

# CHARGED UP



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Southern California Edison's Key Learnings  
about Electric Vehicles, Customers and  
Grid Reliability

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*Southern California Edison's key learnings about electric vehicles, customers and grid reliability*

Southern California Edison (SCE) is a national leader in evaluating, demonstrating and facilitating the safe, reliable and efficient connection of transportation to the electric grid. In the past, we've had the nation's largest private fleet of more than 300 plug-in electric vehicles (PEVs) that traveled more than 1 million miles. In 2009, as PEVs began populating showrooms of major automakers, we wanted to make sure that we – and our 5 million customers – were ready for the new plug-in market (SCE estimates that by 2020, there will be about 350,000 PEVs in our service territory). To achieve this, we assembled a cross-functional team of dedicated resources to support SCE's PEV readiness efforts.

Today, our customers own or lease more than 12,000 plug-in vehicles. That represents about 10 percent of national PEV sales. We are fortunate to serve in a state with so many early PEV adopters; this is why most PEV manufacturers consider California a “launch” market. Here is some of what we have learned, which we hope can help utilities, the auto industry and others as PEV adoption continues to grow.

## EXECUTIVE SUMMARY

In this white paper, we share the challenges we are addressing and the solutions we are implementing, with the goal of helping utilities, the auto industry and other industry stakeholders.

Our lessons learned to date focus on several aspects of PEV readiness, including managing PEV load grid impacts and assessing PEV owners' driving behaviors, streamlining infrastructure installation processes within our service territory, assessing effective means for customer communication and more. Specifically, the lessons outlined in this report include:

- **Our Approach to Managing PEV Grid Impact Is Meeting Our Customer Needs:** Current driving patterns combined with PEV features also seem to minimize the impact of PEV charging.
- **Using the “End Charge” Time Programing Feature Is Good for Our PEV Customers and Their Neighbors:** If start times are staggered and cars are charging at different times during the evening, this minimizes grid impacts and supports system reliability.
- **What Our Customers Want to Know Most About PEVs:** Geo-targeted search engine marketing has proven cost-effective in reaching customers interested in a new PEV.
- **Initial Findings Show Early Adopters of Battery-Electric Vehicle (BEV) Technology Demonstrate Consistent and Predictable Behavior:** A sample of early adopters have indicated that any “range anxiety” had been eliminated after driving their new BEV over time.
- **Multi-Unit Residents May Face Complex Challenges:** Fewer than 5 percent of building owners or condominium associations are even considering installing the necessary infrastructure.
- **SCE and the Cities We Serve Are Charged Up and Ready to Go:** Virtually all of the 180 cities in SCE's service territory are committed to helping their residents plug in by streamlining permitting processes and building infrastructure.

Within SCE's culture of continuous improvement, we believe these lessons learned will enhance our ability to become an even better resource for the integration of PEVs into the transportation system.

## 1. Our Approach to Managing PEV Grid Impact Is Meeting Our Customer Needs

When SCE first started its [PEV readiness](#) efforts in 2009, we quantified the anticipated impact of PEVs on the electric grid before consumers began buying and leasing them. Because “early adopters” tend to cluster in the same neighborhoods and because PEVs

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can draw as much as another household’s electricity load, we developed an operational strategy to upgrade distribution circuits. Over time, circuits need to be resized based on standards that match the changing needs of customers. Just as we now size our transformers to serve plasma TVs, we integrated the expected load from PEVs into standards applicable to our “grid modernization” efforts. Since 2010, of all the nearly 400 upgrades we made to (or identified for) circuits that serve PEV customers, only 1 percent of that work was required due to additional power demands from PEVs. The rest of the work was required under our regular infrastructure upgrade and maintenance schedule.

Upgrading all of SCE’s several thousand circuits would have been cost-ineffective and practically impossible. Rather, we decided to upgrade circuits as needed, wherever we were notified of an actual PEV charging location. And if we have to replace a transformer as part of routine maintenance (such as the transformer being near the end of its lifespan), we will replace it with a transformer that meets our new sizing standards, including the potential PEV load.

This approach is consistent with the PEV market’s trends. About 65 percent of SCE customers who own PEVs drive a plug-in hybrid (PHEV), which runs on electricity and gasoline, and about 35 percent drive a battery electric vehicle (BEV), powered solely by electricity. Current data shows that about 50 percent of PHEV drivers charge at Level 1 (120 volts), so we’re seeing a much lower impact on our grid distribution circuits than if more customers charged at the higher Level 2 (240 volts). While we upgrade transformers every day as part of our routine infrastructure maintenance, less than 1 percent of these upgrades is directly attributable to PEVs (in all other cases, the grid needed reinforcement regardless of the PEV charging addition).

Current driving patterns combined with PEV features also seem to minimize the impact of PEV charging. Studies show that about 70 percent of PEV owners commute 40 miles or less daily. Most BEVs can travel at least 60-80 miles of all-electric range on a full charge and PHEVs will generally run 20-40 miles all-electric range on a full charge before going into hybrid mode. As a result, many PEV owners can fuel at night at home and fully recharge their battery during off-peak hours at Level 1. That means low impact on the grid, low installation costs and the lowest electricity costs if customers are on a time-of-use rate. This is why we urge our customers who drive PEVs to charge up every night at home.

There’s one caveat: we are starting to see an increasing market share of BEVs and these come with on-board chargers with higher capabilities (from 3.3 kilowatts to 6.6 kilowatts or even higher). This could create new implications for grid reliability, which SCE is monitoring. SCE encourages its PEV customers to contact the utility for their charging needs, so we can ensure that local distribution circuits meet the additional energy demands of growing numbers of BEVs.

## 2. Using the “End Charge” Time Programming Feature Is Good for Our PEV Customers and Their Neighbors

Many PEVs have settings that can determine a “start charge” time or “end charge” time. It’s better for grid reliability and neighborhood circuits when drivers program their charging to be complete by a specific time.

“Staggered start times at night minimize grid impacts and support system reliability.”

Setting an end time creates a more random start time pattern because batteries have different “states of discharge” and charge at different levels, thus requiring various amounts of electricity. When customers set an “end charge” time for charging to be complete, they randomize the start time of their charging, which prevents a large number of vehicles from coming online at the same time – avoiding power-load spikes that potentially could affect the local distribution system.

For example, it takes three to seven hours to charge a PHEV at Level 1, depending on the vehicle energy storage capacity and battery state of charge. At a Level 2 charge, that same car could be charged in one to three hours. So staggered start times at night minimize grid impacts and support system reliability as cars charge at different times. It helps offset local peaks that can occur when many customers return home at a similar time at the end of a work day and immediately plug in.

## 3. What Our Customers Want to Know Most about PEVs

From the beginning of our PEV readiness efforts, we have developed education materials and a [website](#) to inform our customers as part of the PEV buying cycle. This is critical to ensuring a positive customer experience because customers will have to make several informed decisions with significant cost implications, including metering arrangements, rates, charging equipment and installation. In fact, the California Public Utilities Commission validated our early market approach to education, requiring all investor-owned utilities in the state to fund education efforts accordingly.

“Geo-targeted search engine marketing has proven cost-effective in reaching customers interested in a new PEV.”

Geo-targeted search engine marketing has proven cost-effective in reaching customers interested in a new PEV. A customer who lives in SCE’s service area and types a PEV model in a search engine is likely to see a message from SCE come up with a link to our PEV content.

Since the beginning of the year, we have averaged more than 15,000 unique monthly page views. This tells us that our customers are interested in our PEV content. When SCE customers visit our PEV website, about 46 percent make their first stop with the [Plug-In Car Rate Assistant Tool](#), which helps estimate PEV charging costs. This simple tool asks customers to input the current price of gasoline and their gas-fueled car’s miles per gallon rate, among other basic information, and provides a recommended SCE [PEV rate](#) and projected annual savings on electric bills. Customers also click to find out more about [public charging station locations](#) from our link to the U.S. Department of Energy’s map, [watch videos](#) on PEVs and read background materials on [environmental benefits](#) and [home electric infrastructure requirements](#).

After customers have gathered the needed information, if they have purchased or are about to purchase a PEV, we recommend that they contact the call center to notify us about their new vehicle and confirm the rate most suited to their charging needs.

Looking ahead, we see more customers also engaging with SCE on social media platforms such as [Twitter](#) and [Facebook](#). This will let our customers continue to learn from SCE experts, as well as from other future and current PEV drivers, because we've discovered that those considering PEVs greatly value input from those who already own or lease PEVs.

One important limitation to our education efforts is our obligation to remain neutral when providing PEV information. As much as our customers want us to recommend vehicles, charging equipment or even a contractor to help with the installation, we are not authorized to provide this advice.

#### 4. Initial Findings Show Early Adopters of BEV Technology Demonstrate Consistent and Predictable Behavior

An SCE study of 92 Nissan LEAF owners shows:

- Average daily miles driven: 35.
- Driven more during the weekdays.
- On average charged only once a day, at home and overnight.
- The type of trips taken in the LEAF weekly did not differ from those taken in other household vehicles (except long road trips).

“Any possible ‘range anxiety’ they experienced before buying one has been eliminated.”

Overall, these drivers are very satisfied with the overall BEV experience and indicate that any possible “range anxiety” they experienced before buying one has been eliminated over time, even when they are away from their home-charging infrastructure. Overnight home charging can usually support daily driving patterns and behavior.

Most away-from-home charging takes place at work and at Level 2. At this point, only a few have access to that and use it mostly because it's free (although this dynamic is expected to change in the future). Most participants have access to free Level 2 charging (other than work), but less than 40 percent took advantage of it during the study. Furthermore, they report they rarely use free Level 2. At-home-charging start times also corresponded to the participants' time-of-use rate plan. This showed us that the rate plans are encouraging off-peak charging behavior as designed.

#### 5. Multi-Unit Residents May Face Complex Challenges

We know that about half of SCE's residential customers live in multi-dwelling units, such as condos and apartments. Our research also shows that despite high interest among condo/townhome owners and renters in purchasing a PEV within five years, fewer than 5

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percent of building owners or condominium associations are even considering installing the necessary infrastructure. We understand that the main obstacles are related to the complexity and widely varying costs of PEV installations for this segment. This also underscores the need for regional approaches and solutions.

The complexities relate to the many concerns of all stakeholders, including local cities/government agencies involved in permitting. Issues include:

- Dedicated charging stations in assigned parking spaces vs. community stations that benefit all residents.
- Decisions on who carries the costs of charging equipment, installation and ongoing maintenance, which may include costly electric panel and circuit upgrades.
- Inaccessibility to electricity in parking spaces.
- Costs and payments for charging when the charging station is not connected to an individual customer meter.

Despite these hurdles and the challenges associated with addressing them, there are multiple rebates and incentives to improve the situation (see links available on our [website](#)). In particular, to encourage charging stations at multi-family dwellings, sites can earn points under the [U.S. Green Building Council's Leadership in Energy and Environmental Design](#) (LEED) building certification program for installing charging stations or providing preferential parking for PEVs.

Also, the [Governor's 2013 ZEV \(Zero-Emission Vehicle\) Action Plan](#) and the [California PEV Collaborative \(of which SCE is a member\)](#) are focusing more on bringing together key players to address this issue, particularly in new multi-family developments. The PEV Collaborative's recommended solutions include, but are not limited to: relying on Level 1 charging, installing Level 2 charging equipment to supply multiple parking spaces and installing charging equipment closest to electric supply services to minimize costs.

## 6. SCE and the Cities We Serve Are Charged up and Ready to Go

Customers had inconsistent experiences before we started our PEV Readiness programs. When BMW launched its MINI E pilot in 2008, excitement turned to frustration for some. Our internal backlogs and lack of coordination with cities, counties, and external agencies meant that people sometimes

had to wait several weeks to switch over to an SCE PEV rate, arrange for any necessary home infrastructure upgrades and receive the required permits and inspections.

**“Virtually all of the 180 cities in SCE's service territory are committed to helping their residents plug in by streamlining permitting processes and building infrastructure.”**

In 2010 and 2011, we re-engineered our processes and began collaborating closely with the cities in our service territory, sharing best PEV practices and supporting their improvement efforts. Today, the entire process of switching rates, upgrading infrastructure, permitting and inspection averages four to five days.

We're proud to say that virtually all of the 180 cities in SCE's service territory are committed to helping their residents plug in by streamlining permitting processes and building infrastructure. [Cities' work to become PEV ready](#) also helps meet their “green” objectives, while supporting SCE's long-term goal of providing a positive experience for our customers who adopt these vehicles into their lifestyles. SCE has identified 50 cities or counties as having a “verified plan” to implement best PEV practices, such as streamlining the process for

infrastructure installations, with single-day city permits and inspections for homes, plus inspections for businesses within 24 hours.

SCE has also recognized the “Champion Cities” of Beverly Hills, Lancaster, Rancho Cucamonga, Rolling Hills Estates, Santa Barbara, Santa Monica and Seal Beach. These municipalities went above and beyond their verified plan by actually implementing PEV readiness best practices and meeting the Champion Cities program’s evidence requirements, including:

1. Implementing process streamlining for EVSE infrastructure installation
2. Implementing public education and outreach programs
3. Actively participating in regional PEV readiness initiatives
4. Implementing PEV infrastructure
5. Amending building codes for PEV charging

These “Champion Cities” are leading the way and have demonstrated to others that it is possible to implement sound and effective PEV readiness practices, even as many communities face difficult financial times.

## **CONCLUSION**

Like the rest of the PEV industry, SCE will keep working to provide safe, reliable and cost-effective charging. We are committed to continuing improvements to help our customers make the best possible decisions to meet their PEV charging needs.

This document highlights some recommended PEV practices in the areas of grid management, home fueling infrastructure and customer interface. We encourage other utilities, the auto industry and other industry stakeholders to continue close collaboration and share their own lessons learned as drivers increasingly transition to PEVs and a new way to fuel.

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**CONTACT:** To learn more about our work in PEV readiness, visit [www.sce.com/ev](http://www.sce.com/ev).

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