based on length of stay, Level 1 charging stations are sufficient to our operation and meets our customers needs. Further studies regarding electrical infrastructure are needed within the Airports to plan for future expansion as EV demand increases and new models develop. In addition to parking, the Airport is considering moving to an EV Fleet for passenger transport and Airport Operations service vehicles.

Organization: Metropolitan Washington Airports Authority
Contact: Kathleen Hoffman, Commercial Parking Business Specialist

International Parking & Mobility Institute

CASE STUDY 7

Early Adoption and Thorough Planning Lead to Effective Load Management and EVSE Deployment at San Diego International Airport

SAN DIEGO INTERNATIONAL AIRPORT

Market Segment:	Airport
Location:	San Diego, California
Facility Type:	Off-street (garages)
Funding Sources:	General operating/capital budget; and federal programs, incentives, and/or grants

Best Practices

Lessons learned through pilot projects have led to a sound plan, set on a foundation built for success.

A thorough electrical study identified electrical system capacity, informing the decision to implement a load management system to accommodate the airport public parking and commercial vehicle EV charger demand.

Program Goals

San Diego International Airport (SAN) has been on the cutting edge of electric vehicle charging for over 10 years. SAN was an early adopter, providing free Level 2 chargers within long-term parking facilities, observing use, and scaling offerings as customer demands changed. SAN has evolved customer offerings as vendor technologies shift and EV charger demand increases. SAN is in the process of installing significant EV charging infrastructure as part of a broader terminal expansion program. Lessons learned through pilot projects have led to a sound plan, set on a foundation

built for success. A few key factors that set up SAN for EV charger success include:

SAN provided conduit pathway and electrical room area for future EV chargers when the existing Terminal 2 Parking Plaza was completed in 2018. This forward thinking saved significant costs for designed EV charger network expansion.

SAN conducted a thorough electrical study that identified the airport's electrical system capacity. This study informed the decision to implement a load management system to accommodate the airport public parking and commercial vehicle EV charger demand. Without this study, SAN may have spent significant dollars retrofitting new facilities to provide the desired amenity.

SAN continues seeing growth in EV commercial vehicles. Rather than assume staff knew the requirement, SAN staff engaged commercial vehicle providers to understand their charging needs. SAN staff worked with stakeholders and engineers assessing the electrical system to develop an implementable plan for DC Fast Chargers to serve the commercial vehicle charging demand.

Organization: San Diego International Airport
Contact: Chad Reese, Environmental Affairs Manager, Planning & Environmental Affairs

CASE STUDY 8

University of Wisconsin-Madison Electric Vehicle Charging Program and Fleet Electrification

Market Segment:	Academic/University
Location:	United States (WI, Madison)
Facility Type:	Off-street (garages)
Funding:	General operating (parking revenue)

Best Practices

Followed a phased process starting with user surveys, and moving through incremental installations and programs on campus.

Program Goals

- Provide lifeline charging for campus visitors.
- Encourage adoption of EVs by students/ employees.
- Support sustainable transportation options.

Program Summary

UW Madison's EV charging program seeks to encourage the adoption of EVs, provide lifeline charging for campus visitors, and support sustainable transportation options.

UW-Madison Transportation Services (TS) began to receive requests for EV charging on a very limited basis in 2010. In 2012 TS completed a customer survey of our parking permit holders to gauge the level of adoption across campus of EVs. In 2013 TS began planning for the installation of charging units that were ordered and installed in 2014 at six locations on campus. The units were Chargepoint dual port level two, providing 12 total ports. Since that time TS has added additional Chargepoint dual port units across campus, providing 12 total locations and 32 ports. Four dual port non-networked level two units were also added via a grant and housing funding in that time. In 2023 TS purchased the first Blink unit, though it has not yet been installed.

Four-hour parking limit at charging stalls make the units available to as many customers as possible. All EV charging on campus currently is free to use at no additional cost to customers with the payment of normal parking fees.

In 2022 TS completed a fleet electric vehicle study and launched a charging unit request for information (RFI). TS also installed cameras at all charging station locations to monitor the equipment.

In 2023 the rebid of the charging infrastructure contract based on the results of the RFI added more level two vendors, DC fast chargers, fleet charging solutions, and solar infrastructure for EV charging. UW also collaborated with stakeholders in the county and across

the entire University of Wisconsin System to share information and resources, including participating in development of a county EV plan and a grant application the county submitted for federal funding through the Charging and Fueling Infrastructure (CFI) Discretionary Grant Program.

Moving forward UW plans to study available electrical capacity on campus before expanding charging units further and may pursue charging fees for use of the chargers either to assist with managing the spaces to maximize the number of users or to help cover expenses. Plans also include electrification of the campus fleet and for charging infrastructure for those vehicles. Finally, TS has an interest in possibly integrating level one charging (without the four hour time limit) to provide stalls to more customers and eliminate the need to move a vehicle if the customer plans to park all day.

Organization: University of Wisconsin Madison Transportation Services
Contact: Darwin Ward, Commuter Solutions Manager

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