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Workplace Charging: Helping Employees Drive Clean Cars

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Summary

Workplace charging is a key to widespread electric vehicle adoption and part of a market pull strategy aimed at attracting new plug-in drivers. Drive Oregon has worked with employers throughout the Pacific Northwest to encourage the support of employee charging and while many organizations develop unique approaches, best practices are emerging that can expedite future projects.

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1. Introduction

The market for plug-in electric vehicles is strong and continues to grow. In the United States, national PEV sales have held steady at nearly 125,000 plug-ins sold annually for the past two years. The public has been mostly receptive, with plug-in vehicle adoption increasing at a faster rate today than the traditional hybrids that were introduced more than a decade ago. Automobile companies are responding, and new plug-in vehicles are being planned to complement the already wide selection of brand and model options available to those in the market for an electric vehicle. As public charging infrastructure develops and new car models are released, more drivers are moving from reliance on fossil fuels to charging at home, at work, and on the go.

Oregon, along with seven other states, recently announced an initiative to put 3.3 million zero-emission vehicles on the road within 12 years. "This initiative fulfills so many of Oregon's goals and will spur the kind of innovation that supports a healthy and vibrant economy," said Governor Kitzhaber in a press release.

Installing an electric vehicle charging station reflects an organizations and communities' commitment to sustainability while also reflecting an internal value for clean zero-emission transportation. With some of the highest per-capita charging infrastructure availability in the nation, and the home of the West Coast Electric Highway, Oregon is determined to support the transition to PEVs.

The transition to electric vehicles requires a multi-faceted effort to transition everyday drivers to becoming accustomed to plugging in their cars rather than driving to a gas-station. As we move close to the goal of an early majority of electric vehicle drivers, the challenge remains of how to accommodate drivers with difficult commutes, inadequate parking at home, and varying schedules and drive times. Workplace charging, supported by public charging, improves the viability of electric vehicles by re-charging their vehicle where drivers spend a significant amount of time, their place of employment.

1.1 Workplace Charging is Important

As e-mobility expands, and automakers throughout the world increase the availability of plug-in vehicle models, the corresponding demand for charging infrastructure to fuel these vehicles also grows. Most electric vehicle owners are able to recharge their vehicles overnight and according to research done for the EV

Project, about 80 percent of charging by EV owners is done at home [1], as referenced as Fig.1. With the electric vehicle market still nascent, there are many private homes that have the ability to support the addition of an electric vehicle charger if the owners need.

Figure 1: Where Charging Occurs

In addition to home charging, plug-in drivers also have the growing network of publicly available charging stations available for "opportunity charging". These stations fill charging demand by extending the range of a battery electric vehicle for inter-city and long range trips. Visible public EV charging also reduce consumers "range anxiety" and can lead users to drive their cars more utilizing a higher percentage of the battery range of their vehicles. Research completed as part of the federally funded multi-state electric vehicle supply equipment (EVSE) implementation effort, "The EV Project", has also shown that the percentage of EV owners charging their vehicle outside of home grows as more publicly accessible charging becomes available [2].

Despite the growing availability of of publicly availability charging there is a greater need for workplace charging opportunities. The second-most likely place a vehicle, outside of the home, will spend time parked is at or in an employers parking lot. By adding the ability to charge at work a driver can potentially double their vehicles all-electric daily driving range. This additional range can then lead to more electric vehicle miles travelled and increase the overall usability of the plug-in vehicle.

Employers are also showing that they are willing to fulfill a larger role in their employees commute options. Depending on the state, or regional government, and other circumstances with the employers this may be required. For employers in Portland Oregon with more than 100 employees, Oregon Administration Rules require that these employers must provide incentives for employee use of commute options like taking the bus, carpooling, or workplace charging [3].

1.1.1 Workplace Charging Increases Plug-in Deployment

According to the U.S. Department of Energy, employees of organizations who provide and support workplace charging programs are 20x more likely to drive a PEV than the average worker [4]. This relationship between sales and charging availability is no coincidence. As drivers consider the long-term viability of plug-in vehicles, having permanent charging stations available to access at the workplace supports the narrative that the transition from internal combustion engines to plug-in vehicles is happening in real-time.

While working at an organization who supports electric vehicle charging, drivers are also subject to the "rolling electric vehicle showcase" of their colleagues' vehicles. The peer pressure to drive a more sustainable vehicle is amplified by seeing co-workers who have chosen one of the many plug-in vehicles on the market. Employee drivers act on this influence in a variety of ways including talking with their co-worker about their vehicle choice and the benefits and challenges of life with an electric vehicle. Regardless of whether there is a *need* for the employees to charge an electric vehicle during the workday, the flexibility to extend the range of their vehicle, and become less reliant on home and public charging, provides additional range confidence and mentally reinforces that adequate charging is available for every circumstance.

1.2 The Need for More Workplace Charging

There is an urgent need to accelerate adoption of plug-in vehicles within the United States and many states such as Oregon, Washington, and California have state goals with a pre-determined number of vehicles sales

needed based on new vehicle registrations. These goals depend on adoption numbers well beyond the early adopter market where cars such as the Nissan Leaf, Tesla Model S, and Chevrolet Volt have had success.

With an understanding that the majority of electric vehicle charging occurs at overnight and at home, a large number of commuters rent, and a growing number of individuals live in apartments, and condominiums. These "garage orphans" are often unable to charge at home and must rely on public charging exclusively in order to use their vehicles. For consumers considering the purchase of an electric vehicle this may immediately put a plug-in car out of consideration. If this same consumer had reliable access to charging infrastructure at their place of employment however, the car can again become an option for daily commutes.

An additional implementation challenge is the income and housing demographics of the driver market that will need to be accessed in order to reach wide-scale zero-emission vehicle adoption. Low-income communities arguably have the most to benefit from cost-of-ownership savings, and the low prices of electricity compared to gasoline. As more low-income families live in multi-unit housing than do single family homes, the ability to charge a vehicle at home is constrained. If workplace charging opportunities became ubiquitous for all levels of employment than this constraint can be diminished and low cost new and used electric vehicles could be considered by more individuals regardless of their choice in residence.

1.3 Building Value for Workplace Charging

A significant number of Pacific Northwest organizations have chosen to support electric vehicles and the interests of their more than 25,000 employees because they see value in providing employee charging programs. Workplace charging sets in motion a way to demonstrate leadership, attract and retain top talent, and even improve employee satisfaction. Programs such as the City of Portland's Sustainability at Work certification, or points gained through a Leadership in Energy & Environmental Design (LEED) certification may also contribute towards recognizing this positive impact on the environment and community. Other state and local programs can play a role as well.

And its simple. There are a wide variety of charging products to choose from and model policies from like-minded organizations to look at. Developing a program that fits the culture of an organizations workforce is entirely customizable to fit within all scales of budgets and organization goals. The U.S. Department of Energy, organizations like Drive Oregon, and many electric utilities are also happy to help guide the conversation.

The importance of workplace charging is also continuing to grow. Parking and charging is uniquely challenging if you choose to live within the urban center of any major city. So called "garage orphans" live in apartments, condominiums, or neighborhoods within the city where installing a charging station might not be immediately feasible. When there is access to charging at a place of employment, complemented with publicly available charging, an electric car becomes a viable option.

Installing a workplace charging station indicates to the public that an organization has shown a commitment toward sustainability and supports their employee's choice to drive a clean electric vehicle. Similar to the ubiquity of bike racks in Portland which attract and serve the many bike commuters, workplace charging stations provide a simple way to communicate to customers, the public, and competitors that an organization is ready for the next wave of plug-in drivers today.

Understanding how other transportation modes are incentivized regionally helps provide a route for building a successful workplace charging program. As with all modes, there is not one answer to supporting an organizations transportation needs. Finding where systems are successful can lead to defining and including addition value for workplace charging projects.

1.4 U.S. Department of Energy Workplace Charging Challenge

As part of the US Department of Energy EV Everywhere Grand Challenge, the Workplace Charging Challenge aims to achieve a tenfold increase in the number of U.S. employers offering workplace charging by 2018. Drive Oregon, an Ambassador for the program, has recruited 35 regional employers to pledge that they will support workplace charging. In addition to connecting employers to resources and providing project support, Drive Oregon hosts an annual award ceremony where new workplace charging partners are recognized by a Department of Energy representative.

This federal program provides no incentives to employee organizations and operates with an emphasis on information sharing and guidance on policy and communication. According to the USDOE, Challenge partners have saved a combined 1.7 million gallons of gasoline and 17 million pounds of greenhouse gas emissions each year and 70% of Challenge partners have received third party positive recognition for their workplace charging [5]

2. Case Studies

There are many similar attributes that may contribute to a successful workplace charging partner. Each of the partners below had their own organizational justification for providing access to workplace charging for their employees. Their respective programs serve widely different audiences, have different relationships to the companies' core business, and offer a look at how todays employers are serving an important role by providing electric vehicle charging infrastructure for their work force.

2.1 Portland International Airport

The Portland International Airport recently installed 42 level-1 PowerPost EV charging stations – the largest electric vehicle charging installation at an airport anywhere in the United States [6]. The decision made to install level-1 infrastructure as opposed to level-2 was based on both cost and necessity. Twice as many chargers were able to be budgeted for the project due to power requirement and equipment costs when compared to similar level-2 chargers. The Port of Portland also rationalized that the long dwell time seen by the employees parked gave ample time for replenishing batteries for the commute home. Due to the limited amperage of the charging, monthly power costs are expected to remain low and consequently there is no employee fee to use the chargers.

2.2 Hewlett-Packard Company

Hewlett-Packard has implemented a workplace charging program for its Corvallis Oregon headquarters with policies that extend globally. With more than 700 registered EV drivers in the US, supporting EV charging has been important for employee relations and commitments to sustainability. Charging is available to HP employees and contingent workers with level-1, level-2, and DC fast chargers used throughout the HP network. Level-2 charging deployed is by far the most prevalent and time plugged into a charger is limited at 4 hours with a penalty fee enforced after 4 hours. Charging equipment, network service, and management are provided by ChargePoint.

2.3 JLA Public Involvement

JLA Public Involvement is Portland Oregon based firm that initiated their workplace charging program through the purchase of a level-2 charger that would also support an employee share-use electric vehicle. JLA realized that by integrating workplace charging and electric vehicles into their organizations image that they could create value for their customers and investors. Subsequent to their installing the charger, the organization was able to achieve a Gold certification in the City of Portland Sustainability at Work program. With one shared plug-in vehicle, and employees encouraged to make use of the free charger with their own vehicles, JLA boasts a 20% adoption rate for plug-ins among its 15 workers.

2.4 SolarWorld

Representing the largest solar manufacturer in the United States, SolarWorld's Hillsboro Oregon facility utilizes several level-2 chargers in addition to a CHAdeMO equipped DC fast charger. For SolarWorld the decision to support electric vehicle charging was simple with customers, and often employees, holding a mutual interest in sustainability and the environment. By encouraging employees and customers to drive on electricity SolarWorld is positioned to increase the awareness for their product, photovoltaic solar modules, and the synergy of electric vehicles and distributed solar. SolarWorld's chargers are free to use by the public and employees.

3. Project Costs & Considerations

The cost of a project is a factor of the level and quantity of chargers that are being installed, in addition to site conditions including the electrical supply. Siting a charging location can be one of the the most important factors of a project. Generally, the closer to the electrical service panel. where power will be obtained, the lower the cost to extend wiring and conduit. With higher rates of charging, higher equipment and wiring costs typically follow.

3.1 Levels of Charging

Battery electric vehicles are a great option for urban commuters and the many drivers who drive a pre-defined number of miles daily. Having access to charging becomes a salient objective soon after the transition to driving a plug-in. Where charging is accessed and the rate of charge become important items to quantify for new drivers. For a number of drivers charging their vehicle overnight via an extension cord is enough to reliably provide enough battery charge for their vehicle. For others, level-2 charging at home complemented by opportunity charging at the workplace and with public infrastructure is what is relied upon.

3.1.1 Level-1 Charging

The slowest rate of charging offered, the majority of level-1 EVSE are non-networked and limited in product features. These chargers are less expensive than level-2 chargers and are particularly well suited for situations where a long dwell time is expected for the plug-in vehicle. In addition to level-1 EVSE, commercial 120v/15a wall outlets may be provided as an option for employees to use with their own equipment until adequate EVSE are provided. Costs range between $99-$1500 USD.

3.1.2 Level-2 Charging

The most ubiquitous level of charging, level-2 EVSE provide workplace and home charging users adequate charging times without large project, or electricity costs. These chargers are offered in a wide variety of feature-sets and an easy way of differentiating between many of the models is if they are network enabled or not. Certain level-2 EVSE provide extensive feature options that allow for usage tracking, payment, utility interaction, and other functions that can be highly useful to the site host. Where cost and affordability are the primary goal, a non-networked level-2 EVSE can provide adequate charging in a variety of situations. A networked full featured level-2 EVSE, however may also provide data and other inputs that a site host prefers. Costs range between $300-$7000 USD.

3.1.3 DC Fast Charging (DCFC)

Direct current fast charging excels at extending the driving range for inter city and long distance trips. These chargers rely on one or several of the leading DCFC charging formats (SAE DC Combo, CHAdeMO, or Tesla Supercharger) and are not interchangeable devices. These chargers have specific high power requirements that can be a challenge for project siting leading to larger costs associated with electric supply panel and distribution upgrades. Due to the high costs associated with installing and maintaining a DCFC EVSE the majority of workplace charging are better suited considering either level-1 or level-2 chargers and making use of the long dwell time of their employees' vehicles. Costs range between $10,000-$75,000 USD.

3.2 Charging for Charging

When planning to add or site new charging stations and develop a workplace charging program, organizations need to decide if and how they will manage the cost to provide the electric vehicle charging infrastructure, and electricity to their employees. There are many options to choose from and a site host can determine the role they would like to play administering the charging program. The level of charging and demand for electricity and the industries culture may be a factor in this decision.

3.2.1 Free Charging

Providing access to an EVSE and the electricity that is delivered at zero cost is likely the easiest way to deliver workplace charging quickly to employees. Site hosts may select basic level-1 or level-2 charging technologies that do not have the functionality to operate within a larger network of chargers while still serving their primary function as electricity dispensers. These chargers are typically less expensive than more featured enabled EVSE models. In instances where there is high usage, or other parking management challenges, the charger is not able provide options to encourage alternative behavior. Operations and maintenance costs are also unable to recouped.

3.2.2 Site-host Managed

Employers can elect to actively manage their charging stations and the employees who choose to park and utilize them. Employer organizations can determine the cost needed to recoup and maintain ongoing use and investment in the electric vehicle charging for their business and pass this cost either in full or at a subsidized level to their employees. These employees may have a monthly cost associated with charger use where access is gained either through key code, the honor system, or other means. This form of management is time intensive but does offer a direct model to pay for electricity, and contribute toward future electric vehicle charging investment. All revenue for charging is returned to the employer.

3.2.3 Contractor Managed

Contractor managed charging solutions are growing in popularity, particularly with enterprise level employers. These networked enabled charging solutions allow for a multitude of customization and data gathering options and allow for variable costs, custom communications, and many other features. These charging systems typically require a monthly agreement that includes access to online data and live support as needed. Revenue sharing will also need to be negotiated with the charging provider as based on how fees are collected by the driver. Costs may be session based, kWh based, or subscription based depending on the model preferred by the host. Any combination of how to monetize the charging station may also be employed.

3.3 Other Revenue Programs

Emerging revenue generating programs are forecasted to play an increasingly important role in the business model for electric vehicle charging. In 2007 California adopted the low-carbon fuel standard (LCFS) rule to reduce the carbon intensity in transportation fuels such as gasoline. States, such as Oregon, have recently adopted similar LCFS legislation and are currently designing a form of system to to purchase, sell, and manage credits generated by the production of alternative fuels, including electricity for EVs. These credits will ultimately have a monetary value for site hosts and aggregators who enroll in the program.

A voluntary carbon market accreditation may also provide an additional means of value for charging stations, particularly for national workplace charging employers and network providers. Similar to other carbon trading market, a voluntary carbon market credit would assign a value to a charging station based on the carbon reduction associated with the gasoline or diesel emissions abated. This value and how it is determined is being looked at by charging and automotive stakeholders and may be a viable option to pursue in the near-term.

Conclusion

In planning for the mass adoption of electric vehicles, and in some locales the complete transition away from internal combustion autos, stakeholders need to have a clear vision where the cars will have access to charging. A combination of programs is needed to support the charging needs of todays electric vehicle drivers in addition to the anticipated significant number of new drivers expected to arrive in the next ten years.

Workplace charging is a simple way to improve employee retention, recruitment, and has been shown to align well with many institutional sustainability goals. There is also an opportunity for employers to demonstrate leadership by acknowledging that transportation needs are changing and that the employers' role

in transportation is likewise evolving. Other pieces of value can be attributed to providing charging options for employees and should be sought out at the local, regional, and national level.

Electric vehicle drivers need access to a variety of charging option, and locations, in order to feel comfortable replacing their legacy internal combustion cars. As the market for plug-ins grows, the significance of "garage orphan" PEV ownership will also grow in significance and a multi-faceted response is warranted. Growing the number of organizations that add workplace charging programs not only supports the existing drivers who drive plug-ins, it promotes the adoption of electric vehicles and builds upon a network of chargers that continue to build the case that plug-in vehicles are a viable alternative to legacy internal combustion cars.

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