Electric Vehicles Are Driving Electric Rates Down

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Plug-in electric vehicles (EVs) offer a key opportunity to reduce harmful emissions and save customers money at the same time. EVs are responsible for far fewer greenhouse gases and local air pollutants than conventional vehicles and become cleaner as more renewable electricity is added to the grid. In addition, EVs are generally much less expensive to operate than conventional vehicles.

EVs are growing as a share of the light-duty vehicle market. As of the June 2022, more than 2.7 million EVs had been sold in the United States alone.[1] Large quantities of cars plugging into the grid could have substantial electric utility system impacts. EVs hold significant potential to reduce electric rates for all customers because they can bring in more revenue than associated costs, largely due to the fact EVs can be charged during hours of the day when the electric grid is underutilized.

This analysis examines costs and revenues associated with EVs between 2012 and 2021 in three of the top utility service territories in the United States for EV penetration: Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). **We observe that over the last decade, EV drivers in PG&E's, SCE's, and SDG&E's service territories have contributed approximately $1.7 billion more in revenues than associated costs, driving rates down for all customers.**

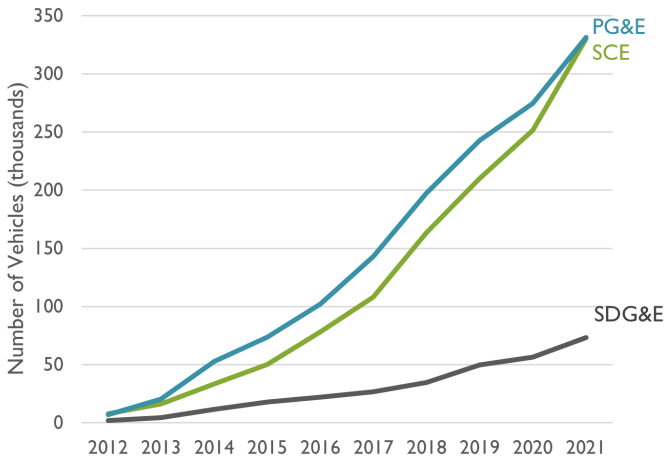
How Are EVs Affecting Electricity Rates?

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 using real-world data, Synapse evaluated the utility system revenues and costs associated with EVs in the service territories of PG&E, SCE, and SDG&E. At the end of 2021, these three utilities alone served more than 735,000 EVs.[2]

Specifically, we analyzed the electricity rates that EV owners pay compared to the marginal cost of providing that electricity (generation, transmission, and distribution costs) plus the expenditures associated with utility EV programs.

Figure 1. Cumulative EV Adoption in California Utility Service Territories



We developed two scenarios to analyze the revenues and costs from EVs: one in which we assumed EVs took service on tiered rates and charged without respect to system costs, and the other in which we assumed 75 percent of customers took service on a time-of-use (TOU) rate and charged primarily off peak. The load curves for each scenario were informed by the EV load profiles from

the California Joint IOU Electric Vehicle Charging Infrastructure Cost Reports,[3] as well as hourly marginal costs from the California Public Utilities Commission's Avoided Cost Calculator.[4] We also used the load profiles for residential customers that are available on PG&E's, SCE's, and SDG&E's websites as an estimation of residential load profiles without EVs.

Revenues from EVs

Charging an EV can significantly increase household electricity consumption. On average, we estimate that EVs in California increase consumption by approximately 260 kilowatt hours (kWh) per month.

California is currently transitioning to default TOU rates and away from the prior default tiered electric rates. Under the previous tiered rate structure, the price of electricity increased as customers moved into higher-usage tiers. The extra electricity required to charge EVs is likely to push people into higher tiers. As a result, EV drivers on tiered rates historically paid high prices for charging their EVs.

Unlike tiered rates, TOU 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.

Accounting for the Costs Imposed by EVs

The costs imposed by EVs are the most important factor in determining the impact of EVs on electric rates for all customers. Fortunately, the Electric Vehicle Charging Infrastructure Cost Reports filed by the utilities show that, when on TOU rates, EV customers are charging at low-cost times for the grid.

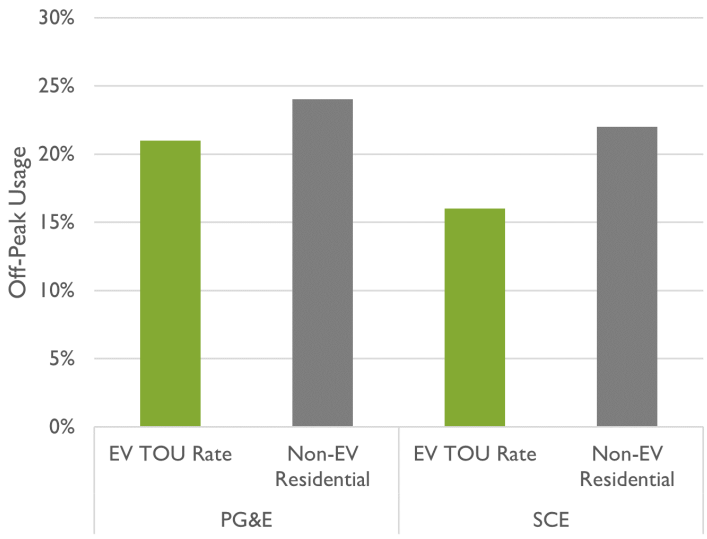
EV Customers on TOU Rates Charge in Low-Cost Ways

The California TOU rate structures generally include a high-priced on-peak period, a low-priced off-peak period, and an in-between mid-peak period. It turns out that these rates are effective at encouraging customers to shift their electricity usage to lower-cost hours, based on 2021 data from the 10th Joint IOU Electric Vehicle Charging Infrastructure Cost Report.

EV Customers on TOU Rates Charge Off Peak

In California, most residential customers have already transitioned to TOU rates, or are in the process of doing so. However, EV-TOU rates provide even stronger price signals to encourage customers to use the grid at lower cost times. These price signals have been effective in encouraging customers to charge off peak, as evidenced by two different metrics provided by the utilities. First, the share of total on-peak usage consumed by customers on whole-home EV-TOU rates relative to non-EV customers indicates that customers on EV rates use a greater proportion of their energy during off-peak hours, even though they tend to consume significantly more energy in general.[5] This is shown in the figure below.

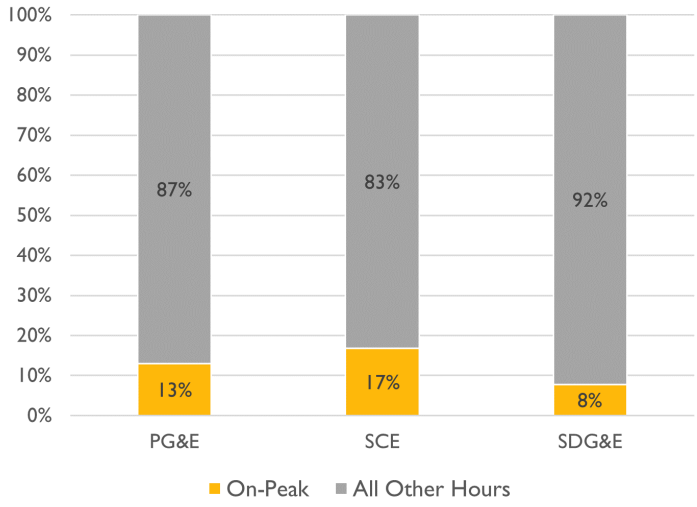
Figure 2. Percentage of Whole-Home Energy Consumption During Off-Peak Hours



Rather than increasing demand on the system, EV customers on TOU rates often hit their monthly maximum demand when the system is least taxed—typically between 11 p.m. and 2 a.m.

Data from the utilities indicate that customers whose EVs are separately metered charge their vehicles outside of on-peak hours between 83 percent and 92 percent of the time, as shown in the following figure.[6]

Figure 3. Share of Charging Occurring during On-Peak and Other Hours



EV Customers on TOU Rates Have Diverse Loads

Residential customers on EV rates tend to have a maximum non-coincident peak demand of approximately 8 kW, which is the power drawn by a typical Level 2 charger.[7] EV customers tend to reach their peak demand at night from 1:00-2:00 am for PG&E customers and from 10-11 pm for SCE customers.[8] This can be thought of as the "Residential EV Class Peak." Although the EV class peak occurs during off-peak hours, concerns have been raised that the combined EV charging demand will result in high costs on the distribution system, particularly if all EV customers plug in when the off-peak period begins. (These have been referred to as "timer peaks.")

Thankfully, this concern is not supported by the data. Instead, the average EV customer's load during the residential EV class peaks is only about 1.9 kW for PG&E EV customers and 1.2 kW for SCE EV customers.[9] This demand is similar to non-EV owners' average demand during the residential class peaks.[10]

To summarize, not all EV customers are plugging in at the same time each night, or they may not be charging every night. This results in average demand during the EV class peak hours being on par with non-EV customers' maximum loads during the residential class peak hours.

Impacts on Rates

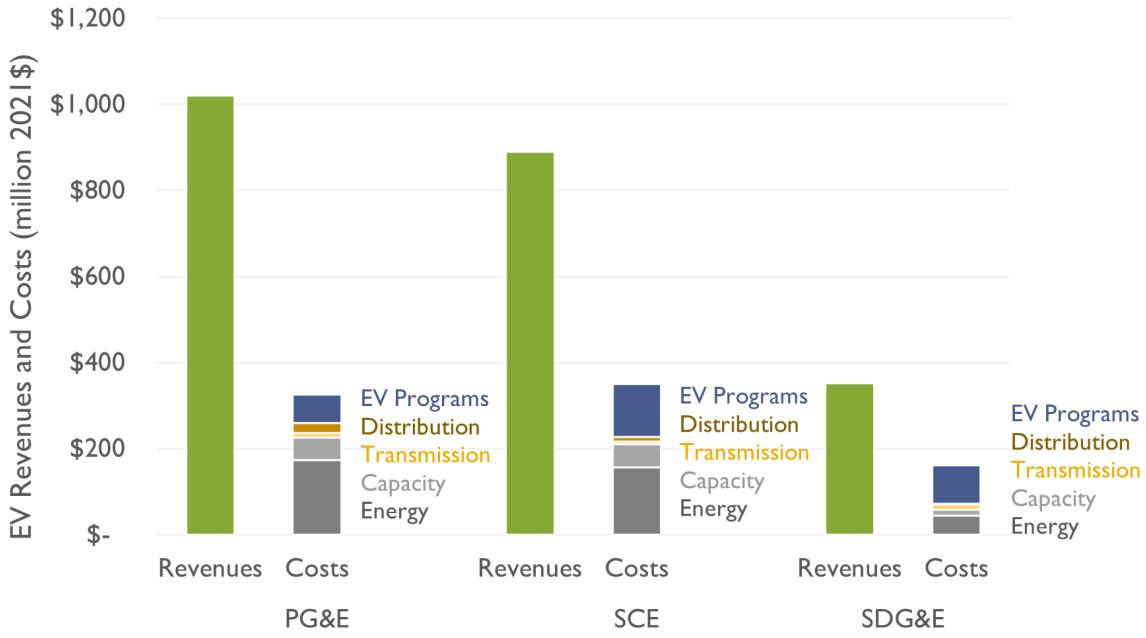
By comparing the revenues from EVs to the costs imposed by EVs, we can determine the impacts that EVs are having on electricity rates. Since California is currently in the process of transitioning to default TOU rates, we conducted this analysis for one case in which most EV customers were assumed to be on traditional tiered rates (as has been the case in recent years) and one in which 75 percent of customers were assumed to be on TOU rates. The rate structure that a customer is on impacts both (1) the utility revenues associated with EVs and EV charging behavior and (2) the associated electric supply and distribution costs. Importantly, we find that EVs generate more utility revenue than costs and put downward pressure on rates for customers in both cases.

The results of our analysis indicate that, across three of the service territories serving the most EVs in the United States, EVs 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. Under the assumption that customers have been paying mid-tier rates between 2012 and 2021, we estimate that EV drivers in PG&E, SCE, and SDG&E territories have contributed $1.7 billion more than associated costs (in 2021 dollars). Figure 4 shows the extent to which revenues from EVs outweigh the costs imposed for the period 2012-2021 under this scenario.[11]

In the case in which 75 percent of EV customers were assumed to take service on rates designed for EVs,[12] revenues still exceeded costs between 2012 and 2021 by a total of $1.4 billion.

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. In fact, recent research conducted by Lawrence Berkeley National Laboratory, PG&E, and the Natural Resources Defense Council shows that shifting EV charging to off-peak times could allow the grid to accommodate all homes having

Figure 4. Revenues and Costs of EV Charging, 2012-2021



EVs without upgrading most parts of the distribution system.[13]

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 that facilitate the deployment of charging infrastructure can accelerate the EV market, growing the potential benefits from widespread EV adoption.

If done carefully, utility-funded investments can deliver benefits to all ratepayer in excess of their costs. Synapse's analysis indicates that increased EV adoption in the two utility service territories with the most EVs in the United States has already resulted in more electricity revenues than costs, and future growth in the EV market will lead to further increases in utility revenues. With TOU rates and targeted investments in charging infrastructure, EV adoption can reduce costs for both EV drivers and other electric customers while reducing harmful emissions.

ENDNOTES

[1] Alliance for Automotive Innovation (2022). Advanced Technology Vehicle Sales Dashboard. Data compiled using information provided by IHS Markit and Hedges & Co. Last updated 9/15/2022. Retrieved from https://www.autosinnovate.org/resources/electric-vehicle-sales-dashboard.

[2] 10th Joint IOU Electric Vehicle Charging Infrastructure Cost Report, filed in Rulemaking 18-12-006. April 1, 2022.

[3] These were previously referred to as the Load Research Reports. These have been filed in various dockets, including R. 09-08-009, R. 13-11-007, and R. 18-12-006.

[4] 2022 Avoided Cost Calculator. Available at https://www.ethree.com/public_proceedings/energy-efficiency-calculator.

[5] 10th Joint IOU Electric Vehicle Charging Infrastructure Cost Report. Data for non-NEM customers, pp. 19 and 56. SDG&E was excluded, as no data for non-EV customers was reported.

[6] *Id.,* pp. 19, 57, and 89.

[7] *Id.,* pp. 23 and 71.

[8] *Id.,* pp. 25 and 70.

[9] *Id.,* p. 71.

[10] *Id.,* pp. 19, 57, and 89.

[11] This assumes that program costs are depreciated over 10 years.

[12] Historically this value has been closer to 20 percent.

[13] Coignard et al., Will Electric Vehicles Drive Distribution Grid Upgrades?: The Case of California. June 5, 2019. Available at https://ieeexplore.ieee.org/document/8732007.

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