

Research Report – UCD-ITS-RR-12-42

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ABSTRACT

Plug-in electric vehicles (PEVs) engage drivers in an essential new behavior—plugging the car into the electrical grid to charge the vehicles' batteries. Broadly, it has been assumed that if away-from-home charging infrastructure is in place and PEV drivers know of it, they will perceive an opportunity to charge. The experiences of early PEV drivers cause us to rethink this assumption. Drivers report a lack of etiquette, i.e., rules to guide their behavior and their expectations of how other PEV drivers ought to behave in the new social interactions. PEV drivers want widely shared, understood, and practiced charging guidelines in order to feel comfortable and confident in charging away-from-home. This study uses thematic analysis of transcripts, amended by field notes, of interviews of 28 PEV driving households in San Diego County, California. Themes emerged within two types of away from home charging. First, public chargers available to any PEV driver were the sites of multiple situations in which drivers' perceived a lack of rules or perceived conflicts between different systems of rules; both inhibited charger use. Second, workplace charging adds an additional layer of rules and possibly resources that may either inhibit or encourage PEV charging. If PEV markets and charger networks continue to grow, charging will be shaped by more systems of rules and regulations, e.g., those governing financial transactions. Our results suggest that new rules may create as much uncertainty as guidance.

INTRODUCTION

The market prospects and social goods of plug-in electric vehicles (PEVs) have been the subject of much recent research (1-7). PEVs' costs and benefits to their drivers and society hinge largely on the fact PEVs engage drivers in an essential new behavior—plugging the car into the electrical grid to charge the vehicles' batteries. (8-11) examined the effects of households' control of electrical infrastructure and parking to facilitate home-based vehicle charging. Guidelines are being promulgated for investments to increase away-from-home charging opportunities for PEV drivers (12, 13). What these analyses and guidelines share is the assumption that if charging is technically available, PEV drivers will perceive an opportunity to charge. However, beyond simply bringing a driver and PEV into the proximity of appropriate electrical infrastructure and beyond even information systems that identify such infrastructure to PEV drivers, charging a PEV brings the driver and the providers of the electrical service into new social interactions, activity locales, and possibly financial transactions.

Here, we report on the role of systems of rules—or as we will show is most often the case, a perceived lack of rules—on present-day PEV drivers' charging behaviors and aspirations for charging. Referring to possible charging behaviors in instances of public or other shared use of charging infrastructure, “As with a lot of things related to electric cars, the etiquette of this will need to be worked out,” (14). While we presently draw no conclusion whether the perceived lack of rules is suppressing PEV sales, we do observe that presently the overall effect of a perceived lack of rules is to suppress PEV charging and thus to diminish the private and social benefits of PEVs. The results indicate that any expectation of a broad transition to PEVs should be informed by drivers', charging service providers' and policymakers' understanding of the often unstated rules that guide everyday life.

Etiquette, Norms, and Morals

Etiquette is a set of rules that defines correct and acceptable behavior within specific social interactions. In addition to differing by interaction, systems of etiquette differ across societies, cultures, and groups. Thus a person may move daily from one setting of social interaction to another—while having expectations of other people and being expected by other people in each of those settings to know and behave according to the rules of that setting, e.g., forms of greeting, means and timing of exchange, order of speaking or acting, etc.

Gert (15) argues that while etiquette and morals are often conflated, a useful distinction can be made: “Etiquette is sometimes included as a part of morality, but it applies to norms that are considered less serious....” The less-to-more serious distinction describes one dimension of systems of rules. Cialdini et al (16) state another: norms may be either descriptive, i.e., describing what *is* done in a particular setting, or injunctive, i.e., describing what *ought to be* done. Both these distinctions will prove useful as we anticipate transitions from an early period of PEV market and charging infrastructure development in which the less formal rules of etiquette may be supplemented or supplanted by more formal rules governing financial transactions and parking. That is, what we will largely describe as the problems of perceived lack of vehicle charging etiquette can not be dismissed solely because we have an expectation that some day there may be many public and workplace charging possibilities whose access and use

are controlled by market mechanisms, motor vehicle regulations, city codes, or other “more serious” rules. The point remains, PEV charging behavior—and thus PEV driving and the concomitant flow of private and social goods—will depend in part on social rules as much as infrastructure deployment.

Caperello and Kurani (17) reported that drivers who were provided a plug-in hybrid electric vehicle (PHEV) for a four to six week period perceived a lack of charging etiquette, thus “many were unsure whether asking to plug-in would be seen as rude or presumptive.” Some of those PHEV drivers reported not asking to charge at friends’ and family’s homes. One chose not to raise the issue with her employer—whose reserved parking space was next to the only electrical outlet available in the parking lot—since she knew she’d only be driving the PHEV for a few weeks. A few said that if they owned a PHEV, they would request an outlet be installed at their work location and/or around their community. In short, a lack of charging etiquette and an unwillingness to transgress competing rules of behavior appeared to have had a generally inhibiting effect on charging in the context of a weeks-long demonstration.

The present sample of PEV drivers differs from the PHEV demonstration drivers in that 1) the present PEV drivers have purchased or leased their vehicles, 2) have been driving and charging their PEVs much longer than the demonstration drivers drove and charged a PHEV, 3) expect to own (or lease) their PEV for years, and 4) are buying (or leasing), driving, and charging their PEVs within a policy and market context in which they expect away from home charging opportunities to be present and increasing over time. Under these conditions, does a lack of etiquette still appear to inhibit charging? What other social rules are shaping and will shape PEV charging behavior?

The Setting

Observations of the role of informal and formal rules to guide PEV charging behavior are drawn from interviews of owners and lessees of PEVs in San Diego County, CA. Sales and leases of PEVs in the study area began in late 2010. Twenty-eight interviews conducted with households in March and April 2012 who own or lease a PEV. Most of these were Nissan Leafs; a few were Chevrolet Volts. The EV Project is deploying PEV recharging infrastructure in eighteen cities in the US; San Diego is one of these cities. In addition to public and other charging installations, the Project provides qualified PEV customers a free 220/240V (Level 2) home charging appliance. In exchange for vehicle and charge data, the qualifying households are offered a wall mount charger and in some cities, up to a \$1200 credit toward installation. The households were also required to buy as a vehicle option the port for 440V quick charging. The vast majority of our sample is participating in this charger program. The manufacturers of both the EV and PHEV provide 110V (Level 1) convenience chargers.

PEV drivers perceptions of the growing number of chargers

As became clear in our interviews, it is not widely known among these households how they might find all away-from-home recharging opportunities. Which is to say, irrespective of the technically correct count of public charging locations and chargers, almost none of these PEV drivers perceive all these opportunities or even how they might find them. The public charging opportunities consist of publicly available Level 2 chargers, privately available Level 2 chargers

to which a given driver may not have access, and the vast number of ambiguously available 110V outlets (Level 1) in parking lots, parking garages, and other buildings from which they might charge with their convenience chargers. In addition to the ambiguity caused by issues of permission or physical access to a charger, the San Diego PEV drivers display widely varying knowledge of, or even interest in, finding away-from-home charging opportunities. Some drivers only use the in-vehicle system; this was critiqued by other PEV drivers as incomplete, slow to be updated with new charger locations, and lacking up-to-the-minute information on the chargers' on-line status, e.g., is the charger in service at the time of the query, is another vehicle plugged in, and if so is that vehicle actually charging? Other drivers used one or more smartphone app. These apps might include only the chargers installed by a particular vendor or they might attempt to be comprehensive. Few households accessed charger location information from their home computer.

METHODS

Participant Sampling

We spoke with PEV drivers in San Diego County, California. The PEV owner and lessee population from which we sampled was those households who had received a free charger through The EV Project as of early 2012. This population had to own their home and have a suitable parking and charging location for their PEV on their premises. This population of PEV drivers in San Diego was sampled as part of a project to study PEV drivers throughout California in early 2012. The survey yielded 1,201 respondents statewide; 336 were from San Diego County. It is from this 336 that the respondents for this interview study were drawn. The PEV owners and lessees, whether from California generally or San Diego specifically, had on average higher income, age, and education levels than the general San Diego population. Previous research identified similar socio-demographic differences between samples of general populations and new-vehicle buying households (Axsen and Kurani, 2009 (same as previous Axsen and Kurani 2009)).

The goal of the interview sampling was to cover the range of several household and driver attributes. Households for the interviews were selected based on household income, gender of the primary PEV driver, age of the survey respondent, households made up of employed or retired households, and whether the home had a solar photovoltaic systems or not. While sampling across the available range of income and socio-economic measures may seem obvious choices to stratify the interview sample, the solar/no-solar one may be surprising. We thought it desirable as approximately one-third of households buying or leasing a PEV in the study had a home solar photovoltaic installation.

Interview Protocol and Analysis

Interviews were conducted in March and April, 2012. The interviews were conducted by four researchers; two for each interview. Most interviews were conducted at the participant's home and consisted of the primary driver of the PEV. Every attempt was made to include spouses and partners, especially if they drive the PEV, too. Interviews lasted between one and two hours. The discussion was guided by a list of specific topic areas: purchasing the PEV, charging, information sources including the vehicles' instrumentation, and their sense of a community

forming around PEVs. Questions were open ended and participants were encouraged to discuss items they found important to further allow the research team to understand each driver's experiences. Interviews were audio recorded and supplemented by field notes and observations made during the interviews.

The interview team conducted meetings every few days while conducting interviews to discuss preliminary themes that were arising to determine if additional questions should be added or emphasized in future interviews. Upon completion of the interviews, each researcher reviewed the audio recordings and compiled a review of households in which they had been an interviewer. These reviews included the major themes discussed in the interview and specifics of each person's experience with their PEV. These household reviews were then compared against each other to locate themes across households representing common experiences, ideas, and valuations across interviews (18). To identify themes in the data, the researcher conducted a three-step coding process that included (a) open coding on the first reading to locate themes and assign initial codes, (b) axial coding to review and examine initial codes, and (c) selective coding to look for examples to illustrate themes (19).

RESULTS

PEV Drivers Encounter Situations with Unknown or Unclear Etiquette

Several experiences these PEV drivers faced highlight when and where they perceived a lack of expectations or rules to guide their behavior and the behavior of others. These experiences are categorized and discussed below: drivers attempting to create charging etiquette between users of public charging, drivers frustration regarding a lack of rules—or possibly, conflicting rules—between PEV drivers operating within different business models, navigating workplace charging, and drivers discontent with employees using public chargers that are presumed to be for customers. These PEV drivers had a variety of experiences with charging and parking at work and other public locations. Some experiences contribute to the creation and spread of systems of etiquette; others highlight a need for etiquette to resolve ambiguities that tend to suppress charging. We take “away-from-home” charging as the general category that contains public charging, workplace charging, and other charging possibilities that don't neatly fit either of these two categories. We take public charging to be those charging opportunities offered to any PEV driver—whether the parking and charging location is on public or private property or along a public road, i.e., curbside parking and charging. Workplace charging is distinguished by its restriction by a private property owner to employees, partners, and others whose employment is at that property. Other categories include the homes of friends and family where a PEV owner might charge, uncontrolled Level 1 charging, and other places that are outside the direct control of the PEV driver and her business or employer. The categories may seem self explanatory, but as our respondents reveal, confusion if not actual conflict arises precisely because the categories themselves can be unclear. Personal names referring to participants are pseudonyms.

Public Charging

Access to, use of, and importance of public charging to their daily travel varied among the PEV drivers. Some only charged at home. Some had made one or two outings or field trips during their months of PEV ownership to locations with public charging just to see, and if possible,

experience using it. Some made more frequent, but still occasional use of public charging. And some charged whenever and wherever possible. Almost every initial encounter with a public charger was described to us in terms of uncertainty about the guidelines and rules for using the chargers. Even pulling up to an available charger at an empty parking space can raise the question, “How long am I allowed to park and charge here?” An occupied charger prompts questions too, “How long will they be there? Is that car fully-charged? If it is, can I un-plug it to plug mine in?”

Do You Mind if I Plug-in My Car? Sunshine had experience charging her PEV around town, however, one time she found herself nearly out of charge, far from home, and with no idea where the nearest charger was. “I left my mother’s house and...[the car] says 5 [miles] and I just went, ‘Uh-oh!’ And she lives in the middle of nowhere...I’m thinking, what am I going to do. Well I have 24-hour road assistance, this could be it. Then [another] Leaf went the other way...I followed them to their house and begged them to use a little charge and they were great.” Her husband chimed in, “You gave them \$5.” To which Sunshine added, “I did, I did. I was so happy.” This was the only occasion someone told us about paying a stranger who was another PEV driver to charge and while there Sunshine knew no etiquette to dictate if or what she should pay, she offered \$5 which the other PEV owner readily accepted for a 20 minute charge.

Attempting to Create Charging Etiquette Floyd and Sunshine also expressed the frustration of many participants regarding the lack of etiquette for public charging. They weren’t sure when they could unplug another PEV so they could charge theirs or how to contact another PEV driver whose vehicle was parked at a charger if needed. They thought they had found answers to many of their questions at meetings organized by local PEV drivers. These meetings give PEV drivers an opportunity to discuss issues and tell stories. Floyd and Sunshine were introduced to a method of between-driver communication that had been developed by PEV drivers in the 1990s. A small paper card titled “Electric Vehicle Courtesy Charging Protocol” has these instructions for drivers of other PEVs, “If you are in need of a charge you may unplug my electric vehicle after it reaches the time indicated below. Please reconnect the charger if you return before I do.” It also had a line for contact information so anyone could call the driver of the already plugged-in PEV if needed. At the bottom was a list of times and instructions on how to read it. The PEV driver would place a paperclip on a time slot. This was an indication to other PEV drivers that they wished to be charged until the indicated time in order to complete their desired charge. The directions read, “Please do not unplug before the time indicated by paper clip.” There was also an “Unplug at any time” option. Floyd and Sunshine were thrilled to learn this etiquette and acquire the tool to implement it. However, they were the only interviewees to mention this card; it does not appear at present to be a widespread practice among these PEV drivers.

A Lack of, or just Different, Rules between Different Business Models Our interviewees are participating in one business model—private ownership (or leasing) by individual users of a PEV. An alternative business model, car-sharing of PEVs, is also happening in San Diego. Every one of our interviewees who mentioned car sharing in San Diego voiced frustration. Julie explained the shared-car PEVs were being parked and charged in spots she perceived to be “public” charging spots. She specifically complained that this happened at a charger she wants to use and that it inhibits her use of it. In frustration, she wrote to the president of the car-share company, “You are a business. You need to be able to support your business. You need to buy chargers... To make it so no one else can use [public] chargers because your cars are parked

there 24/7—it's not okay.” Phil also lamented, “It seems like those [shared cars] are taking all of the spots recently...they are always there...hogging the L2 chargers.”

Public chargers are limited in number and location but were free to use at the time of the interviews. Household PEV drivers were irritated because car-sharing users were monopolizing what the households perceived to be a public resource. Not only did this violate the household's expectations that the business should pay its own way, it compounds the problems the household PEV drivers already have. As Floyd and Sunshine told us, household PEV drivers are already struggling with the rules and means for contacting each other—that problem is only exacerbated when the PEV driver is unknown because they may be the next driver of the shared car, i.e., not the person who parked the shared car. The households believe that company should have their own chargers to support their business and should not rely solely on public chargers. Our interview subjects—none of whom have rented one of the shared-car PEVs—perceive public chargers to be used as an occasional charging solution. The majority of these PEV drivers does all or most of their PEV charging at home and use public charging occasionally. They expect the car-sharing company to do the same—the majority of charging of the shared-car PEVs should be done at company owned chargers. Any individual renter of shared-PEV would use public charging when they needed additional range.

Workplace Charging

None of the PEV drivers we interviewed were dependent on workplace charging; most were not able to charge at work at all. The few drivers who had access to Level 1 or 2 charging at their workplaces inform this discussion. Our informants bought or leased their PEV thinking workplace charging would not be an option and were comfortable commuting roundtrip without charging during the workday. But, these few who could took advantage of the free (to them) electricity at their workplace to charge their PEVs whenever possible, typically daily.

The importance of workplace charging is apparent in two ways. First, intentionally or incidentally the company may provide additional resources to facilitate the social relations to manage PEV charging. Second, the ability to charge at work shifts the time and place of other charging, thus affecting what other charging interactions drivers may have.

PEV Drivers Create Rules and Etiquette to Manage Charging at Work The workplace introduces additional sets of etiquette, norms, and rules defined by the company—the building(s), the management structure, the areas of expertise represented within the company, whether people have assigned parking spots, and so on. Because a few of our interviewees work for the same company, we heard how these PEV drivers used existing tools within the company to self-organize PEV charging etiquette as part of creating and managing PEV charging at their workplace. The company is housed in multiple office buildings with multiple parking facilities co-located within a single “campus.” Our respondents who work there estimate there may be as many as 30 drivers of a variety of makes and models of PEVs at the company. A few of these are driving older PEVs, including some self-built PEV-conversions.

The buyers and lessees we interviewed who had acquired their new OEM-PEVs starting in late 2010 did not anticipate being able to charge at work, in part because they did not expect the company would install chargers. As Phil said, “I thought I'd mostly do it at home, I didn't even

know there would be the level of infrastructure they put in at work, it's nice but it's a perk..." The company attempted to manage expectations and discourage PEV drivers from assuming they could rely on regularly recharging at work. Phil continued, "...that comes through on all the emails, don't buy your [PEV] planning to charge at work, it's a plus." The PEV drivers created a system of rules for charging. The primary rule seems to be "first come, first serve," but this is subject to several conditions. They have created rules and processes to handle exceptions, e.g., someone needs to charge to get somewhere else during the day. In these instances, the person wanting to charge their car sends an email to a listserv of PEV drivers to see if someone who is parked at or connected to a Level 1 outlet or Level 2 charger can make it available. These requests are generally granted. Phil explained, "It is first come first serve...I'm usually one of the last ones into the office so I don't get to charge all that often...There are times when I need to charge and I'll speak up and people will say you can have it." Phil also explained how the PEV drivers have developed a Wiki—a Web site that allows anyone to revise content using only a web browser—to communicate with each other, "There's how to deal with charging, the etiquette...it's a Wiki so anyone can edit it...generally it [has] questions about when spots are available and people talk about the [charger] software, what to expect as a new driver, vacating a spot, plug in whoever is on deck. It's all a little community."

There is one employee at the company whose round-trip commute is just under his car's range. By mutual agreement amongst the PEV drivers, a Level 2 charger is reserved for him to ensure he has enough charge to drive home. Another driver explained that he is allowed to leave his car plugged into a 110volt outlet for the entire day unbothered, whereas the established etiquette is that those who charge on the Level 2 chargers are supposed to move their car once their charge is complete. Sanjeep described his recharging pattern, "Since my commute is not that far, actually it's 6 or 7 miles...I plug into a 110volt and by the time I [leave to] come home I am fully charged. So during the weekdays I never need to charge at home, only on weekends do I charge at home."

Unplugging someone else's car in order to charge your own was a delicate issue. In response, PEV drivers at the company attempted to create etiquette to avoid conflict: they shifted responsibility to the driver of the first PEV, i.e., the one plugged in first. When that driver leaves, the rule is they should plug-in another PEV parked near the charger if the driver of that other PEV left the charging port door open. However, this only works for one of the types of EVs because of how the charging port door works. Those with other PEVs are unable to count on this standard. John explained, "You can't be sure that they're done charging or if they will plug you in when they leave so now there's this whole social thing about if my [charge port] door is open then plug me in when you leave—which at work works, but other places, no."

The charging etiquette outlined on the company Wiki is fluid and negotiations resume when a new situation arises. As an example, some of the chargers in the companies parking areas are positioned so that only one parking space can be reached by the charger's cord. At other chargers, two parking spaces are within reach. Each now has its own set of rules. Phil said, "There are debates over what the etiquette is...if a station can reach two spots then it has a different protocol than one that is dedicated [to one spot] because the ones that are dedicated you are just supposed to charge and go. The others, if you can plug somebody else in then you can stay in that spot for the whole day. I don't know if some of those are just unofficial rules or if they are codified or anything."

In addition to a system of rules to manage their charging resources and a participatory process for its continued development, the PEV drivers worked together to create new knowledge about that resource. It did not take them long to realize they could not plug in PEVs to all the 110V outlets at once without tripping circuit breakers. Taking matters into their own hands, they mapped the electrical wiring in the parking structure. Sanjeep explained, “We have done some investigation and revealed ... four outlets are on the same circuit and only one of them can be used. So you go around and see if somebody else is already plugged in. [If someone else is] then you don’t. Otherwise it’s going to trip the circuit.”

Other Workplace Charging Scenarios Most of our interviewees did not have access to a charger or outlet at work. Of the few who did, most used a 110v outlet, and none required a charge to return home. One person, Hans, notified his company before plugging in to their 110v outlet; he did not perceive it to be a problem because the outlet was already installed and the electricity he used was minimal.

Discontent with Employees Using ‘Customer’ Public Chargers The placement of chargers in the parking lots of businesses is seen by PEV drivers as an inducement to visit those businesses—or at least use their chargers. The use of those parking spaces and chargers by PEV drivers perceived by some of our households to not be customers or potential customers violates our households’ expectations of who those chargers are meant to serve. In the particular instances related by our interviewees, the chargers at shopping malls and large stand-alone retailers are located in customer, not employee, parking areas. Customers who drive their PEV to these businesses are irritated because they perceive that employees who are PEV drivers are routinely using these chargers without moving their car once their charge is complete. David explained,

“When I go to [the store] there’s always a silver Leaf...I know it’s the same silver Leaf because they have a baby car seat...and so I went in the morning. And I had to go back in the afternoon...and there’s the car...charge is complete... I can understand that when a car is finished charging they may not be back for another half an hour...maybe periodically they come out and check. Well I went back purposely that evening and the car was still there, I realize it’s an employee. So now not only are you competing with other [PEV] owners and [shared-car PEVs], you now have the employees who have a [PEV] and are going to park their car there all day. It’s like waiting in line at Disneyland. Are you willing to wait 2 hours to get on?”

Our interviewee is frustrated that there are no limits on charging in “public” and believes it is bad etiquette to leave a car at a charger all day especially if the car has finished charging. We note David does not need to charge his PEV at this public charger because he lives less than five miles away and yet is irritated by this other PEV driver’s behavior. Ironically, David is participating in behavior that could potentially irritate other PEV drivers; he has parked at a public charger at a business, finished his shopping at that business, and then walked one mile to another store so that he could charge his PEV longer. He explains, “We actually walked [to the second store] because I figured it’s not going to be worthwhile just charging [at the first store] for twenty minutes.” David is irritated with someone who is using the charger all day but thinks it to be acceptable to leave his PEV connected to a charger at a store he has finished patronizing.

This exemplifies why etiquette is desired by so many; what is acceptable to one may not be acceptable to others.

DISCUSSION AND IMPLICATIONS: WHAT DOES THIS MEAN FOR THE FUTURE?

Clearly, the installation of physical charging infrastructure is one prerequisite to widely available PEV charging at homes, workplaces, and elsewhere. The experiences reported by early PEV drivers makes it equally clear that the process of deploying charging infrastructure does not end when the last nut-and-bolt is tightened, electrical connection is made, and it's location updated to any of the variety of charger locator media. PEV drivers want widely shared, understood, and practiced charging etiquette, rules, and other guidelines. They want these in order to feel comfortable and confident in charging away-from-home. They want to be certain of what to expect and know how to navigate different charging situations. The general conclusion about the stories of a perceived lack of charging etiquette is that a lack of shared and practiced rules inhibits use of away-from-home charging. We are not able to estimate the size of the effect based on this study. The results do put a negative valence on hypotheses about the magnitude of the effect.

Given resources and a sufficiently proscribed context, some of the PEV drivers who spoke with us have shown they are capable of developing systems of rules, processes for negotiating those rules, and media for communicating to the affected group of drivers. But we only heard this within the confines of a single company. Efforts to revive previous rules and methods of communication among a broader population of PEV drivers appear to have been less successful. Our informants Floyd and Sunshine have not seen any other of the small cards with paperclips. Further, that all of our respondents talked about situations in which they don't quite know what is proper or allowed indicates a continuing general lack of etiquette guiding charging away-from-home.

How far should we expect etiquette—a “less serious” set of norms—to take PEV drivers into the future? Would PEV drivers benefit more from formal, stronger, and more rigorously enforced guidelines and requirements? Rules, regulations, and perhaps laws may steer PEV drivers toward further use of their PEV by easing fears they have about away-from-home charging. Most of the PEV drivers who spoke with us did not rely on public charging because of a lack of chargers in public or at work, or because they fear any such chargers might be unavailable because someone else may already be parked and charging. This perceived unreliability of access to chargers limits how far our respondents drive their PEVs. That is, their present experiences, even on a field trip to the park to see and test the chargers, can shape their expectations about and valuation of a future, more far-flung, and denser network. If the same perceived lack of rules about these new social interactions around plugging in their car is not solved for a nearby station they don't have to charge at to return home, what expectation can they have of using a charger they absolutely need to access to return home?

Among other sets of rules that many PEV drivers in this study want is a reservation system to secure access to a charger at a specific place and time. Having to pay for charger access may necessitate such a reservation system and replace any uncertainty in etiquette with steadfast rules or regulations. Without such a reservation system, it is possible that etiquette will be just as

important even after formal rules are imposed as charging shifts from a free convenience to a paid service.

The difficulties that the reported lack of expectations and etiquette created for our interviewees can confound recommendations that might flow from this research. Our PEV driver who is most disgruntled with “employees” occupying charging he believes is intended for customers is in fact assuming the offending PEV driver is an employee of the store. That person could just as easily be an employee of another nearby store or a commuter who parks in the store’s lot and takes a carpool, bus, or light-rail from that point to work. If the offending driver is an employee of the particular store that installed the charger, solutions may be sought in the promulgation of policy inside that company regarding employee use of the charger or the installation of chargers for employee use. If it is anyone else, the solutions may have to do with the promulgation and enforcement of time limits on parking. The solution to all these problems may be to require payment for access to charging or for charging itself, i.e., the electricity rather than the parking space.

This study was completed at a time when public charging was free to these PEV drivers. Billing for access to public charging started in the meantime, and will likely impact public charging behavior. A number of payment models are being explored, all designed to make paying for charging simple and convenient. Drivers might subscribe to a charging service, swipe their credit card, enter a charging account number, or insert coins or bills into a meter to charge their PEVs. In many cases, drivers will only be charged a single fee for parking and charging. “Smartcards” or radio-frequency identification (RFID) devices programmed with user information enable the station host to collect usage data in addition to payment (12). Still, simply because the social interactions around public charging may now be governed by new rules regarding financial transactions does not obviate that etiquette of some kind may still apply. It is possible that moving public charging from an interaction shaped by less formal, “less serious” rules, to those that govern financial transactions may make PEV drivers comfortable enough to depend on public charging. The new expectations and rules that apply because there is now a financial transaction involved may simply open whatever existing etiquette there is to re-examination and renegotiation, i.e., a new round of uncertainty about the rules.

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