6 UTILITY CONSIDERATIONS

As previously noted, electric vehicle charging adds significantly to a typical household's electrical usage, with the potential to double the existing load.[95] It is therefore critical that California utilities anticipate and plan for the deployment of PEVs so that they can manage the increased load. Coordination with local governments can facilitate the preparation for anticipated increase in electrical load to ensure the continued availability of safe and reliable electricity.

Studies and modeling by a number of groups including the Electric Power Research Institute,[96] have shown that California's electrical grid can easily handle large numbers of PEVs; however, isolated problems could occur in neighborhoods that have a concentration of PEVs if the utility is not made aware of local EVSE installations and locations in which a large number of vehicles plug in during peak utility load periods. This section covers local governments' collaborative role with utilities, efforts utilities have undertaken to assess local electrical capacity, electricity rate options including special PEV time-of-use (TOU) rates that could mutually benefit both customers and utilities, as well as the importance of educating customers about off-peak charging. In addition, other charging system approaches such as photovoltaic integration and DC Fast Charging are addressed.

CPUC Regulation and Guidance

Utilities in California are divided into municipal- and investor-owned groups. Municipal utilities are governed by a local district board or City Council. Investor-owned utilities are private corporations governed by their Boards of Directors and regulated by the California Public Utilities Commission (CPUC). The CPUC has been investigating issues related to the implementation of PEV charging for approximately two years under Rulemaking 09-08-009 and has issued two decisions that are important to industry stakeholders and PEV drivers.

The first major policy decision (Phase 1, issued June 2010)[97] addresses the issue of whether private businesses that sell electricity for the purchase of vehicle charging should be considered utilities and therefore subject to regulation by the CPUC. In its decision, the CPUC set a goal of encouraging competition in this new market and determined that businesses that sell PEV charging services should not be defined as utilities.

The second decision of the CPUC (Phase 2, issued July 2011)[98] provides additional direction to utilities on PEV-related charging issues, including rate design, provision of sub-meters to track PEV energy use, involvement of utilities in the promotion of PEVs, and other issues. Municipal utilities, while not subject to CPUC regulation, are closely watching the direction that the CPUC is taking, as they are often required by the state legislature to implement policies similar to those required of the investor-owned utilities.

Utility Notification of EVSE Installations

Recommendation #34 – Notify utility of charger installations.

Utilities have been working closely with automakers and local governments to prepare for the deployment of PEVs. They have reached agreements with GM and Nissan on an "automatic opt-in/ affirmative opt-out" notification system, in which automakers will notify utilities of PEV purchases (unless customers specifically ask the automaker not to do so). Utilities have also been active in educating consumers and local governments on the importance of providing notification of EVSE installations so that utilities can plan for necessary infrastructure upgrades. The current system, while helpful, does not capture all PEV purchases. A useful addition to the existing communication between utilities and local governments would be for local jurisdictions that issue EVSE installation permits to notify utilities when permits have been issued.

As part of a standardized permitting application and checklist, include a check box that permits the local agency to share EVSE information with the local utility, and establish a process for efficiently sharing that information with the local utility. While permit information itself is already a matter of public record, this will provide the timely information utilities need to promptly and effectively accommodate for the additional electric load that chargers present.

6.1 ELECTRICITY RATE INFORMATION AND METERING

Many California utilities offer special TOU rates to encourage PEV owners to charge during nighttime "off-peak" hours when utilities have surplus capacity. Most PEV users, including fleet and residential customers, may find it convenient and cost-effective to charge overnight. Some TOU rates, however, require additional electrical equipment to be installed by customers and additional metering equipment to be installed by utilities. A careful analysis of the costs and benefits of off-peak rates is required to determine the best option for each customer. Some utilities have created excellent on-line rate calculators to help customers evaluate their options. Utilities encourage customers to contact them for more information.

PEV Charging Habits and Impact on Residential Rate Options

There are more than 50 electric utilities in California and each has its own unique electricity rate structure. In general, residential rates fall into three categories:

- **Flat rate** — The same price per kilowatt-hour is paid, regardless of how much is used or when it is used;
- **Tiered or block rate** — The more electricity used, the more is paid per kilowatt-hour. These rates are designed to encourage conservation. There is no difference in cost based on time of day, however costs are higher in the summer months. Typical residential rate structure offered by most utilities (both municipal and investor-owned.
- **Time-of-use (TOU) rate** — This lower rate rewards customers who use electricity when it is most available and cheapest for utilities to produce – generally, at night (also known as an off-peak rate).

PEV drivers typically have several rate choices. The best rate for their individual situation will depend on a number of factors, including:

- Frequency that PEV will be charged at home
- Daytime vs. nighttime charging
- All other electric household load tendencies
- Total electrical load

The table below summarizes various rate options available to California PEV drivers.

Rate	Optimal benefits to PEV drivers when:	Considerations
Tiered Rate	(i) current usage is fairly low, or (ii) solar panels are installed at a home.	Adding PEV charging to the household load has the potential to shift a household into a higher tier, raising the per kWh cost for household electric usage.
Whole House Time-of- Use (TOU) Rate	Most or all electricity usage is during off-peak hours (i.e., family members are not at home during the day)	Daytime cost per kWh may be higher than daytime tiered or flat rates. Existing utility meter is replaced by a utility TOU meter but no other upgrades are necessary.
PEV Time-of-Use (TOU) Rate	(i) Current residential electricity bill is already in higher tiers, or (ii) PEV charging could shift household into a higher tier.	There may be a cost to the PEV driver to install a separate meter and/or service, or other equipment needed to take advantage of the low off-peak charging rate.
Flat Rate per kWh	The rate is low.	No penalty for using more electricity. Does not encourage a shift to charge during off-peak hours

Table F - California Residential Electricity Rate Options

Special Utility PEV TOU Rates

At the present time, customers who purchase a PEV have 2 or 3 rate options available depending on the utility:

1. Stay on the current tiered or flat rate plan
2. Change to a TOU rate for the entire usage (requires new time-of-use meter)
3. Change to a TOU rate for the EVSE usage only (requires new utility service and panel and new TOU meter)

Most PEV drivers may wish to change to one of the TOU rates, assuming that the majority of residential charging will occur during off-peak hours (after 6 pm and on weekends.) By contrast, customers that charge primarily between 10 am and 6 pm, when demand and TOU rates are highest, may want to stay with a regular rate plan.

The first TOU option places the entire house—including the EV charger—on the special PEV TOU rate, which varies significantly depending on when power is utilized. For example, in PG&E territory, the "Experimental TOU Low Emission Vehicle rate" known as Schedule E-9[99] provides electricity at night at a significantly lower rate than the peak period rate. The Southern California Edison (SCE) rate plan[100] provides off-peak EV charging at a rate of 11 cents/kWh for charging between 9 pm and noon, 22 cents/kWh for day-time charging in the winter, and 28 cents/kWh in the summer.[i]

The second TOU option places only the EVSE on the TOU rate. Currently this requires a second electrical panel, utility service, and meter. To assess specific conditions in a customer's home, the customer will likely need to pay a licensed electrician for an analysis. Depending on the evaluation results, the utility may install a second electrical service conforming to local jurisdiction and utility requirements, including local permitting and inspection guidelines. Once an electrician confirms that a second meter and panel installation is feasible and appropriate, some utilities will install the second meter at no charge, while others may impose some fees.

In order to take advantage of special PEV TOU rates, recommended practices to be used in conjunction with time-of-use rates include setting thermostat timers for off-peak hours; using washing machines, dryers, and dishwashers during off-peak; using timers on the electric water heater; and timers and photocells on lights and sprinklers.

Table G presents websites that provide information on relevant programs for the major investor-owned and municipal utilities in the state. Customers of smaller utilities should consult their local utility website or call the customer information center.

i PG&E and SCE allows customers to opt out of the TOU rate if it is not suitable for customers' electricity use patterns, but there may be some time constraints in terms of how often they can change.

Utility	Options	Website
Southern California Edison	SCE offers customers a choice of a whole house time-of-use rate that meters the home and PEV together— or a time-of-use rate for the PEV only. SCE also provides an online rate calculator and encourages customers to call for a customized, free rate analysis to determine best options.	www.sce.com/PowerandEnvironment/PEV/rate-charging-options.htm
Los Angeles Department of Water and Power	Los Angeles Department of Water and Power offers a $0 .025 cent per kWh rate reduction for off peak charging. Customers can chose to install a separate meter and service to take advantage of inexpensive off-peak rates plus the PEV charging discount. Or customers can choose a time-of-use rate without a second meter and receive a 500kwh per month discount of $.025 per kWh.	www.ladwp.com/ladwp/cms/ladwp014298.jsp
Pacific Gas and Electric	Pacific Gas and Electric Company offers a special discounted rate for Electric Vehicle (EV) customers, the Experimental Time-of-Use Low Emission Vehicle rate (Schedule E-9A or E-9B).	www.pge.com/electricvehicles www.pge.com/PEVcalculator
San Diego Gas and Electric	SDG&E has two residential PEV charging rates. The first EV-TOU rate allows customers to take advantage of lower off-peak (night-time) rates. The second rate, EV- TOU-2, places the entire home on TOU rates. Special metering may be required. An experimental sub-metering rate is also available.	www.sdge.com/environment/cleantransportation
Sacramento Municipal Utility District	An optional discounted electric rate is available for charging PEVs. The Residential Time-of-Use Electric Vehicle (RTEV) rate offers a $.0243 (winter) to $.0271 (summer) discount per kWh and requires a separate meter and service.	www.smud.org/en/residential/environment/plug-in-electric-vehicles/PEV-rates.htm

Table G - Incentives to PEV owners by utility

Sub-metering

The California Public Utilities Decision in Phase 2 of Rulemaking 09-08-009[101] directs utilities to explore another option—sub-metering. Sub-metering allows the utility to direct a portion of electrical usage to a separate meter with a different rate. For example, San Diego Gas and Electric has implemented an experimental rate program that allows customers to choose a sub-metered off-peak EV charging rate. The amount of electricity used for EV charging is then subtracted from the total electricity used in a month and billed at a separate rate. Sub-metering is a major shift in utility rate structures and there are many issues to be decided before these new options are implemented.

Commercial charging and demand response programs

There are currently no special PEV rates for commercial customers. Most commercial rates vary by time-of-day and season. Commercial rates also include monthly demand charges[ii] based on the maximum amount of electricity or peak load. To save money, some customers choose rates that allow the utility to interrupt service when supply circumstances demand it.

Many sophisticated building energy management systems also enable managers to balance a variety of loads to ensure that demand charges are minimized even if there are several chargers being accommodated on a single campus or property. Some chargers also incorporate software that can communicate with corporate energy management systems. Software has also been developed to send a shut down signal to the chargers as requested by the utility.

As discussed above, utilities throughout the state are offering special rates to encourage PEV use and to establish incentives for PEV owners to recharge in off-peak hours when the utility has surplus distribution capacity, and greener renewable electricity is more widely available. Table 2 summarizes the current offerings of the largest utilities throughout the state.

ii Demand charges are calculated by using the highest level of usage during a 15 minute period out of an entire billing cycle. That usage (in kW) is then multiplied by the demand charge rate. Demand charge rewards customers who, more or less, use a constant lower rate of electricity throughout the month and encourages customers to be cautious of their energy use. See http://www.pge.com/mybusiness/myaccount/explanationofbill/mediumbiz/3/ for more information.

6.2 INTEGRATION OF PEVS WITH RENEWABLE ENERGY AND EFFICIENCY STRATEGIES

Many utility industry experts have expressed concern that PEVs could create problems for the utility grid if deployed in large numbers without adequate provision to spread charging to off-peak periods. At the same time, PEVs have the potential to help utilities balance their load across peak and off-peak hours through demand response programs that can modulate charging rates. In addition, as technologies evolve, some vehicle batteries could eventually serve as distributed energy storage assets that can help provide a variety of grid services – including frequency regulation (balancing supply and demand) – via two-way connections to the grid. Thus, PEVs represent both a challenge and a potential asset for grid operators. It is likely that the gradual pace of PEV deployment will give utilities sufficient time to adapt their operations to ensure the most efficient utilization of PEVs, and to deploy the smart charging and vehicle-to-grid (V2G) controls and communications needed to ensure that PEVs are seamlessly integrated into the power system.

The most important issue in PEV integration on the grid is ensuring that customers charge at off-peak times. In California, the largest peaks occur in the summer when air conditioning load is highest, typically in the 2pm to 6pm timeframe. Some utilities have reported that even a single 240V PEV charger could overload transformers during peak hours, under heavy air conditioning or other loads.[102] To mitigate the effects on transformers and other distribution equipment, utilities are striving to make their grids "smarter" – by installing smart residential chargers and metering to ensure that existing transformers are not overloaded.

Another option that many commercial and residential customers will find attractive is integrating solar photovoltaic power into their home energy mix. To the extent that solar power can substitute for more expensive grid-tied power, utilizing solar power to directly charge vehicles may be a cost-effective option, with the added benefit of further reducing greenhouse gas (GHG) emissions. In addition, through vehicle-to-building (V2B) connections, it will be possible for some future PEVs to provide back-up power to homes or offices during a power outage. Finally, as utilities and auto-makers begin to implement full vehicle-to-grid (V2G) connections, PEV drivers and charge station owners may be able to provide a range of ancillary grid services in return for payment from energy service providers.

In the PJM utility system territory in the mid-Atlantic states, for example, a utility-university-industry coalition known as the Mid-Atlantic Grid Interactive Car Consortium[103] (MAGICC) has demonstrated that specially equipped PEVs can provide frequency regulation services to the grid from the vehicle (when plugged into a charging

station) by turning on charging to balance excess supply on the grid, and providing energy back to the grid to balance excess load. This service, when aggregated across many vehicles, can be sold into the wholesale energy marketplace, with payments arranged by an energy aggregation company. According to the MAGICC Consortium, the commercial payments now being provided to fleet owners in the MAGICC pilot test area amount to nearly $2000 per vehicle per year. This kind of compensation for use of PEV batteries could – over the long-term – help transform PEV economics. However, numerous technical and commercial hurdles need to be resolved to make V2G connections a reality in the near-term.

In California, a variety of pilot V2G projects are underway within the Bay Area, at the University of California at Los Angeles, and at UC San Diego. In addition, NRG Energy has announced its intention to enter the V2G market with a product offering that may provide up to $1000 per vehicle per year, once the necessary equipment and communications standards have been adopted by automakers, utilities, and energy service companies.[104] Finally, both Nissan and Mitsubishi have announced support for V2B services,[105] and GM is participating in research.[106] These activities suggest increasing industry movement towards enabling PEVs to participate in the energy services market.

6.3 DC FAST CHARGING

Unlike 240 volt AC Level 2 chargers that take 3 to 8 hours to fully recharge a depleted battery pack, DC Fast Chargers can recharge a Nissan Leaf battery pack from 20% capacity to 80% capacity in just under 30 minutes.[107] While DC Fast Charging is unlikely to be installed in homes due to the high cost of equipment and installation, some commercial enterprises are viewing DC Fast Charging as a business opportunity.

A number of manufacturers have developed DC Fast Chargers for release late in 2011 or early 2012. Most manufacturers are currently going through national laboratory testing and listing. Since no U.S. SAE standard for DC Fast Charging connectors currently exists, early units will be fitted with connectors that meet the Japanese CHAdeMO standard. The Nissan Leaf has DC Fast Charge connectivity available as an option,[108] while the Mitsubishi "i" will have DC Fast Charge as standard equipment.[109] Other automakers have not yet announced their DC Fast Charge plans. Consumers are advised to check with their vehicle manufacturer regarding the appropriate frequency of DC Fast Charging, as some manufacturers indicate possible degradation of battery life if DC Fast Chargers are used as the primary mechanism for charging.[110]

While rapid charge times are beneficial, DC Fast Charging installations raise a number of challenges for property owners and utilities, specifically:

- The power requirements of DC fast charging—anywhere from 50 kilowatts to over 150 kilowatts at 480 volts may require costly electrical upgrades
- The demand on the utility of instantaneous high voltage may require utility upgrades to existing infrastructure
- The current rate structure can result in high electricity demand charges.

Despite these challenges, some regions – notably San Diego and the Bay Area – are moving rapidly to deploy large numbers of DC Fast Chargers, with over 100 DC Fast Chargers planned for the Bay Area in 2011-2012.[111] The U.S. based Society of Automotive Engineers is considering adoption of a new Fast Charge standard (known as Combo-2) that could be adopted by some US and European automakers.[112] Timelines for adoption are uncertain, with estimates varying from three to six years for complete testing, validation, and production of vehicles equipped with a new standard. In the event that an additional DC Fast Charge connector standard is added to the marketplace, vendors anticipate that new chargers would be deployed to meet the additional charging demand from new models, much as diesel and biofuel pumps have been added to many fueling stations. In the absence of a published SAE standard, existing charger makers are not able to determine whether retrofits of existing chargers would be feasible, or how much they might cost.