NovaCHARGE

Empowering The Future™

The Definitive Guide to Capitalizing on the EV Revolution

www.novacharge.net

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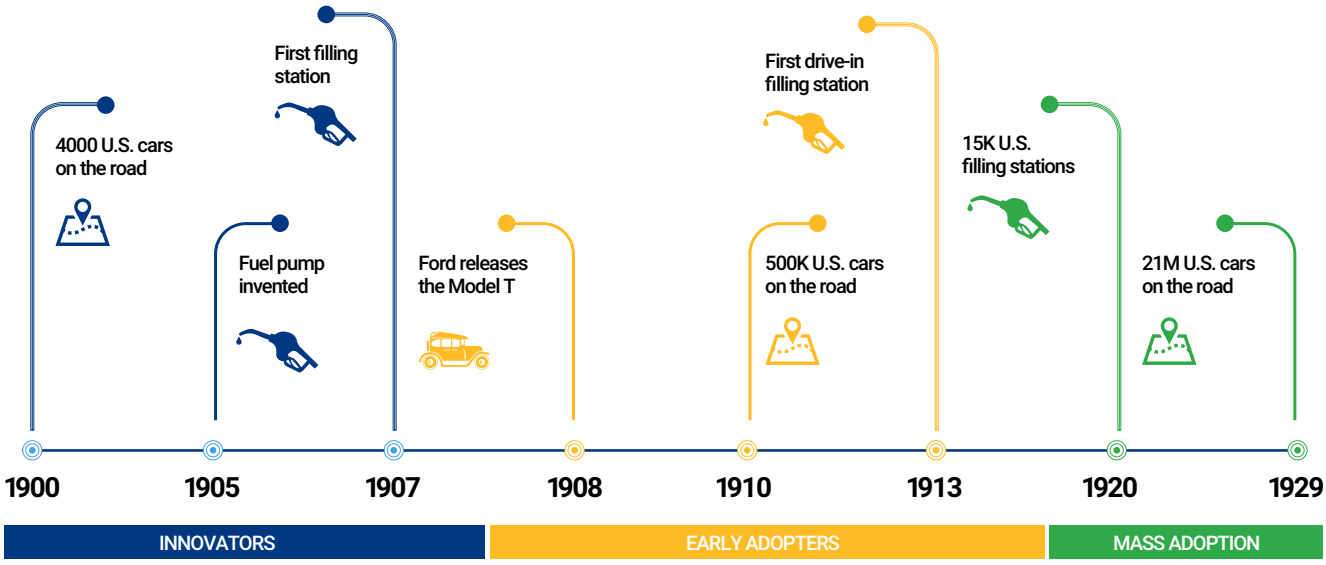


The first step in Capitalizing on the Electric Vehicle (EV) Revolution is to gain an understanding of the EV adoption cycle.

Fortunately, the past can be a key indicator of the future.

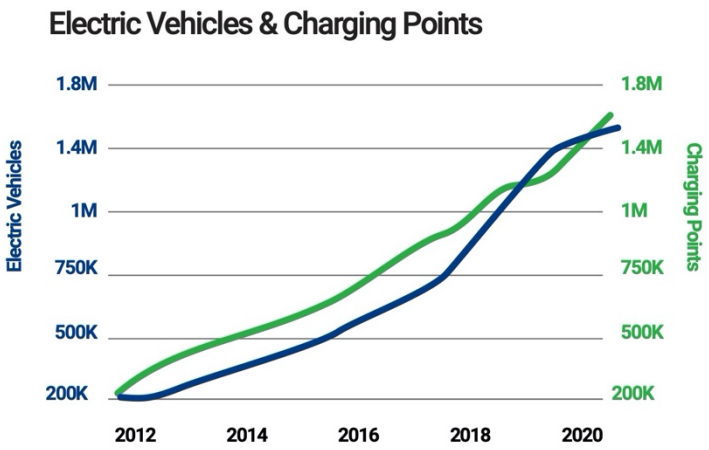
It only took 3 decades for automobiles to transition from symbols of the rich to expectations of the middle class.

This was a process enabled by technological developments, supported by a dedicated nation-wide infrastructure, amplified by millions of drivers & supported by government initiatives.

A similar pattern is developing within the EV industry.

Prior to the introduction of the Nissan Leaf, Chevy Volt, and Tesla Roadster around 2010, EVs were considered too impractical and expensive that they were mostly adopted by enthusiasts or well capitalized specialist applications. Today, EV sales boast a 50%+ CAGR. The United States is arguably at the end of the second decade of electric vehicle adoption, with the early adopters having worked through many of the challenges to make way for mass adoption throughout the 2020s. By 2030, EV sales are predicted to surpass internal combustion engine vehicles.

- **Innovators:** Address technical challenges & develop business models.
- **Early Adopters:** Learn from early adopters & develop a scalable infrastructure.
- **Mass Adoption:** Leverage learnings and introduce offerings to a ready & excited audience.



As more carmakers have moved to produce new models to make EV broadly available and affordable to the average household in a variety of forms, one of the remaining barriers to adoption is charging infrastructure.

Ubiquitous charging points is a pre-requisite to the broad EV adoption ahead. Just as gas stations proliferated alongside the internal combustion engine, so too will EV charging infrastructure continue to scale with the adoption of electric vehicles. The International Energy Agency has recommended an average of 10 EVs per charging outlet; the United States is hovering near 20 EVs per outlet as of October 2020.

Why government is investing in EV charging infrastructure

It's no secret that the government can be and has been a major change agent, particularly as it pertains to infrastructure. Through policy and action, it's clear the US government wants wide-spread EV adoption.

There are several reasons for this:

Lower pollution

Means lower population-level disease burden and healthcare costs to taxpayers. More than 250 million internal combustion engine vehicles account for 28% of yearly greenhouse gas emissions, leading to a yearly loss of 123,000 to 381,000 disability-adjusted life-years across the population.

Fleet efficiency

As the national fleet goes electric, total cost of ownership for the fleet and its operation will plummet. Further, an EV fleet makes the government less reliant on fossil fuels and creates resilience through energy diversity.

National competitiveness

The government has long considered public infrastructure key to national security & operational cohesiveness and has legislated to that effect, such as with the Federal Highway Act of 1956 which ensured free movement of key military assets. A nationally scaled EV fleet would of course require broad EV charging infrastructure.

> "Our reliance on petroleum makes us vulnerable to price spikes and supply disruptions. EVs help reduce this threat because almost all U.S. electricity is produced from domestic sources, including coal, nuclear, natural gas, and renewable sources." -- Energy.gov

Initiatives & Incentives

Numerous federal and state incentives in the form of initiatives, tax credits/exemptions, rebates, grants, or loans are both driving citizens to purchase electric vehicles and the private sector to invest in charging infrastructure.

> **Clean Cities Coalition -** A US Department of Energy program to "support the nation's energy and economic security by building partnerships to advance affordable domestic transportation fuels, energy efficient mobility systems, and other fuel-saving technologies and practices." By 2018, coalition activities prevented 5 million carbon dioxide-equivalent tons by securing hundreds of millions in funding to complete hundreds of EV infrastructure projects across the US.
>
> **Workplace Charging Challenge -** A U.S. Department of Energy program with the goal of partnering with 500 employers committed to providing their employees with access to charging. By 2016, more than 600 workplaces had installed over 5,500 charging stations accessible to nearly one million employees. In addition to direct partners, more than 200 other employers also began to offer charging, suggesting that the Challenge was a catalyst for the growth of workplace charging even beyond direct participants.

Federal EV incentive examples:

- **Flexible Billing federal income tax credit of up to $7,500** for the purchase of an EV
- **30% tax credit up to $30,000** on EV charging infrastructure purchases

State EV incentive examples:

- **New Jersey began offering a $5,000 rebate** on the purchase of an EV in 2020.
- **New York offers an income tax credit** of up to $5,000 and rebates of $4,000 per charging port for Level 2 charging stations installed at public, workplace, and multi-unit dwelling parking lots.

Recognizing the value in having a stake in EV infrastructure, many utilities are also following suit with private incentives to promote charging station deployment. For example, the Tucson Electric Power Co. offers rebates on Level 2 chargers of $4,500 for business and local nonprofit customers and $6,000 per port installed in multi-family facilities.

Why businesses are investing in EV charging

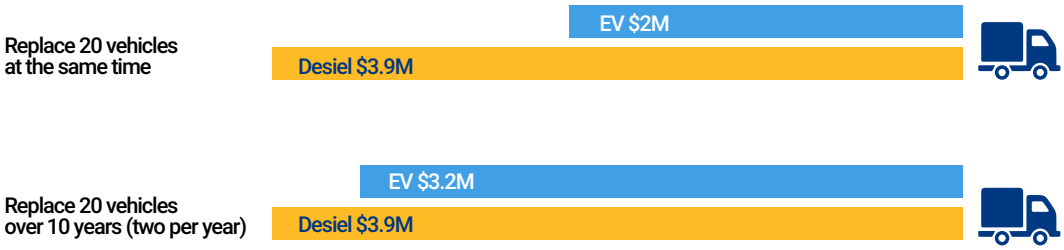
In addition to utilities, many businesses are also realizing that, beyond incentives, investing in EV infrastructure pays dividends by providing a service that attracts visitors, retains customers & employees, cuts cost, drives revenue, and helps meet corporate social responsibility & sustainability goals.

Fleet operators are drastically reducing costs

While the initial costs of electric vehicles and associated infrastructure may be more expensive up front compared to internal combustion engines, **long term gains achieved by vastly reduced fuel costs and maintenance of much simpler machines** (a few moving parts vs. hundreds) make EV fleets an attractive investment.

A study by PG&E found that a 47% reduction in fleet TCO could be achieved over a 10-year period, factoring in tax credits and a significant decrease in costs to fuel and maintain an EV fleet vs. traditional. Further, they suggest that TCO can be optimized by bulk transitioning rather than piecemeal replacement:

"While replacing vehicles gradually over time has its benefits, concentrating the transition to EVs in a shorter period of time can improve TCO. This is primarily due to the cost of site improvements to add electrical service, upgrade switchgear, and install EVSE, which do not scale linearly with the number of EVs. More specifically, it is cheaper (per unit) to install ten chargers at a site than it is to install two."



Retailers are driving in-store foot traffic and increasing dwell time

Retailers are recognizing the benefits of EVSE installed on site, specifically in driving foot traffic and achieving corporate sustainability goals. Data from several vendors and the National Renewable Energies Laboratory (NREL) show that customer dwell times during charging sessions can range from 30 minutes to 2 hours.

Simulations performed by Atlas Policy taking into account increased in-store dwell time and a variety of charging models were used to create a forecast of 10-year net-present value (NPV), finding a range from around twenty to forty thousand dollars per installed station.

10-year NPV per station cost model

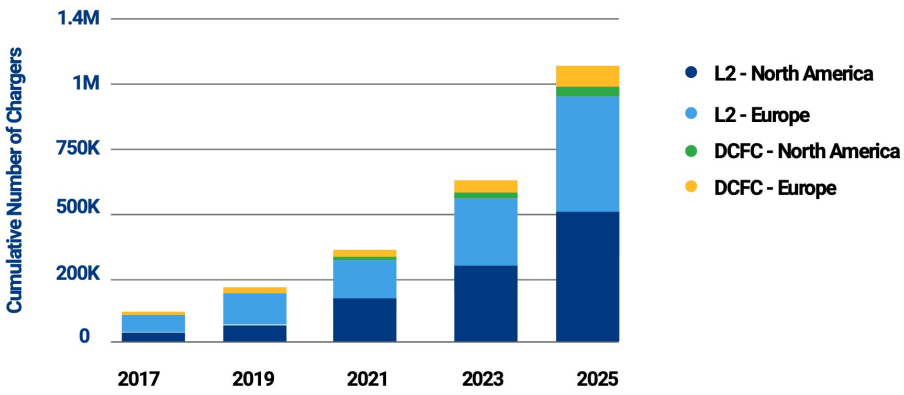
	No fee	Cost Recovery (flat fee)		Profit Center		Third Party Owner/Operator
Cost	n/a	$0.25/kWh	$3.00/session	$0.49/kWh	$6/session	n/a
10yr NPV	$24,375	$30,101	$33,631	$35,416	$42,548	$14,251

CRE firms and workplaces offering competitive perks

As the proliferation of electric vehicles continues, **workplaces are joining the efforts to create distributed EVSE**, sponsored further by government initiatives such as the Workplace Charging Challenge. Companies such as GM, Coca-Cola, Google, and many others have been equipping their facilities with EV chargers for over a decade with much success.

In 2010, GM began by installing 100 Level 2 chargers across key employee parking lots. To keep up with increasing demand over the next few years, they began adding Level 1 chargers as well. By 2016 they had 350 Level 2 and 150 Level 1 chargers. By early 2020 they had 918 stations and announced an additional 3,500 stations to be installed across its facilities in the US and Canada.

Number of Workplace Chargers by Type & Geography



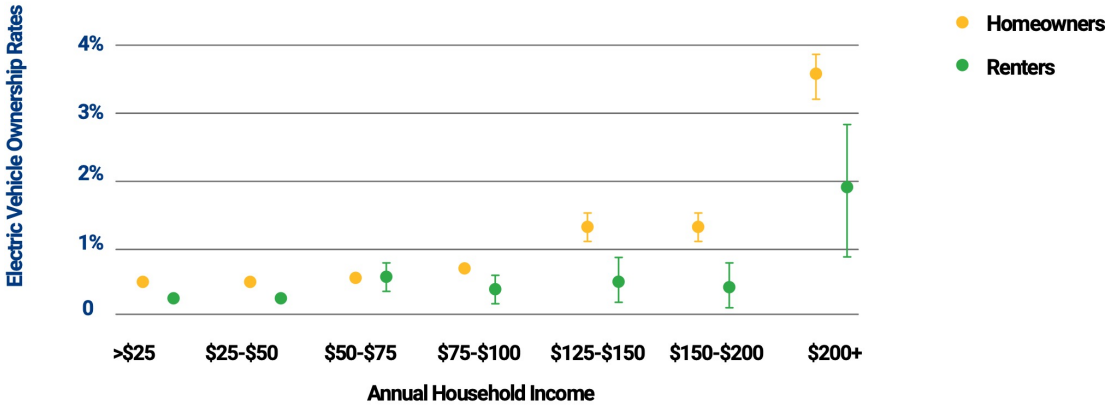
Multi-family housing attracting and retaining residents

For eco-conscious communities**, supporting EV adoption with charging infrastructure has been a major differentiator for attracting residents** and promoting sustainable business. In 2013, Green Rock Apartments, an urban community in Minneapolis, MN began installing a variety of chargers in their communities as a resident amenity as well as infrastructure to recharge company-owned Nissan LEAFs.

As of 2020, Green Rock has taken advantage of several incentives to equip multiple properties with Level 2 and DC fast charging EVSE. This not only positioned the company's operations for more efficiency, but also allayed the charging concerns of several residents and led them to invest in electric vehicles.

> "The chargers are a major draw for tenants and make the units more valuable... tenants stick around because of the perks." -- Dale Howey, Green Rock Apartments Owner

Household Income & Electric Vehicle Ownership



Glossary:

- **EVSE** - electric vehicle supply equipment, also called charging stations, charging points.
- **EVSP** - electric vehicle service provider
- **PEV/BEV** - plug-in/battery electric vehicle
- **PHEV** - plug-in hybrid electric vehicle

Selecting the right Charger

The goal of this piece is to introduce decision-makers to the types of EV chargers and to suggest factors to consider when choosing hardware and network vendors.

A few questions to consider early in the process:

1. **Who** will be using the chargers?
2. **What's** the parking scenario (i.e. on-street, garage, lot)?
3. **When** will users have physical access to the charger--i.e. protected parking or public?
4. **How** important is data and remote access?

Charger Selection

Level 1

This charging device is included with the purchase of every electric vehicle. It plugs into a standard home wall socket and provides a 110-120V, 12-16A continuous "trickle" charge which takes about 10 hours to provide 20-50 miles of travel. They require very little maintenance beyond ensuring a working outlet. A commercial Level 1 charger is an inexpensive option for parking environments where the vehicle will be parked for longer periods and will have shorter travel distances.

Level 2

The commercial versions of Level 2 vehicle charging stations deliver 16-48 amps continuous at 240V and are designed for use in a public environment, providing roughly 25-30 miles per hour of charge. Options include access control management, RFID and credit card readers to allow for point of sale transactions, heavy-duty construction, advanced communication and safety features. Level 2 chargers require minimal maintenance and are often designed modularly so that malfunctioning components can be replaced instead of the whole unit. This is the most common commercial charger type due to its moderate cost and charge times more appropriate for consumer applications.

DC Fast chargers

DC Fast Charging (480 volt, 60-200A continuous) is the fastest method for charging and is capable of providing a full charge in less that 30 minutes depending on the battery size. They are the priciest kind of charger, costing $10-50k and typically require upgrading electrical infrastructure to support the increased load. DCFC units require periodic maintenance because they have multiple components such as cooling systems and filters that do not exist in Level 1 or Level 2 units. They are a great option for vehicles in fleet and commercial facilities and can also make attractive destination chargers for retailers and highway stops.

Charging Station Basics

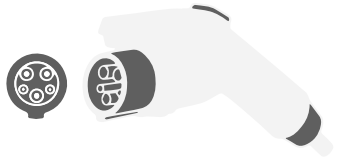
Charger Level	Power Supply	Charger Power	Miles/Hr Charge	Full Charge	Cost Range
Level 1	120VAC	1.4kW	3 - 4 miles	12 - 16hrs	$300 - $1,500
Level 2	240VAC	3.3kW - 19.2kW	8 - 60 miles	2 - 4hrs	$1,500 - $3,000
DC Fast Charge	480VAC	25kW - 150kW	100 - 350 miles	< 30 min	$12,000 - $35,000

Standards: Connectors

Since 2001, the Society of Automotive Engineers (SAE) has developed and maintained standards for electric vehicle charging cords, connectors, and energy transfer protocols, ensuring that all charging stations and EVs have a common charging plug and receptacle.

Level 1 & 2

Chargers have only two varieties of connectors in the United States: the J1772 and Tesla's proprietary connector (because of course).



Type 1 SAE J1772

Tesla US

DC fast charging

Is just a little more complicated, with **2 different standards and Tesla:**

- **SAE Combined Charging System (CCS)** which uses the base J1772 pin design but adds a lower bank of 2 pins to the connector. This is the standard most US-sold cars use.
- **CHAdeMO** connectors are only used by Nissan and Mitsubishi EV models in the US.
- **Tesla** -- same proprietary port as the level 2 charging option

CCS Combo 1

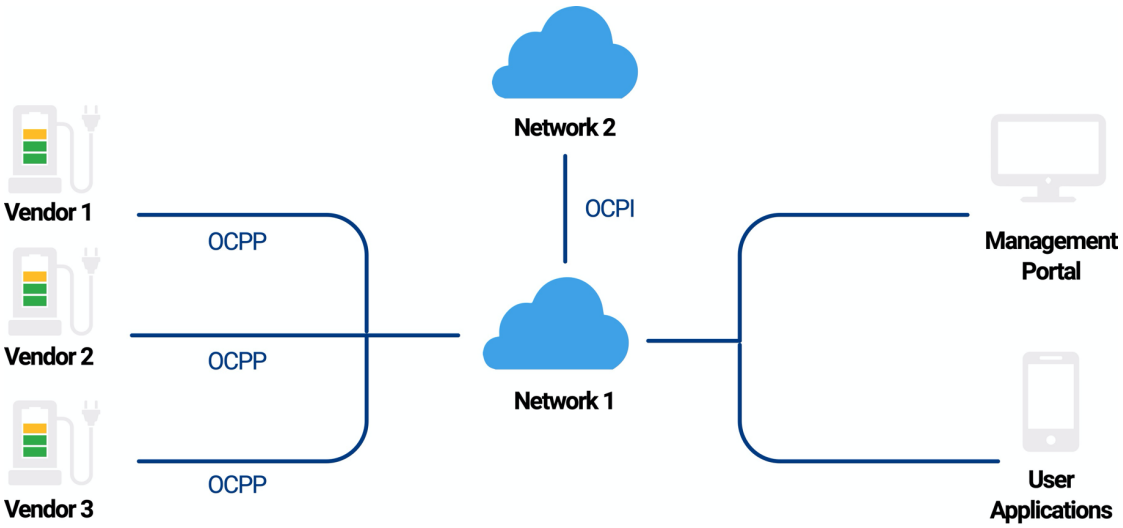
Chademo

Tesla US

Standards: Communication

An important consideration when selecting a charger vendor is ensuring compliance with industry standard communication protocols. Look for hardware built using the Open Charge Point Protocol (OCPP) standard. OCPP is an open communication protocol built into the charging station that interfaces with a central system controlled by the operator. There has been and will continue to be changes in the EVSE charging landscape, so it's important that whatever hardware is chosen won't become a stranded asset if the original network provider is no longer available. Furthermore, OCPP chargers prevent vendor lock-in and allow operators to port units to a different network if necessary.

The charging network story is very similar to that of cell phone networks. When the iPhone came out, it was only available on the AT&T network-- some users may have been very satisfied with the phone but dissatisfied with the service; however, they were locked in the network until years later when iPhone became available on other networks. **For charging station operators, OCPP enabled hardware is like the phone that can work on any network.** On the driver side, the OCPI standard is used in parallel to allow roaming between networks.



For charging station operators, **OCPP-enabled hardware provides a hedge against vendor lock-in** and ensures centralized cloud management of units even if they're from multiple companies, for example if different departments or individuals have purchased different charger models at different times.

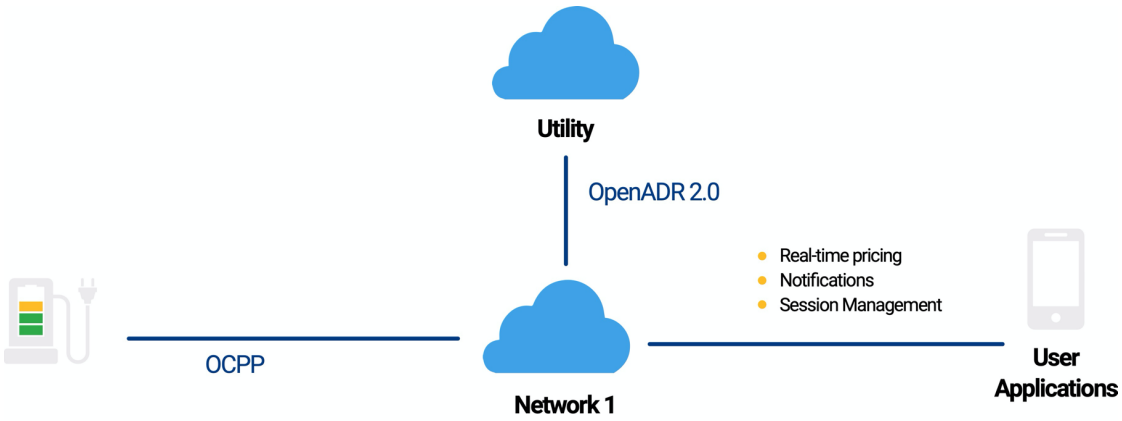
Charging networks

Allow for advanced centralized management of geographically distributed charging infrastructure. While not vital for all business models or use cases, charging networks are necessary when any data analysis, remote management, and dynamic access control are required. This is often referred to as "smart charging" and costs more due to network connectivity and usage fees.

There are currently several independent charging networks in the US, with each platform generally consisting of a management portal for operators to remotely administer charging stations and user applications for drivers to find stations and pay for charging. Driver alerts during charging sessions and automated notifications for operators make smart charging an important element of ensuring smooth operation and user satisfaction in many use cases. **Not all charging network companies offer charging station hardware and may require the client to be responsible for station selection, installation, and management.**

OpenADR 2.0 compliance

Open Automated Demand Response (OpenADR) is a public standard to communicate price and reliability signals from an electric utility to electricity consumers and is used to manage & reduce peak load on the grid.



For operators of EV chargers, charging networks equipped with OpenADR provides the ability to automatically reduce peak grid usage in order to save directly on energy costs as well as avoid incurring demand charges. Automating and optimizing peak loads across many charging sessions in real-time ensures a scalable EVSE infrastructure that helps sites avoid costly fees and **sometimes can also delay electrical infrastructure upgrades due to the intelligent use of the existing power delivered to the site.**

Choosing the Right Location

Site considerations

It's important early in any EVSE project to contact your utility to ensure that the current electrical service delivered to the site is adequate to support the proposed EVSE additions as well as discuss metering requirements if appropriate in your application. Additionally, enlist the help of electricians to determine site specific requirements and constraints to make the install as seamless as possible. Oftentimes, EVSE vendors that handle end-to-end install can assist in these activities.

Electrical

Charging station installation costs can exceed the cost of the hardware itself and are influenced by a number of design factors that should be considered such as:

- **The electrical box nearest the prospective location** - closer panels mean less cabling and trenching; 25ft is the maximum recommended distance from the charging station to the electrical box
- **The capacity of the electrical box** - how many available dedicated circuits?
- **The capacity of the site's transformer infrastructure** - in the case of DC fast chargers, additional transformers often must be installed on site, adding significant cost
- **The size of electricity served to the site** - work with ADR2.0 compliant vendors to ensure that peak usage doesn't exceed the capacity of your utility plan or you may incur a large demand rate overage charge.

Location

There is typically a trade-off between prominence and cost. Stations that are the most visible are usually pedestal mounted and farther away from electrical boxes, requiring more expensive EVSE options as well as trenching which can cost from $10-$20/ft through soil and $100-$150/ft through asphalt or concrete. Companies looking to promote 'going green' may opt for more expensive and prominent install locations whereas employee or fleet charging use cases may utilize less prominent locations.

A further consideration is how the parking scenario will change with the addition of charging stations-- if there are fewer EVs to service, then occupying prime parking spaces with EVSE may be less desirable than placement behind the building. Consider a location where the lighting and visibility situation will provide the most safety for the user as well as the hardware.

Mounting Options

Commercial charging stations can be mounted either to existing structures or to the ground with a pedestal.

Wall/pole/ceiling

Mounting units to existing structures is generally cheaper to install since less hardware and labor are required. This is a popular option for garage and parking deck scenarios.

Pedestal

Pedestal mounted units tend to cost $500-700 more than their wall mounted counterparts plus the additional cost to trench cabling. They provide more flexibility in placement and can service more than one vehicle, appropriate for parking lots and on-street parking scenarios.

Rough Estimates of EVSE Install Costs

	Level 2 | Garage | Wall		**Level 2** | Curb | Pedestal		**DC Fast**	
	low	**high**	**low**	**high**	**low**	**high**
Charging station	$1,500	$2,500	$1,500	$3,000	$12,000	$35,000
Materials	$260	$610	$200	$450	$10,400	$26,000
Labor	$1,490	$3,690	$3,300	$9,000	$6,600	$18,000
Permitting	$50	$200	$50	$200	$50	$200
TOTAL	$3,300	$7,000	$5,050	$12,650	$29,050	$79,200

*data from RMI

Data from Rocky Mountain Institute show a roughly 50% cost variance between wall and pedestal mounted units, while DC Fast chargers are between 2 and 6 times more expensive than the costliest Level 2 installations. Many organizations adopt a hybrid approach, with multiple charger types and mounting scenarios on site for different kinds of user and business needs.

Once trenching or other site modification is required, **installing multiple EVSEs at once can lead to a cheaper per unit cost,** incentivizing the install of a bank of chargers rather than one offs. Note that these costs don't consider any network fees, which should be weighed in the budgeting and vendor selection process.

Optimizing the Business Model

As charger and location are ironed out, **it's also vital to consider the specifics** around who will be responsible for the station, how the station dispenses power, and how drivers will reimburse station owners for energy use (if at all):

- **Ownership model** -- who is paying for the station and who is responsible for the site where its located
- **Usage model** -- does power dispensing need to be tracked
- **Billing model** -- how drivers pay for charging sessions

Ownership model

Owner/operator

The charging station owner is responsible for installation, operation, and maintenance, and is often called the charging point operator (CPO). **The CPO assumes all risks and costs of installation** and operation and has control over the user experience and billing arrangements (if any).

Host/owner

In this case, **the site host owns the space on which the charging station sits** and also controls the power. In some cases, the charging station owner is fully responsible for coordinating with the utility, installing & operating the units without intervention from the host. In the case of multi-family charging, the property coordinates with utilities and electricians and sets community power-sharing rules while the resident pays for and owns the charging station hardware.

Usage model

Basic

Basic units are simple energy dispensing devices. They have no notion of user access control or billing for service. These are not usually appropriate for public charging applications, and typically apply best to protected parking scenarios where usage data and cost recovery aren't necessary.

Authenticated

Authenticated may be publicly available units and use a secondary device like a key-fob or a mobile app to verify the identity of the user before dispensing power. These units can track energy usage by account; networked units can access this data and manage users remotely, while non-networked units do not have remote features.

Networked

Fully networked units are remotely accessible. Networked chargers provide advanced functionality that increase the utility of a station, such as automated demand response, dynamic billing arrangements, flexible business model adjustment, driver alerts for completed charges, remote diagnostics and usage data.

Billing Model

While some charging station owners choose to give power away for free, for example to increase dwell time in retail scenarios, some CPOs choose to bill for charger use, either as a cost recovery effort or as a profit driver. This is also often a method to dis-incentivize bad driver behavior, such as occupying a charging station parking spot despite full charge.

- **Per Hour:** typical per hour pricing does not vary throughout the day at the driver level but will vary for the host based on peak demand and time-of-use rates.
- **Per Session:** This is usually appropriate for scenarios where drivers will have shorter and more regular sessions, such as in certain workplace charging implementations.
- **Per kWh:** This accurately accounts for the true cost of electricity for the charging station owner by charging drivers the "time-of-use" (TOU) rate, but does not give an incentive for a car that is fully charged to leave the space
- Idling: charging station owners can choose to penalize drivers who continue to occupy a charging space even after being fully charged

Site Type	Typical Dwell Times	Charging Hours
Residential	14 hours	10 pm. – 6 a.m.
Workplace	8-9 hours	9 am. – 2 p.m.
Retail	1-3 hours	11 am. – 8 p.m.

Some site owners have tried combinations of these approaches, such as charging a flat rate for the first two hours, then an increasing rate for longer sessions. Some workplaces configure their EVSE to be free to employees during the day while being open for paid public charging outside of business hours.

Planning for EV Chargers

Throughout the process of installing and operating EVs, owners should enlist the help of electricians and utilities to ensure sufficient electrical infrastructure. Consideration must be given to the site's existing electrical infrastructure, specifically:

The electrical box nearest the prospective location

- The capacity of the electrical box
- The capacity of the site's transformer infrastructure
- The size of electricity served to the site

Property Managers

The two most common approaches for installing EV chargers in multi-family communities is either when residents purchase with coordination from property managers/HOAs or when property owners/HOAs purchase as a community amenity. In either case, **the property manager may begin the vendor vetting and selection process with two basic questions:**

- How much power do you have to work with?
- How do you want to be reimbursed for energy use?

Charger Selection

It's common for EV owners to buy their own charging hardware. This reduces the upfront risk and cost to the property but also means the hardware leaves with the owner. That said, the goal of the property manager is to get homeowners set up in a way that's most convenient for them, unobstructive for other residents, and cost effective for the property. Many managers will compile a set of vetted options of EV chargers from which owners can choose.

Curating a list of OCPP-enabled smart chargers may enable you to satisfy resident EV needs without upgrading the electrical system or setting up submetering. All smart chargers have built in, utility-grade metering and are intelligent at saving power at peak times during the day while still charging vehicles in appropriate timeframes. For example, if a site has 700 amps to work with, the right equipment can automatically manage all charging sessions in real-time to never exceed that limit. OCPP compliance means that regardless of the charger vendor, the units can be centrally managed with a single system.

Since 2009 the Open Charge Alliance has promoted the benefits of the Open Charge Point Protocol (OCPP) in order to make Electric Vehicle (EV) networks open and accessible. **OCPP is an application protocol for communication between EV charging stations and a central management system, also known as a charging station network, similar to cell phones and cell phone networks."**

In reality, it's critical to control the charger infrastructure in multi-family scenarios with complex ownership considerations-- if, for example, unmanaged chargers of a few EV drivers pushed the site into a new demand rate, that price increase affects the whole community. OCPP-enabled chargers can be centrally managed with OpenADR 2.0 compliant charging networks to strike the appropriate balance between charging rate and peak usage in real-time.

"The OpenADR Alliance was created to standardize, automate, and simplify Demand Response (DR) and Distributed Energy Resources (DER) to enable utilities and aggregators to cost-effectively manage growing energy demand & decentralized energy production, and customers to control their energy future. OpenADR is an open, highly secure, and two-way information exchange model and Smart Grid standard"

Energy Reimbursement

The other important question to consider is how do you want to be reimbursed for your energy? Can energy bills be included with HOA or other resident fees, or would you need to process credit card transactions at the unit? The former is less expensive, while the latter may be more scalable and require less employee time.

Even if a property chooses to not charge for the energy doesn't mean they don't want cost visibility or to control energy dispensation. Further, it may be prudent to adjust strategy over time, so many properties are adopting smart chargers which provide the flexibility to make changes to the business model as needed while also ensuring that all costs are known to owner, manager, and resident stakeholders.

Fleet operators

Fleet operators

Fleet operators of all sizes have been increasingly investing in replacing internal combustion engine vehicles with EV for two key reasons:

- **Cheaper fuel** -- costing around half of gasoline equivalent vehicles
- **Cheaper maintenance** -- a few moving parts in an EV vs. hundreds in traditional

However, many fleet operators may not know where to begin once they've taken the plunge and ordered the first round of EVs, specifically concerning charging infrastructure and the ensuing process changes with employees. There's no one-size-fits-all and EVSE needs flow from how these fleet vehicles will be used:

- How many miles per day vehicles are driving?
- How quickly they need to recharge

Charger Selection

Since many fleets are shifting to EV in stages, it's important to consider high quality equipment that's capable of the appropriate business model today but also can evolve as the EV fleet grows.

Level 2 chargers are the typical choice in this use case as they have charge times appropriate for fleet scenarios as well as the potential for advanced networking features often utilized by fleet operators. Since these units will often be in high-use, high-stress, and open weather conditions, it's important to assess EVSE vendor equipment accordingly. Steel based units are only as good as their first scratch, then it may start to rust. Mixed material units may have moisture penetration problems due to different materials expanding at different rates per temperature. Look for all-composite, NEMA 4 enclosures which can withstand driving wind and rain. Further, look for rubberized connectors and at least 25-foot charger cord length for parking flexibility on the lot.

Networked or Non-networked

Most fleet customers want to collect charging data to see how much energy is going to each vehicle so they can track the energy costs to the business, and thus are drawn to networked options. The initial thought for networked chargers was to know when cars were charging; however, it turns out that it's more valuable to know when a car is NOT charging, as fleet vehicles need to be ready to go every single day. Automated alerts are possible with networked chargers. For example, if someone forgets to plug it in, an automated notification can be sent to the fleet supervisor to handle the issue before it becomes a problem the next morning when employees are needing to go.

In addition to tracking and reporting energy usage, networked chargers also enable management of energy usage. If part of the fleet plugs in during the middle of the day, chargers may be configured to dispense less power to keep peak usage from spilling over into a higher demand rate for the site. With EV, it's all about programming the network to optimize use and take advantage of time-of-use programs your utility has or just by controlling peak rate, so the business isn't forced into a new demand pricing category for one day out of the month of increased usage.

Ultimately, fleets aren't usually investing in basic chargers, opting instead for networked solutions, especially in scenarios with parking lots that may be accessible by the general public. Each networked charger can also require user authentication using a secondary device such as a key-fob so only authorized users can charge at designated times per day.

Workplace Charging

In recent years, many workplaces have begun investing in charging infrastructure for several reasons:

- Employee benefits - reduces range anxiety for existing EV owners as well as encourages employees who are considering purchasing an EV, particularly for those who have longer commutes or may be unable to charge at home.
- Employer benefits - promotes brand image and corporate sustainability goals while contributing to employee recruitment, retention, and productivity. Further, EVSE infrastructure enables an easier transition of any company vehicles to EV.

In addition to evaluating electrical details of the site, it's important in the planning stages of acquiring EVSE to set business goals as well as appoint leadership who will facilitate vendor selection, install, and ongoing management. Employee surveys are also very valuable in this stage, as it's important to properly estimate current and future demand.

A few other key considerations:

- Will this be a free amenity for employees?
- Usage policies concerning when and how long employees can charge
- Will the chargers be available to the general public? All or part of the day?

Charger selection

Evaluating charger levels and EVSE vendors will extend from goals set in the planning and survey phase. The right hardware will ensure that not only are short term goals met, but also be flexible enough to accommodate changes and growth over time.

Level 1 chargers are by far the cheapest options and can either come in the form of a grounded outlet that employees can use with their existing charger cord-set or as a proper mounted station. While Level 1 chargers may be a cheap way to get started with EVSE, the lack of control & reporting features and much slower charging lead the vast majority of workplaces to invest in Level 2 which has become by far the most common charger level in these settings.

Level 2 chargers can be configured as basic, authenticated, or networked. Basic chargers have no notion of access control or usage and may be appropriate for a small number of chargers in a protected parking environment while authenticated charging uses a secondary device such as a key fob to verify a user's identity before dispensing power. Networked level 2 chargers are the most flexible and scalable option as they can intelligently share power across concurrent charging sessions, handle reservations, collect payments, report usage data, manage driver alerts, and can be set up to be available for certain users at certain times of day.

DC fast chargers are usually not appropriate for workplace charging scenarios given their high per unit cost and electrical capacity considerations. However, workplaces with the goal of opening their charging stations to the public in addition to employees may be interested in this option as a means to drive destination charging for new customer acquisition. Alternatively, if the employer is moving to adopt EV for its company vehicles, having DC fast chargers on site can provide an invaluable backbone infrastructure to support that adoption.

Ultimately, many workplaces have adopted hybrid solutions that include majority Level 2 charging with policies in place for lingering post-charge, a small number of DC fast chargers, and a few Level 1 chargers that allow employees to stay in the same parking space for the duration of the workday.

The costs to operate an EV charger include the cost of electricity, possible demand charges, network fees, and maintenance. Of the former two, data from the Plug-in NC program found a roughly $12/mo energy cost per station with charging sessions every weekday (5-7kWh/session @ ~$0.10/kWh), while demand charges can be as high $25/new kWh.

Usage & Payment Policy

Since many employers are investing in networked chargers with intelligent power management, the latter cost may not become an issue while the former is usually small enough for most organizations to absorb for the benefit of their employees. However, while many workplaces have maintained a commitment to provide free charging as an employee perk, an increasing number of use fees as a means to optimize charger use, for example to charge a fee for lingering in the parking space once charging is complete. Further considerations are required if the units will be open for public charging, particularly with regards to liability concerns and restrictions on when public users can use the charging station.

Retail

Retailers have been increasingly investing in publicly accessible charging stations for several reasons:

- **Publicly available stations** attract new customers
- **Increased customer in-store dwell time** and spend per visit
- **Charging stations drive revenue** from charges and in some cases advertising
- **Enhanced brand image** and corporate social responsibility

For retailers, it's especially important to involve the utility early in the process as the utility can not only help them plan for the future infrastructure but also inform the company of any local, state, or federal incentives. In addition to electrical considerations, it's important in planning stages of acquiring EVSE to set business goals as well as appoint leadership who will facilitate vendor selection, install, and ongoing management.

Charger Selection

With very lengthy charge times, Level 1 chargers are typically a non-starter. The decision is typically between Level 2 and DC fast chargers. Moreover, **networked chargers are essentially a necessity in this use case**, as public driver behavior can be unpredictable, and bad behavior such as long linger times must be dis-incentivized with fees that can only be assessed in the context of smart chargers controlled by a central network. They provide the advanced flexibility required to adjust business models and fee structures as well as intelligently manage dispensing power based on the site's electrical capacity and time-of-use rates throughout the day.

For destination locations looking to stand out to prospective customers, DC fast chargers are an attractive amenity that can win new customers as well as retain existing customers. While expensive, these can be a great option for locations with typically shorter dwell times, such as highway stops and fast food establishments.

Business and Revenue Model

There are three typical pricing structures used by retailers:

- **Profit center** and source of revenue
- **Cost recovery** on unit, installation and energy cost
- **No fee**

While the no fee scenario may still be profitable due to increased customer spend, retailers investing in public EVSE can use fee structures to create a balance between dwell times and customer turnover. Estimates performed by Atlas Public Policy found that the average value a charging station delivered to a retail business for scenarios with a 25 to 50-minute dwell time was over 5 times greater than scenarios with 50 to 75 minutes of dwell time. Businesses with different ticket sizes will likely find different optimal fee parameters to maximize in-store spend. **Fortunately, with networked chargers, tuning these values over time can be done remotely at scale across the EVSE infrastructure.**

Additionally, several retailers are beginning to explore the creative use of in-store product discount rebates for charging sessions to promote in-store foot traffic and increased overall spend per visit, especially in gas stations, highway stops and other short dwell time scenarios where DC Fast chargers are part of the EVSE portfolio.

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