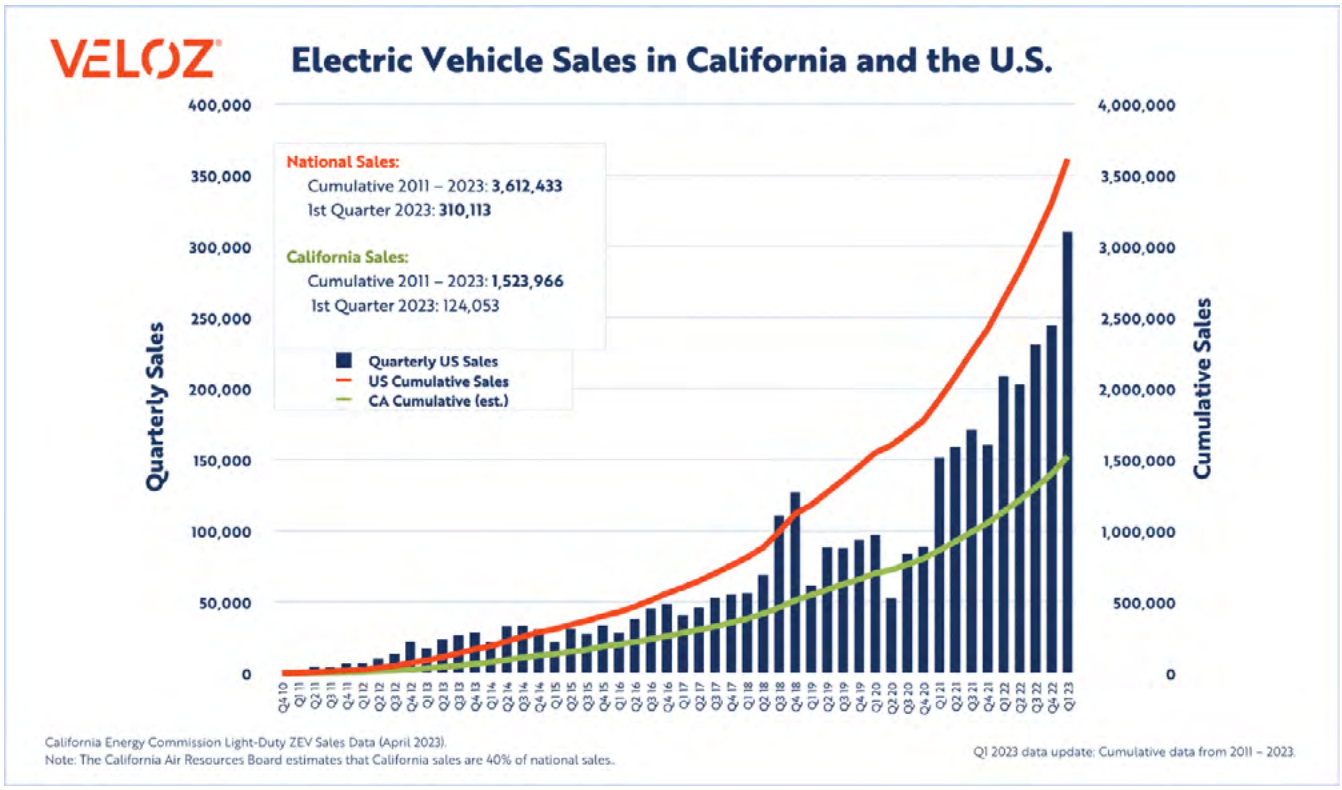
MODERN ELECTRIC VEHICLE **RATE DESIGN OPTIONS**

In Part 1 of this series, "Is Your EV Strategy Ready — Yet?", we examined why it's important for utilities to develop an electric vehicle strategy to meet the rising demand. Here, we delve into rate design options for EV charging.

Electric vehicle (EV) sales increased dramatically in 2022, with more than 750,000 new all-electric cars registered in the United States — a 55% increase over 2021 sales. Data from the California Energy Commission in the figure below show EV sales in California and the U.S. from 2011 through the first quarter of 2023. While the trend is upward, analysts describe the recent increase as "explosive."[1]

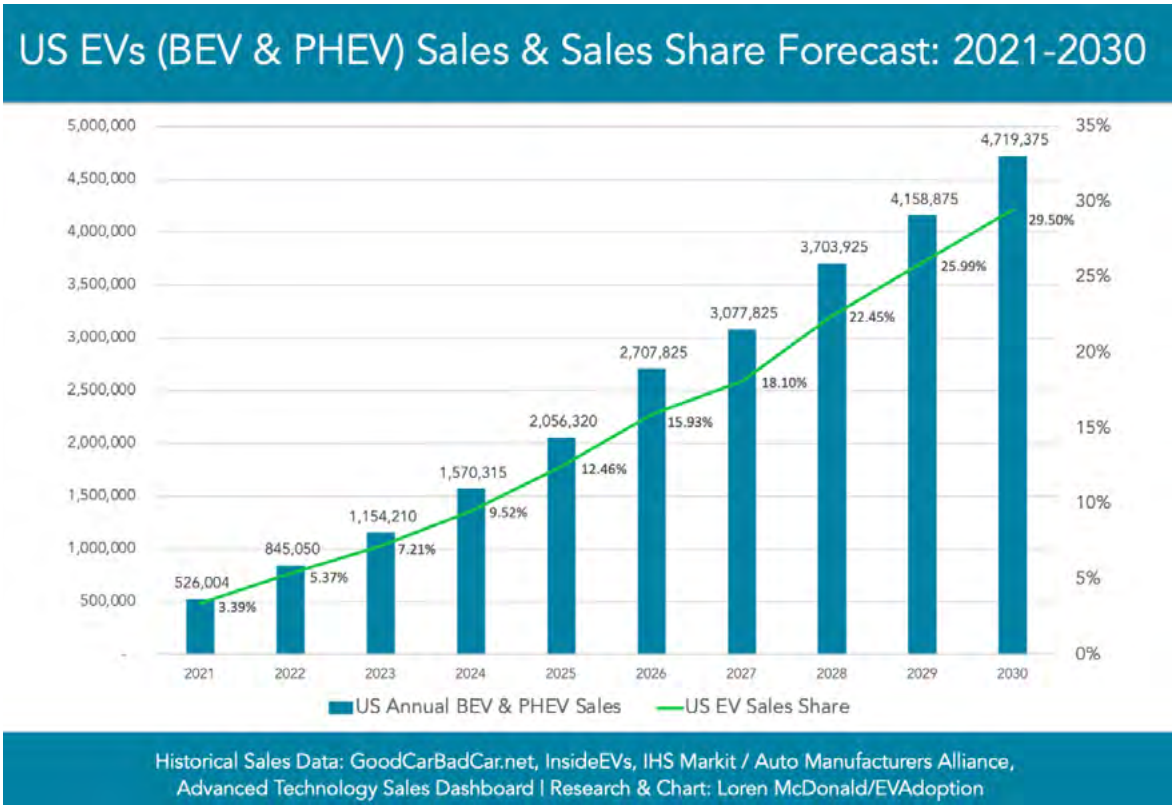


Source: California Energy Commission website

[1] Lauren Sforza, "U.S. Electric Vehicle Sales Surge in 2022, Gain on Tesla," The Hill, January 6, 2023.

Factors contributing to this growth include consumers' interest in protecting the environment, improvements in battery capacity and range, and government policies such as the Infrastructure Investment and Jobs Act and the Inflation Reduction Act tax credits for EVs.

Along with the increase in sales, the EV market share has been steadily rising, as the graph below demonstrates, and is predicted to exceed 30% or more of total vehicle sales by 2030.[2]



Note: EVs include battery EVs and plug-in hybrid EVs.
Source: EVAdoption EV Sales Forecasts

Although forecasts vary widely because of rapid changes in government policies and the automobile industry, many analysts expect strong acceleration in EV adoption. S&P Global Mobility predicts that EV sales could reach 40% of total U.S. passenger car sales by 2030, and others believe EV sales could exceed 50% by 2030.[3] In certain jurisdictions, the growth trend may be expedited by local laws and regulations that establish aggressive carbon-emission goals.[4]

At this growth rate, the International Energy Agency estimates EV electricity demands will reach 153 TWh by 2030,[5] compared with 2.94 TWh in 2018 and 4.68 TWh in 2020.[6] That's an increase of over 32 times!

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[2] Javier Colato and Lindsey Ice, "Charging into the Future: The Transition to Electric Vehicles," Bureau of Labor Statistics, Beyond the Numbers, Vol. 12, No. 4, February 2023.

[3] Ibid.

[4] For example, California legislation requires all new passenger vehicles and light trucks to be EVs or plug-in hybrid EVs by 2035. California Air Resources Board, "Advanced Clean Cars II Regulations," August 25, 2022.

[5] International Energy Agency, "Electricity Demand from the Electric Vehicle Fleet by Country and Region, 2030," October 26, 2022.

[6] Jeffrey Ryser, "US EV Sales Tumble in 2020, but EV Load Increases with More Charging Stations," S&P Global Commodity Insights, January 29, 2021.

THE EV **GROWTH EFFECT**

If growth rates to 2030 are even close to those projected, utility distribution systems will face massive challenges, as most are not designed or equipped to handle the increased load. For example, according to current information from Calmatters,[7] to meet total electricity demand, California would have to:

- Encourage off-peak charging of EVs.
- Accelerate the shift toward solar and wind power generation, including vast construction of wind farms.
- Expand the number of public chargers in the state by 1500%.
- Develop technology to send electricity from cars back to the grid at high-demand times.
- Increase electricity production 85% by 2045, which would require generation capacity to be tripled.

Utilities can take measures to help mitigate the EV load issues. These include upgrading the distribution system, targeting specific circuits with energy efficiency measures to reduce load, and encouraging customers to adopt behind-the-meter distributed energy resources. These are expensive to undertake and would have large disruptions on traffic, roads, and residential neighborhoods. A better alternative to spending a vast amount of capital on infrastructure is to redesign tariffs to manage the charging load, fairly recover costs, and empower customers with flexible rate alternatives.

To gain a greater understanding of rate-based solutions, we identified and analyzed several modern EV rate designs, weighed their pros and cons, and explored how to implement them.

TIME-OF-USE RATES

The most common way for utilities to manage EV charging is time-of-use (TOU) pricing tariffs. According to a recent report by the North Carolina Clean Energy Technology Center, new EV rate structures with time-varying rates were considered in 31 states during 2022.[8] The graphic on the next page demonstrates EV charging rates as much as 95% lower at off-peak times, typically at night. However, as solar photovoltaic deployment continues to rise and daytime power prices fall, off-peak times will begin to shift.[9]

TOU rates provide strong incentives to encourage off-peak charging and are appropriate for EVs because such rates encourage charging when costs on the system are lowest and environmental benefits are greatest. TOU rates can be real-time, hourly, or based on distinct time periods, or they can be discounts for use during off-peak periods. Many utilities have adopted TOU rates that apply to the whole household, and now many utilities are beginning to develop TOU rates that apply to EV charging only. Each approach has pros and cons.[10]

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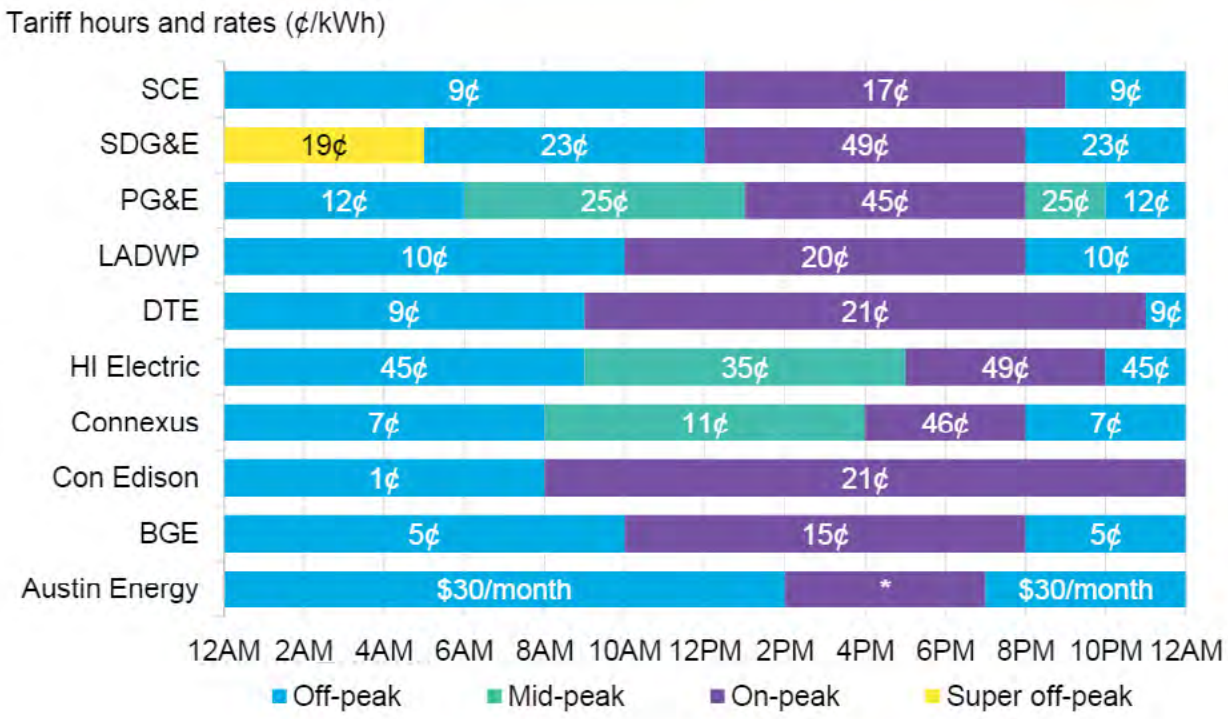
[7] Nadia Lopez, "Race to Zero: Can California's Power Grid Handle a 15-Fold Increase in Electric Cars?" Calmatters, February 6, 2023.

[8] North Carolina Clean Energy Technology Center, "The 50 States of Electric Vehicles," February 2023.

[9] Bloomberg New Energy Finance, "U.S. Utilities Offer Multiple Electric Car Charging Rates," July 7, 2017.

[10] For additional details, see Alliance for Transportation Electrification, "Electric Transportation Rate Design Principles for Regulated Utilities," July 2021.

EV Charging Tariffs for Selected U.S. Utilities



** Indicates charging is discouraged.*

Source: Bloomberg New Energy Finance

Whole-House TOU Rates

Many utilities across the country already offer voluntary whole-house TOU rates and have deployed advanced metering infrastructure (AMI) to capture the required supporting interval data. These rates generally include super off-peak rates at times when supply is high and/or demand is low. Interestingly, this does not necessarily mean overnight. For example, in Arizona, where the proliferation of solar is high, afternoon load is so desirable that "reverse demand response" programs were approved in 2017 to shift the super off-peak TOU period to the afternoon, when solar production is high and there is often excess generation.

The challenge with whole-house rates is that the high on-peak charges apply to the home's entire electricity usage, not just the EV charging. In California, for example, whole-house rates expose Pacific Gas and Electric (PG&E) customers to rates as high as 56 cents per kWh from 4 p.m. to 9 p.m., which is much higher than the statewide average rate of 26 cents per kWh. Customers may be willing to shift EV charging to the overnight hours, but other, more traditional evening household usage may not be as flexible and could incur higher charges.

EV-Specific TOU Tariffs

In response to the challenges of whole-house rates for EVs, utilities are developing EV-specific TOU tariffs that apply only to the power an EV uses. These tariffs reflect system electricity demand patterns, localized electricity demand patterns, and resource availability. Each utility has unique conditions that justify different TOU tariff

structures to manage EV demand. The key to higher participation in these optional EV-charging rates is evolving technology that allows measurement of EV usage without separate meters.

For example, instead of a whole-house rate, Indiana Michigan Power created a TOU option specific to stand-alone EV charging.[11] Through smart EV charger technology or the installation of separate metering, the utility can isolate the demand requirements for the EV, allowing customers to use energy for all other loads on a business-as-usual basis. This allows customers to retain their usual whole-house flat rate and take advantage of a TOU rate strictly for EV charging. In addition, the EV-specific metering has the added benefit of providing more detailed consumption data for the utility to use in EV forecasting and planning.

One challenge with the EV-only rates has been the cost of installing a second meter. However, most EV chargers now come with Wi-Fi capability (i.e., virtual submetering), and states are beginning to develop communication protocols for submetering of EV chargers. To leverage virtual submetering technologies for EV charging, utilities will need to ease their concerns about the accuracy and verifiability of data from sources other than revenue-grade meters.

SUBSCRIPTION-BASED EV RATES

In California, PG&E offers a commercial and industrial monthly subscription-based EV rate, in which the subscription charge is designed to avoid demand charges. The rate combines a customizable monthly subscription charge with an energy-only TOU rate calculated to blend demand-related costs of service. Charging is most affordable midday, when PG&E has higher levels of renewable generation.

Austin Energy also recently added a flat $0.21/minute rate for the city's more than 25 fast chargers to its ongoing Plug-In EVerywhere network subscription plan, which offers unlimited charging for $4.17/month at its over 1,000 level 2 public charging ports.[12]

Xcel Energy's EV Subscription Service pilot in Minnesota is currently at its maximum number of participants, but the utility has a proposal before the Minnesota Public Utilities Commission that includes a request for this program to become permanent, allowing a larger number of participants or removing the enrollment limit entirely. The pilot offers unlimited EV charging from 9 p.m. to 9 a.m. for flat monthly charge of $42.50 that includes rental, installation, and maintenance of the charger, data and service fees, and energy charges for overnight and weekend charging.[13] A lower monthly subscription rate of $32.65 is available if customers pay for the charger and installation in a lump-sum amount of $770.

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[11] Michigan Public Service Commission, Indiana Michigan Power Company Electric Rate Book M.P.S.C. 17, February 10, 2020.

[12] Austin Energy, "Plug-in Austin Electric Vehicles."

[13] Xcel Energy, "EV Subscription Service Pilot."

MANAGED CHARGING **INCENTIVES**

Baltimore Gas and Electric (BGE) is leveraging separately metered level 2 chargers to directly control when customers can charge their EVs. Its Residential EV Smart Charge Management program allows the utility to modify the customer's EV charging at any time to help manage peak demand. Customers are permitted to opt out of the program a maximum of four times per month before losing eligibility for the monthly bill credit incentive, and they must retain the incentive for at least three months of the year to remain in the program. This program is also available to commercial customers. BGE provides level 2 chargers for the participating customer's EV fleet and assigns a specific charging schedule. Similarly, commercial participants may opt out of their assigned schedule up to four times per month. With regard to cost recovery for BGE, the costs associated with providing the chargers may be deferred to a regulatory asset and amortized over a five-year period.[14]

Connecticut-based United Illuminating Company is another utility offering managed charging for EVs.[15] The offering has two tiers: passive charge management (customer-controlled) and active charge management (utility-controlled). This flexibility allows data to be collected using a connected (Wi-Fi communicating or "smart") level 2 charger, use of an EV's onboard telematics (charging data originating from the car itself rather than the charger), or disaggregation of data from the utility's existing AMI. Customers receive incentives for installation and connection of level 2 chargers or enrollment incentives for participating via an existing connected level 2 charger, transmitting data using EV telematics, or allowing the utility to disaggregate AMI data to measure performance. Ongoing incentives are based on monthly performance relative to a customer-defined off-peak charging schedule and/or participation in demand response events called by the utility.

Another idea is to improve the integration of intermittent renewables into the grid by incentivizing charging when solar generation is readily available at a low cost. PG&E tested this in a two-year pilot project called Charge Forward that allowed managed charging of EVs when production from renewables was high. The pilot successfully shifted 19,000 kWh away from peak periods and reduced the use of carbon-emitting generation. PG&E is incorporating the learnings from this pilot into a new monthly subscription rate for EVs.

MODERN RATE DESIGNS: THE ECONOMIC SOLUTIONS THAT GIVE CUSTOMERS CHOICES

Just as the EV market has evolved over the past decade, so have the rate design mechanisms to support it. Early rate option designs were often required by public utility commissions to test customer interest and reactions. Currently in some areas of the country, EV tariffs are only developed after significant review and analysis to

[14] Baltimore Gas & Electric Company, "Electric Vehicle Charging Rider," September 15, 2022.

[15] Eversource and UI, "Connecticut Electric Vehicle (EV) Charging Program: 2023 Participant Guide for Residential EV Drivers," January 25, 2023.

determine the cost-effectiveness of supporting the charging infrastructure. Federal corridors for EV charging and conflicts between retailers, utilities, and contractors to see who should install and own these stations have led to yet another type of tariff to support.

Utility management must be proactive to understand all the options for developing EV rate designs. A good starting place is to address these must-haves:

- Awareness of tariff and metering options,
- Understanding of best practices for EV charging,
- Identification of pilots that could become permanent programs,
- Knowledge of jurisdictional filing requirements, and
- Development of new rate designs with proper metering for cost recovery in anticipation of the expected load.

After addressing these items, utility management should turn attention to the need and approach for measuring cost-effectiveness of the EV program.

Stay tuned for Part 3 of this series for more on measuring the cost-effectiveness of EVs and EV charging.

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