Electric Vehicles Are Driving Electric Rates Down

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Electric Vehicles are on the Rise

Plug-in electric vehicles (EVs) are growing as a share of the light duty vehicle market in the US and globally. In California, EV sales have been increasing especially rapidly. Between September 2017 and August 2018, EVs accounted for 6.5 percent of new light duty vehicle sales in California.[1] California's two largest utilities, Pacific Gas & Electric (PG&E) and Southern California Edison (SCE), estimated that there were more than 250,000 EVs in their service territories in 2017,[2] a number which has certainly increased substantially since that time.

Another sign of the accelerating transition to cleaner electric transportation is the number of electric models that auto manufacturers are planning to introduce in the next few years. According to a June 2018 study by the consulting firm AlixPartners, 207 new EV models will be available globally by 2022.[3] With more available options that suit a wider range of customer needs, EV sales are likely to continue increasing in the coming years. With large quantities of cars plugging into the grid, there is a potential for significant electric utility system impacts.

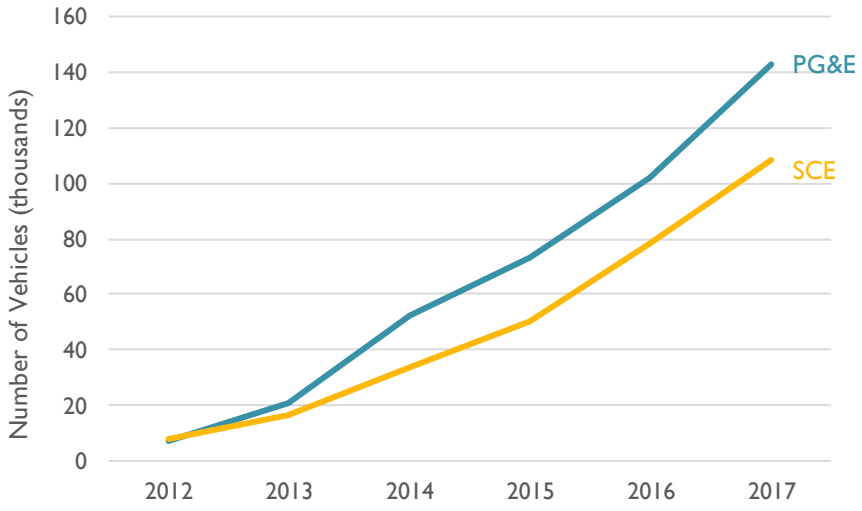
How are EVs Affecting Electricity Rates?

Recent growth in EV adoption has raised the question of how EVs affect the electricity rates paid by all households, including those that do not own EVs. This is an important equity question that should be analyzed when determining the role that electric utilities should play in supporting the transition to EVs. Answering this question requires comparing electric utility revenues from EV charging with utility costs associated with serving EV load. If the utility revenues from EVs exceed the utility system costs, then EV adoption can reduce electricity rates for all customers. Conversely, if the costs are greater than the revenues, non-EV owners could end up paying more for their electricity.

To address this question, Synapse evaluated the utility system revenues and costs associated with EVs for the two utilities with the most EVs in their service territories — PG&E and SCE. Specifically, we analyzed the electricity rates that EV owners pay compared to the marginal cost of electricity plus the costs associated with any upgrades to the grid required to accommodate EV charging and the expenditures resulting from utility EV infrastructure programs.

Our analysis relied on EV load profiles from the California *Joint IOU Load Research Reports*, as well as on-peak and off-peak marginal costs filed by the utilities in their most recent rate cases.[4] We also used the load profiles for residential customers that are available on PG&E's and SCE's websites as an estimation of residential load profiles without EVs.

Figure 1. Cumulative EV Adoption in California Utility Service Territories



Real World Revenues from EVs

Adding an EV can significantly increase household electricity consumption. Based on annual mileage data collected by the California Air Resources Board, we estimate that EVs in California between 2012 and 2016 increased consumption by approximately 250 kilowatt hours (kWh) per month.

Currently, most California EV drivers pay tiered electric rates, in which the price of electricity increases as customers move into higher-usage tiers. The extra electricity required to charge EVs is likely to push people into higher tiers. As a result, these customers tend to pay high rates for charging their electric vehicles.

However, roughly one quarter of EV drivers in California are on time-of-use (TOU) rates. These rates have different prices during on-peak hours and off-peak hours, and are meant to align prices more closely with the actual cost to provide electricity during those hours. By charging EVs primarily during off-peak hours, customers can simultaneously lower their electric bill and reduce costs on the grid.

Figure 2. Estimated PG&E EV Charging During Summer Peak and Off-Peak Periods

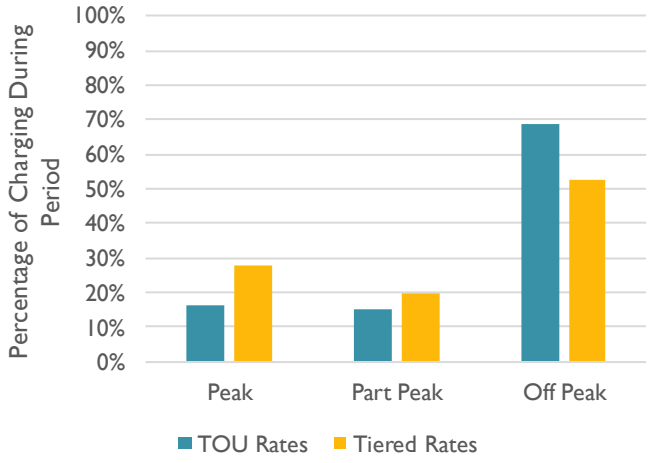


Figure 3. Estimated SCE EV Charging During Summer Peak and Off-Peak Periods

Accounting for the Costs Imposed by EVs

EV customers on tiered and TOU rates have differing charging patterns, with those on TOU rates shifting more of their usage to off-peak hours. For our analysis, we first estimated the hourly load associated with EV charging on both TOU and non-TOU rates. This was done by taking the difference between the load profiles for EV customers provided in the 2017 *Joint IOU Electric Vehicle Load Research Report*[5] and average load profiles for all residential customers.[6]

Next, we estimated the cost associated with serving additional load during those hours. A substantial portion of electricity costs are related to serving system peak demands. Peak demand is the largest amount of power that the grid needs to be able to supply instantaneously. The utility system must be built with enough generation, transmission, and distribution capacity to meet the local and system-wide peaks, even though it's needed only for a few hours a year. An important way that EVs can limit grid costs is by charging off peak and avoiding contributing to higher peak demands (and thus the need to invest in more distribution, transmission, and generation assets).

Figures 2 and 3 contrast the charging habits of EV customers on TOU rates (left bars) relative to EV customers on tiered rates (right bars) during the peak, part-peak, and off-peak periods. In PG&E's service territory, customers on TOU rates charge almost 50

percent less during peak periods than do customers on tiered (non-TOU) rates. As EV adoption increases, TOU rates will be increasingly important as a way of encouraging charging during off-peak periods to minimize utility system costs. California is in the process of adjusting TOU periods and implementing default residential TOU rates, which will help in this regard, though optional TOU rates will still be critical to manage load and increase fuel cost savings.

To estimate the total cost of serving EV load, we used utility marginal cost data for energy, generation capacity, and transmission and distribution capacity. These costs vary by time of day, and therefore we accounted for the difference between peak and off-peak costs wherever possible.

Energy Costs

EVs require more electricity to be generated whenever they are charged. The marginal cost of energy is equal to any fuel and other operational costs required to produce one additional unit of electricity. Producing electricity is more expensive at times when there is higher demand and older, more expensive power plants are used to generate the additional electricity. In contrast, electricity costs can be trivial during hours when low-cost renewable energy is plentiful.

Generation Capacity Costs

Generation capacity costs are associated with ensuring that enough power plants are available to meet the grid's peak demand (plus a reserve margin). Additional power plants may be needed if EVs require electricity during peak hours, and this can impose additional costs.

Transmission and Distribution

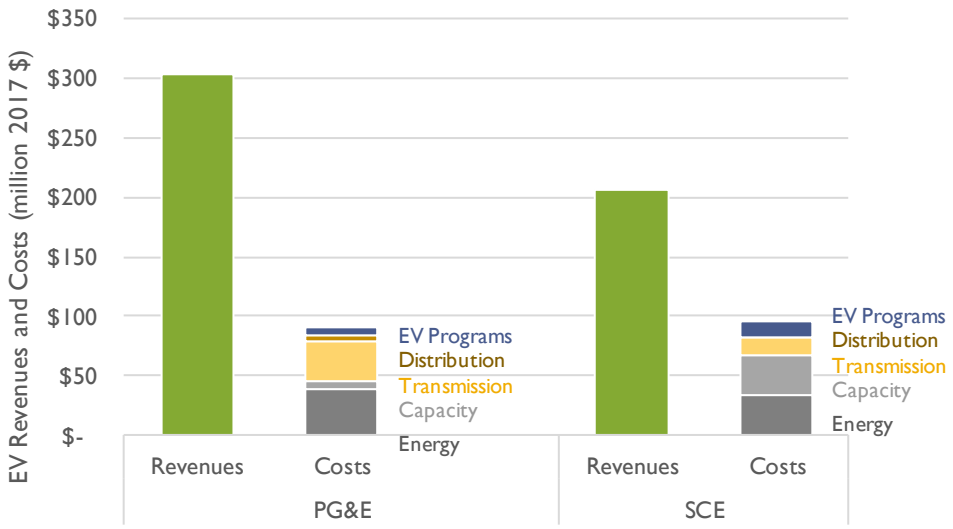
Transmission and distribution system costs reflect the cost of delivering electricity from power plants to customers. These costs are also heavily dependent on peak load because transmission and distribution lines are sized to handle the highest instantaneous amount of power they need to transmit. Increased electricity consumption from EVs could eventually lead to a need for new transmission lines.

Utilities may also need to upgrade the distribution systems that provide electricity to end-users if the local peak demand increases. A neighborhood in which there are many EVs, for example, could require distribution system upgrades to serve the new EV load. So far, California load research data indicates that these upgrade costs have been quite small. Accounting for inflation, distribution upgrade costs through 2017 were less than 1.5 percent of EV revenues in PG&E's service territory and 0.2 percent of EV revenues in SCE's service territory.[7,8]

Utility Programs

The California Public Utilities Commission has approved a variety of utility programs to support transportation electrification. The expenditures to date have been relatively modest, but will increase over the next several years. We accounted for utility program expenditures through 2017 in our analysis. While expenditures associated with such programs will increase in future years, so will the revenues from a growing number of EVs.

Figure 4. PG&E and SCE Revenues and Costs of EV Charging, 2012-2017

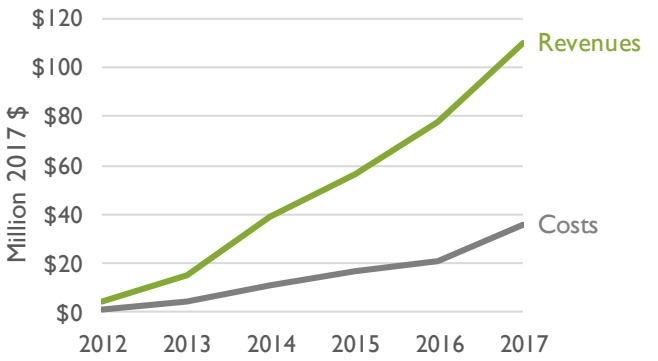


Results

Our analysis indicates that, from 2012 through 2017, EVs in California have increased utility revenues more than they have increased utility costs, leading to downward pressure on electric rates for EV-owners and non-EV owners alike. This finding holds across both utilities, and for customers on standard tiered rates and TOU rates. Figure 4 shows the extent to which revenues from EVs outweigh the costs imposed for the period 2012-2017.

A key reason why revenues from EVs outweigh the costs is that EV customers — particularly those on TOU rates — tend to charge during off-peak hours. By charging during off-peak hours, EVs impose minimal costs on the grid and help to utilize resources more efficiently.

Figure 5. PG&E Revenues and Costs Associated with EVs



Revenues from EVs Can Help Fund EV Charging Infrastructure

EVs can provide substantial emissions reductions while also helping to reduce electricity rates for all customers by using the system more efficiently. Utilities can play an important role in ensuring that EVs benefit both EV drivers and non-EV drivers alike by encouraging EV customers to enroll in TOU rates. In addition, utility investments to facilitate the deployment of charging infrastructure can help close a growing charging infrastructure gap and accelerate EV adoption, increasing associated revenues in the process.

If done carefully, utility-funded investments can deliver benefits to all ratepayer in excess of their costs. Our analysis indicates that increased EV adoption in California has already resulted in more electricity revenues than costs, and future growth in the EV market will lead to further increases in utility revenues.

The gap between revenues and costs associated with EVs has increased over time. With TOU rates and targeted investments in charging infrastructure, EV adoption can reduce costs for both EV-drivers and other electric customers while also cleaning the air and insulating consumers from the volatility of the world oil market.

ENDNOTES

[1] Alliance of Automobile Manufacturers. Advanced Technology Vehicle Sales Dashboard. Available at https://autoalliance.org/ energy-environment/advanced-technology-vehicle-sales-dashboard/

[2] Southern California Edison Company, Pacific Gas and Electric Company, and San Diego Gas & Electric Company. December 29, 2017. Joint IOU Electric Vehicle Load Research Report: 6th Report.

[3] AlixPartners. 2018. "A 'pile-up of epic proportions' awaits auto industry as investments necessary to an electric and autonomous future balloon just as market slows, according to AlixPartners study." Available at https://www.alixpartners.com/media-center/press-releases/pile-up-awaits-auto-industry-investments-electric-autonomous-future-balloon/

[4] Southern California Edison Company, Pacific Gas and Electric Company, and San Diego Gas & Electric Company. December 29, 2017. Joint IOU Electric Vehicle Load Research Report: 6th Report.

[5] Southern California Edison Company, Pacific Gas and Electric Company, and San Diego Gas & Electric Company. December 29, 2017. Joint IOU Electric Vehicle Load Research Report: 6th Report.

[6] Dynamic Load Profiles for PG&E rate class E-1 available at https://www.pge.com/nots/rates/tariffs/energy_use_prices.shtml, and for SCE rate class DOM-S/M available at https://www.sce.com/regulatory/load-profiles/dynamic-load-profiles.

[7] Southern California Edison Company, Pacific Gas and Electric Company, and San Diego Gas & Electric Company. 2012-2017. Joint IOU Electric Vehicle Load Research Reports.

[8] Total distribution system upgrade costs between 2012 and 2017 were $4.5 million for PG&E and $0.3 million for SCE, both in 2017 dollars.