Tahoe-Truckee Plug-in Electric Vehicle Toolkit for Utilities

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1. Introduction

This toolkit was developed as part of the Tahoe-Truckee Plug-in Electric Vehicle (PEV) Readiness Project led by the Tahoe Regional Planning Agency. It provides an overview of the key considerations for utilities who are seeking to develop a strategy related to transportation electrification.

- Integrate Transportation Electrification across Utility Operations:
  - Establish notification protocol for installation of residential charging infrastructure.
  - Consider rate structures for EV charging that are consistent with utility cost recovery.
  - Understand grid impacts of EVs in service territory: Initial assessment of potential impacts on existing distribution assets (including substations, circuits/feeders, etc.); track market to the extent feasible (vehicles deployed, *visitors* / 2nd home owners to the region); and utilization of charging infrastructure.
  - Incentivize charging: discuss opportunities to recover costs, obtain LCFS credits, etc.
  - Integrate electric vehicles into long-term planning (such as integrating renewables and two-way communication between vehicle-grid).
- Active Outreach and Awareness:
  - Utility as a trusted advisor and arbiter of EV information (education and awareness role).
  - Engage with other stakeholders.

2. Integrate Transportation Electrification across Utility Operations

The widespread deployment of PEVs presents an unprecedented opportunity for electric utilities to increase asset utilization through increased electricity use, and has the potential to reduce electricity rates. One of the primary concerns associated with PEV deployment is the potential negative impact from increased load on the local electric grid. The degree of the impact depends on parameters such as PEV penetration rates, the current condition of local distribution infrastructure, and strategies used by the local utility to manage additional load. Utilities across the country have implemented a wide variety of pilot projects and assessments to better understand consumer PEV usage patterns and how certain management tools, such as smart meters, may help mitigate impacts on the grid. Using tariff structures and incentives, utilities are actively seeking solutions that maximize PEV charging to periods of lower electrical demand, such as off-peak hours.

2.1. Establish notification protocol

One of the primary causes for concern for PEVs is clustering of the load associated with PEV charging. Utilities generally have a transformer replacement program to target regularly transformers that have reached the end of their useful life or have been identified as grossly overloaded. However, the adoption of PEVs may occur faster in some areas, thereby causing gaps in the information that utilities

would generally use to inform their replacement programs. Some replacements occur because a transformer fails while in service; utility notification protocols can help avoid transformer failure. For utilities to minimize the potential grid impacts of charging PEVs, they need to know where the vehicles are being deployed and how they are being charged (e.g., Level 1 vs. Level 2). This information allows the utility to evaluate if the local distribution system is adequate to serve PEV charging needs. For commercial installations that require electrical inspectors and permitting (e.g., Tesla deploying its row of SuperChargers in Truckee), there is less risk associated with utility notification because the entities involved are more accustomed to dealing with utilities. However, with residential installations, utility notification protocols that can adequately manage significant volumes of residential notifications through the use of automated processes are non-existent.

The typical residential installation will have three parties: 1) the homeowner and PEV driver, 2) the contractor, and 3) the electrical inspector. The electrical inspector is there to protect the interests of the homeowner on behalf of the local government. Contractors engaged in the installation of EVSE have generally been trained to encourage the homeowner to contact his/her local utility and notify them of the installation. Even if homeowners do not contact their utility expressly to notify them of an EVSE installation, most homeowners likely will take advantage of special PEV rates offered by utilities. Despite these various opportunities to notify the utility, there is still considerable anecdotal evidence of homeowners who have chosen to forgo utility notification after installing EVSE and charging a PEV. Even at low rates of non-notification, this has the potential to become a significant problem.

In California, advance notification began on an ad hoc basis, but in July 2011 the CPUC directed utilities to conduct an assessment of early notification efforts and evaluate opportunities to formalize the process. In a joint report with SCE regarding PEV notification,[1] PG&E identified the following requirements for notification data needs to meet its needs:

- **Comprehensiveness**: To ensure grid reliability, safety and stability, PG&E would require data to be as comprehensive as possible to properly anticipate areas where transformer loading is nearing failure. This would include data for charging locations for not only new PEVs, but used PEVs or use resulting from a change of address. PG&E estimated it had captured 80% of new PEVs sold in the service territory using existing notification processes.
- **Granularity**: The location information should be as specific as possible, ideally with a street-level address as opposed to a zip code or city block. The data should also include charging levels to evaluate potential demand and impact on circuits. Though privacy and confidentiality concerns exist, PG&E expressed commitment to protecting customer data in compliance with applicable regulations and laws. Currently, OEMs are sharing notification data at the street address level, but may require PG&E to pay for supplemental reports including delivery date to customer.
- **Timeliness**: Utilities would prefer notification of new EVSE prior to the installation to identify potential distribution infrastructure problems resulting from incremental coincident peak loading.

[1] Southern California Edison Company, "Joint IOU assessment report for PEV notification," December 2011, p. 14, available online at: http://docs.cpuc.ca.gov/efile/REPORT/156710.pdf.

Currently, a reporting period from OEMs and other third parties has not been standardized and should be addressed.

- **Scalability**: As the PEV market becomes more mature, utilities have expressed concern about the amount of manual activities required to collect data, and that unless they could become automated in some way, the process would not scale well with increased PEV adoption. Notification sources could provide data in a standardized way that would allow it to be automated. Currently, reports provided by OEMs are based on internal processes and will require additional automation to be able to be useful at higher PEV adoption rates.
- **Costs**: Utilities have also expressed concern about potential internal and external costs for obtaining notification data, including the costs to secure notification commitments from third parties and analysts to compile the data. Though costs are currently relatively low, there is a potential for costs to increase in the future and options to mitigate notification costs will be evaluated.

According to the same report, [2] the primary methods PG&E uses to collect PEV data in its service territory include data provided by OEMs, such as General Motors and Nissan. GM's regional manager for California provides data to PG&E on a biweekly basis and Nissan shares data on a quarterly basis through its third-party analytics firm, Oceanus.

There is also legislation in place to ensure that utilities are able to obtain data directly from the DMV. Senate Bill 859 (SB 859, Padilla, Statutes of 2011), sponsored by the California Electric Transportation Coalition (CalETC), LADWP and SMUD, authorizes California utilities to obtain PEV registration data from the DMV; however, the law also imposes restrictions on how to use DMV data to protect consumer privacy.[3]

2.2. Consider rate structure for PEV charging

Utility rate structures are one of several key decision factors for potential PEV consumers, and can represent the difference between a consumer accruing a return on their investment or realizing a net loss. The most significant savings for PEV drivers are from a reduction in fuel expenditures. Utilities should continue to evaluate their rate structures in the context of the potential impact on PEV consumers. These include an analysis of secondary meter options, alternatives to the traditional tiered rate structure, and options for existing or future of TOU rates. For example, SDG&E's VGI Pilot Program application with the CPUC (filed April 11, 2014, A.14-04-014) features a dynamic rate for workplace and MDU settings that reflects grid conditions and the changing cost of energy throughout the day.

Some utilities have opted to charge higher rates during times of peak demand and lower rates during off-peak hours through time of use (TOU) tariff structures. Historically, TOU tariffs have motivated consumers to use electricity during off-peak hours to prevent high utility bills. Technological solutions to

[2] Pacific Gas & Electric Company, "Filing of Information in Response to Administrative Law Judge's Ruling," March 2011, p. 4, available online at: http://docs.cpuc.ca.gov/efile/RESP/166108.pdf.
[3] Senate Bill No. 859, Chapter 346, Padilla, Vehicles: records, confidentiality. Available Online: http://leginfo.ca.gov/pub/11-12/bill/sen/sb_0851-0900/sb_859_bill_20110926_chaptered.pdf

reduce grid impacts and minimize costs for consumers include smart charging technologies, which track daily usage patterns and restrict charging to periods when surplus electricity is available.

Currently, many different time-variant structures exist and each has advantages and disadvantages. Since many utilities are just beginning to experiment with demand management, different regions may find different combinations more beneficial. Some of these time-variant structures include:

- **Whole-house Time of Use with One Rate**: This rate has both the house and the PEV on the same rate with one meter. This type of rate encourages electricity consumption during off-peak hours. One of the primary benefits of this rate is that it avoids the need and costs associated with a second meter. The primary requirement to achieve lower bills on this type of rate is that customers need to adjust their typical behavior to minimize the amount of electricity consumed during peak hours and maximize the amount of electricity consumed during off-peak hours.
- **Fixed fee/fixed fee off-peak**: This rate requires PEV owners to pay a flat monthly fee for unlimited charging (the time could be restricted, such as limiting to off-peak charging). Though this rate is easy to use for both the utility and the customer and doesn't require the use of a second meter, the rate may not necessarily encourage use during off-peak periods.
- **Two-meter house with high-differential pricing**: This rate has the house and the PEV on the different rates with one meter for the house usage and another meter for the PEV consumption. This encourages electricity consumption during off-peak hours for the PEV and allows the house to be on a normal residential rate, such as a flat rate. One of the primary benefits is that it allows the residents of the house to continue consuming as before without any disincentive to consume during peak hours. The primary requirement to achieve lower bills on this type of rate is that customers need to adjust only their PEV charging times to maximize the amount of electricity consumed during off-peak hours. The disadvantage of this rate structure is the need and costs associated with installing a second meter.
- **Sub-metering off PEV charging circuit with high-differential pricing**: This rate is similar to the two-meter house rate, except the PEV charging circuit is sub-metered and simply subtracted from main meter use. The advantages of this rate are that it is appropriate for MDUs, potentially less expensive for customers, and allows for differential pricing. However, these rates are typically experimental at this time, and may not be available at all.
- **Demand response (can be combined with options above):** In this rate structure, the utility enters into a contract with a user or an aggregator to control the power flow to PEV during high load times or provide a financial incentive for reduced charging level. This feature may be especially useful for local grids near 100% capacity and for providing other grid services to the utility. However, poorly implemented demand response programs by the utility or aggregator could inconvenience PEV drivers if the battery is not charged to the desired level when needed.

2.3. Understand grid impacts of PEVs

One of the key concerns about electrification of the transportation sector is the potential impact to the electric grid. If vehicle charging occurs coincident with peak demands, increased loads will drive a need

for new investment in generation, transmission and distribution capacity. If charging can be managed to occur primarily in off-peak periods, much of the load will potentially be served with existing infrastructure such that impacts on the electric grid will be significantly reduced and there will be a potential for significant grid benefits.

Impacts on Distribution Assets

The residential charging of PEVs is most likely to impact utility distribution assets, including substation, substation transformer, feeder, and circuits. As utilities seek to understand the potential impacts of PEV charging on distribution impacts, they should consider the following key parameters:

- PEV deployment: Current and forecasted population, differentiated by vehicle architecture (PHEV vs BEV; to the extent feasible)
- Vehicle energy consumption: Understanding how vehicles are driven (distance, efficiency, etc.) and the associated energy consumption in units of kWh.
- Load shapes: Seek to understand where and when PEV drivers are charging; how they may charge with intervention (e.g., TOU rates or managed charging).
- Consider rates: residential charging, TOU charging, non-residential charging (on a commercial circuit), etc.

With regard to the distribution assets, utilities will need to catalogue capacity rating, utilization, peak loads, number of customers (residential and commercial), and forecasted growth (absent PEVs). The consideration of these parameters should enable a utility to understand the near- to long-term impacts on critical distribution assets.

PEV Clustering

PEVs, like hybrid electric vehicles and rooftop solar photovoltaics (PV), will cluster in certain areas. Clustering presents a potential challenge for the utility distribution system, as a few PEVs charging coincident with the distribution peak could exceed the rated capacity of installed equipment. To account for clustering, we allocated the forecasted PEV adoption to ZIP+4 zones with weightings based on historical hybrid electric vehicle adoption.

Tracking Market

The electric vehicle market is changing rapidly, whether it be vehicle offerings or advances in charging infrastructure. These are markets that utilities are not necessarily naturally accustomed to tracking. However, with the potential opportunity and disruption to the utility business that PEVs represent, it is critical that utilities take a more active approach to understanding and tracking vehicle and infrastructure markets. ICF recommends that utility track metrics such as the number and type of electric vehicles deployed, number of visitors to the region and second home owners that drive electric vehicles, characteristics of residential charging, and the characteristics of non-residential charging (including workplace and public charging at Level 2, and DC fast charging).

2.4. Maximize use of existing incentives

California's Low Carbon Fuel Standard (LCFS) provides utilities with an opportunity to earn credits for selling electricity as a transportation fuel. Per the LCFS regulation, however, utilities must use LCFS credit proceeds to benefit current PEV drivers; furthermore, IOUs must seek CPUC approval for their plans regarding the use of LCFS credit proceeds. A variety of proposals have been put forth to the CPUC – including vehicle buy-down programs and rate reductions (see table below). As the market for PEVs evolves and the LCFS credit market matures, utilities should be encouraged to continue to explore opportunities to find innovative mechanisms to spur adoption using LCFS credits that are in line with CARB's LCFS Program requirements. The LCFS program is an excellent opportunity for utilities to explore creative ways to engage consumers.

Utility	Description of Proposal to CPUC
Pacific Gas & Electric	• On-bill credit to PHEV and BEV drivers; credits based on vehicle battery size. • Provide information about availability of credit to customers
San Diego Gas & Electric	• Return credits to drivers under the manner in which they were generated • Provide information about availability of credit on website featuring the credit as an additional benefit for PEV drivers
Southern California Edison	• Propose a Clean Fuel Reward offered to PEV adopters through dealers at the time of vehicle purchase • Provisions for new and used-vehicles (purchase or lease)
Sacramento Municipal Utility District	• Propose a Clean Fuel Reward at the time of vehicle purchase • Support public charging infrastructure investment
Los Angeles Department of Water and Power	• Provide rebates for PEV charging infrastructure

2.5. Integrate electric vehicles into long-term planning

Utilities regularly produce Integrated Resource Plans (IRPs); IRPs are electricity system planning documents that lay out the resource needs, policy goals, physical and operational constraints, and general priorities or proposed resource choices of an electric utility, including customer-side preferred resources. IRPs also outline how utilities can align with GHG emission reduction targets and achieve other targets e.g., a Renewable Portfolio Standard of 50% by 2030. Most recently, SB 350 requires the California Energy Commission to produce guidelines for and to review the IRPs of publicly owned utilities (POUs). Investor owned utilities (IOUs) conducted comparable integrated resource planning processes, and present these to the California Public Utilities Commission (CPUC). As utilities develop their IRPs, it is increasingly important that they consider the impacts of electric vehicle charging.

3. Active Outreach and Awareness

The introduction of new technologies like PEVs requires careful coordination and continuous outreach to consumers to deliver high-level messaging at the local and regional levels to highlight PEV availability and benefits, including total cost of ownership as well as environmental, health, and community benefits. Furthermore, it is important to communicate on a frequent basis the direct financial and nonfinancial benefits to drivers including tax credits, grants, and the PEV driving experience (e.g. fast acceleration and quiet vehicle operation) and the differences associated with fueling from the grid rather than from a gas station.

3.1. Utility as Trusted Advisor in the PEV Market

Utilities have a critical role to play when communicating with consumers about the benefits of PEVs. As PEVs can be part of greater customer engagement about their energy consumption, utilities should expand their advisory role in this area. Utilities have a 30-plus year history of serving as trusted advisors with other end-users, including in the deployment of energy efficient technologies (e.g., air conditioners, lighting, refrigerators, etc.). Furthermore, the Electric Power Research Institute (EPRI) reports that a synthesis of multiple surveys of potential PEV drivers indicates that there is a strong belief that it is the utility's role to develop charging infrastructure and educate consumers.[4]

Most utilities in California are already engaged in initiatives related to PEV deployment – including through coordination with Clean Cities groups, involvement with the California Plug-in Electric Vehicle Collaborative, or with other local/regional efforts. Continuing engagement in these types of initiatives is critical to the success of PEV adoption. Furthermore, it helps bolster the case for utilities to serve as a trusted advisor. Utilities should continue involvement with existing initiatives and identify new opportunities where available.

While many utilities[5] are educating customers about PEVs, ICF notes that when the California Public Utilities Commission (CPUC) previously ruled (Phase 2 of Rulemaking 09-08-009) that investor owned utilities (IOUs) cannot own electric vehicle charging infrastructure at customers' facilities (which has since been revisited and reconsidered), it also limited the scope of education and outreach activities by IOUs. More specifically, the ruling prohibited "mass marketing" and a requirement "to target customers with an interest in Electric Vehicle" (rather than the broader segment of automobile intenders). This ruling effectively prevents IOUs from engaging in broader educational initiatives aimed at the general public regarding PEVs and the benefits of fueling vehicles from the grid.

[4] Multiple EPRI reports including: a) Characterizing Consumers' Interest in and Infrastructure Expectations for Electric Vehicles: Research Design and Survey Results (2010), b) Southern Company Electric Vehicle Survey: Consumer Expectations for Electric Vehicles (2011), c) TVA Electric Vehicle Survey: Consumer Expectations for Electric Vehicles (2011), and d) Texas Plugs In: Houston and San Antonio Residents' Expectations of and Purchase Intentions for Plug-In Electric Vehicles (2012).

[5] It is worth noting that as part of the requirements for utilities earning credits under California's LCFS (participation in the LCFS program is voluntary), utilities must commit to educating the "public on the benefits of EV transportation (including environmental benefits and costs of EV charging as compared to gasoline)." The regulation suggests public meetings, EV dealership flyers, utility customer bill inserts, radio and/or television advertisements, and webpage content.

In addition to the information utilities already provide (e.g., PEV rates, environmental and societal benefits), utilities could provide critical and reliable tools about PEVs (e.g., to help customers understand the total cost of ownership or choose the charging level needed based on their driving behavior). As noted in the Ernst & Young report, when utilities decide where they want to sit in the emerging ecosystem (and in the case of IOUs, where they are *allowed* to sit), a stable value chain is likely to emerge. As such, the long-term success of (light-duty) vehicle electrification depends on meaningful utility engagement. Plus, considering that a typical call to a utility's call center about PEVs may lead to a conversation about rates, metering, billing, information resources, PEVs at homes with solar energy and other related topics, the utility is ideally suited as the "first stop" for a PEV inquiry.

3.2. Engage with PEV ecosystem partners

Outside of existing initiatives, utilities should continue to seek opportunities to engage with PEV ecosystem partners to educate consumers about the benefits of PEV ownership. These include engagement with automobile manufacturers (OEMs), dealers, and private and public fleets, government agencies, and PEV charging industry market participants.

There are a range of utilities that have engaged ecosystem partners through consumer education; some examples are outlined here:

- Georgia Power developed the "Get Current Drive Electric" campaign, a combination of online information, media campaign, and informational resources for residents and businesses/employers.
- Hawaii Electric has a "Go EV" program highlighting reduced rates, petroleum displacement,
- California utilities can also borrow from the PEV Collaborative's "Best.Drive.Ever" campaign, which provides ride-and-drive events, focusing on communicating directly with consumers about why electric vehicles make sense.