

# **Review and Assessment of Electric Vehicle Rate Options in the United States**

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Technical Update, January 2018

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# ABSTRACT

In response to the resurgence of electric vehicles (EVs) in the automotive market, electric utilities are creating rate structures specific to EVs. The design of rate structures potentially considers different objectives—to encourage EV adoption, align with utility cost, and/or incentivize charging behavior that harmonizes grid operations. This report provides a review and assessment of a sample of publicly available EV rates, with the goal of informing utilities and public stakeholders in the establishment and modification of their own rate design.

Included in this study is a review and summary of 51 currently effective tariffs, or rate options, from 21 electric power companies nationwide. Regulatory documents by public service commissions or boards of directors were also collected as part of this study.

The key findings of the rate design structure study were:

- Rate options are available for residential and non-residential customers. Non-residential tariffs generally include rate options for commercial customers and sometimes include specific public charging tariffs. Residential options are the most pervasive and specific public charging options are the least common.
- The most common rate design attributes include Time-Of-Use energy charges paired with seasonal differentiations.
- Monthly charges apply to all but one utility.
- Demand charges are not pervasive, but voltage tiers or energy usage tiers apply to some rate options.

The review of regulatory decisions revealed that assessments of the rate structure often focus on usage periods, cost recovery and ratepayer protection, where discussed. Specifically:

- Commissions generally supported Time-Of-Use structures, with the rationale that these reflect cost differentiation and provide signals to shift electric consumption to lower cost periods.
- An important attribute often cited for commission approval was the demonstration of a good mechanism of cost recovery from the rate structure without spreading revenue shortfall onto other ratepayers.
- Low participation rate was sometimes cited as a reason to disallow requests for pilot rate option extensions, reasoning that the goal of incentivizing EV adoption is not facilitated when the result is low enrollment.

## Keywords

Electric vehicles

Rate structures

Regulatory assessments



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# 1

## BACKGROUND AND OBJECTIVES

### Background

With the resurgence of electric vehicles in the automotive market, several electric utility companies are creating rate structures specific to electric vehicles. EVs are often promoted as a mechanism to reduce greenhouse gas emissions. However, the quantity, speed, and location of charging all have implications on distribution grid design, planning, and operations.

Understanding these issues is in the public interest because overall system reliability and efficiency may be promoted if EV users can be incented to charge when utility costs are lower.

To create and offer utility customers rate design options that may incentivize charging behaviors with minimal impacts to reliable, cost-effective, and affordable grid operations, their use by EV owners needs to be understood so that potential increases and other changes to future capital investments may be appropriately planned and resourced. This information may further be used to improve system load factor, thereby creating a public benefit from lower overall cost of electricity.

### Objectives

The research questions that arise include the need to understand pervasiveness of EV rates and the types of rate designs that are being developed. Are they cost-based or driven by some other objective? The answers will help the industry understand the sustainability of such rate options over time. Having a rate in place that sends a signal to customers to charge their vehicles at certain times enables better system load factors than unmanaged charging, and is expected to improve grid reliability and cost effectiveness. A better understanding of these mechanisms and their potential interrelationships may in turn help to produce electric utility service plans that are more efficient if they incent more predictable behavioral outcomes over time (e.g., cost-based end-use decisions may help utilities offer service plans more aligned with actual utility costs).

Keeping abreast of current activity in this space through the sharing of ideas and understanding across different regions and utility markets is needed to better understand and adapt to changing utility customer needs, load requirements and for greater electrification. As utility generation profiles continue to drop in terms of overall GHG emissions, this can also help society meet carbon emission goals.

In this research project, EPRI conducted secondary research, including a technical assessment of publicly available EV rates and summarized findings. The primary information source is from public utility commission proceedings and utility websites. The goal was to identify, where possible, whether these rate designs were created to align with the underlying cost basis or to promote EV adoption.

### New Learnings

EV rates are at the forefront of wide-scale changes responding to EV users' connection to the distribution grid with corresponding impacts on utility assets, infrastructure and planning.

However, there is not presently a single repository of information to compare what is being developed to incent, or at least not hinder, their adoption. Considering and exploring publicly available EV rate options based on insights from what utilities and public service commissions are currently doing is expected to generate inputs and outputs for how to address challenges posed by EV technology, penetration, customer reactions, and grid operations and integration that are needed to assess present efficient electrification objectives.

Having such an inventory of current offerings can help inform utilities and public stakeholders as they seek to establish and modify their own rate design proposals and objectives by allowing them to quickly assess the considerations for what has been implemented to date. This research project provides a review of rate design options designed for EVs which may also give insight to the basis for these rates and their potential longevity, which could influence associated objectives such as greenhouse gas emission regulations and lower cost grid service through managed charging.

# 2

## RATE REVIEW

The research conducted showed that rate options are available for residential and non-residential customers (including business and public charging options), but with different pervasiveness. Table 2-1 provides an overview of the distribution of rate options over three customer segments, reflecting the pervasiveness of various rate design components. At present, there has not been a universally applicable approach to EV rates design. Table 2-1 is a summary of the differences and similarities in the underlying rate construct.

**Table 2-1  
Distribution of rate options for three customer classes**

		Customer Classes		
		Residential	Non-residential	
			Business	Public Charging
Number of Utilities		21	6	5
Number of Rate Options		29	14	8
Rate Structures*	Time-of-Use (TOU) Energy Charges	26	7	5
	Monthly/Daily Fixed Charge	26	12	0
	Demand Charge	2	2	0
	Seasonal Differentiation	19	3	1
	Separate Rate, Fee or Rider	1	2	0
	Discount/Bonus Offer	2	3	0

\*Rate structure statistics are based on the number of rate options rather than the number of utilities, because multiple rate options with diverse rate structures can be offered by the same utility.

For all rates reviewed, a comparison of rate structures and eligibility is provided in Table 2-2. A comparison matrix with detailed rate pricing is also provided in Appendix A. Information on rate structures for specific utilities was compiled from a variety of regulatory and other documents, which are referenced specifically later in this section.

### Frequency by Customer Class

Rate options for residential customers are more pervasive than options for non-residential customers (see number of rate options and utilities counted under customer classes in Table 2-1.) All 21 utilities reviewed had residential rate options<sup>1</sup>. Only six utilities offer business customer

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<sup>1</sup> There are approximately 3,300 electric utilities in the US. About 200 of which provide power to the majority of consumers. (<https://www.statista.com/statistics/237773/the-largest-electric-utilities-in-the-us-based-on-market-value/>)

rate options, including SDG&E, SCE, HECO, LG&E, DTE, and Pacific Power. Public charging rates are offered by five of the utilities evaluated (HECO, IPL, KU, LG&E and Pacific Power).

## **Energy Charges**

The most common variable within the rate structures reviewed is a Time-Of-Use energy charge paired with season differentiations (see number of rate options in the structure categories of TOU Energy Charges and Seasonal Differentiation in Table 2-1.) Following are qualitative and quantitative comparisons of energy charges in terms of their seasonal differentiation, usage periods and price differentials.

### ***Seasonal Differentiation***

All rate options with seasonal differentiation reviewed have two seasons - summer and winter - except SRP, which has three seasons: winter, summer and peak summer. DTE, HECO, and IMP have one season, and LADWP has riders that are the same for both seasons.

### ***Usage Periods***

Among utilities that have time-of-use structures in their rate options, those with two periods (on and off) include APS, KU, LG&E, BG&E, DTE, Xcel, Minnesota Power, ConEd, Pacific Power. Utilities with more than two periods include SRP, SDG&E, SMUD, SCE, PG&E, HECO, GA Power, IPL, Consumers Energy, and DVP. These may include a super-on, a super-off, or a mid-peak period. A shoulder, or mid-peak period was used by SCE, PG&E, HECO, IPL, Consumers, and DVP. SMUD has a super on-peak period. SRP, SDG&E, Georgia Power, DVP have super-off-peak periods.

### ***Price Differentials***

Price differentials are discussed in the literature as being a key attribute of the effectiveness of Time-of-Use rates. The ratio of on- to off-peak prices and summer to winter prices needs to be high enough to incent customers to change behavior to save money on their energy bills and also to be a tool to manage load shapes. However, rates are also intended to be based on actual costs. There is flexibility, since there is no uniform dictum of what costs might be included in these various categories, particularly on- and off-peak energy costs. When based simply on variable energy costs, rates tend to reflect the average cost of the wholesale market or utility generation resource mix dispatched on the margin. As shown in the variability of the ratios in this study, these can vary significantly across utilities and regions.

The differentials of energy charges (dollars per kilowatt hour [kWh]) between on-peak and off-peak hours (calculated as  $100\% \times \text{price}_{\text{on-peak}} / \text{price}_{\text{off-peak}}$ ) range from 111% - 943% in summer and 100%-485% in winter. The differentials of energy charges between summer and winter (calculated as  $100\% \times \text{price}_{\text{summer}} / \text{price}_{\text{winter}}$ ) range from 87%-507% across the on-peak prices and 84%-109% across the off-peak prices.

## **Monthly Charges**

All utilities except IPL have monthly charges. Monthly charges for the rates reviewed ranged from \$2 to \$20 for residential rates and from \$5 to \$220 for business rates. SDG&E has a daily rate.

## **Demand Charges**

The pervasiveness of demand charges in the rate options is low. Only three utilities reviewed use demand charges in their EV rate design. APS and Pacific Power have demand charges in their residential rates, and SCE has an option of business rate with a demand charge.

## **Public Charging Options**

Most of the public charging specific rate options have fees per charging session; one company charges on an hourly basis. LG&E offers a fee per hour rate option as well as a rider option for business customers and IPL similarly offers a fee per charging session for public charging.

## **Other**

Slightly more than half of the companies break out energy charges by distribution, transmission and generation components. A few have other cost categories specified.

A few constructs were unique, including:

- The Con Ed bonus program provides a discount per month if vehicles are charged off-peak. This rate option also offered a discount to the standard tariff for the off-peak energy rate.
- LADWP offers a simple, flat discount per kwh off the otherwise applicable rate schedule as a rate rider.

**Table 2-2  
Summary of rate structures by utilities and rate options**

Utility	Rate Schedule	Customer Class	Rate Structure Characteristics						Eligibility, Special Conditions, Participation Cap
			TOU	Monthly/Daily Fixed Charge	Demand Charge	Seasonal Differentiation	Separate rate, fee, rider	Discount	
APS	R-TECH	Residential	x	x	x	x			On-site qualified technologies (including EV) purchased within 90 days of enrollment; AMI meter in place required [1].
SRP	E-29	Residential	x	x		x	x		Participation subject to meter equipment availability and the presence of required smart meter proprietary communications; limited to 10,000 customers [2].
SDG&E	EV-TOU	Residential	x	x		x			Customers supply and own facilities to separately meter EV charging [3].
	EV-TOU2	Residential	x	x		x			The utility will supply, own, maintain meters and equipment utilized for billing [4].
	PEVSP	Business							SDG&E smart meter or interval data recorder type meter as primary meter required; limited to 500 submeters [5].
	PEVSP2	Business							SDG&E smart meter or interval data recorder type meter as primary meter required; limited to 500 submeters [6].
SMUD	RPEV_1	Residential	x	x		x			Households with PEV charging on 120V or 240V circuit [7].
	RPEV_2	Residential	x	x		x			EVs charging on a dedicated circuit with a separate meter/sub-meter [7].
SCE	TOU-EV-1	Residential	x	x		x			Charging on a separate meter provided by SCE in Single Family Dwellings concurrently served under a Domestic schedule [8].
	TOU-EV-3	Business	x	x		x		x	Charging on a premises or public right of way; separate SCE meter is required; maximum demand <20kW [9].

**Table 2-2 (continued)**  
**Summary of rate structures by utilities and rate options**

Utility	Rate Schedule	Customer Class	Rate Structure Characteristics						Eligibility, Special Conditions, Participation Cap
			TOU	Monthly/Daily Fixed Charge	Demand Charge	Seasonal Differentiation	Separate rate, fee, rider	Discount	
SCE	TOU-EV-4	Business	x	x	x	x		x	Charging on a premises or public right of way; separate SCE meter is required; maximum demand 20 kW-500 kW [10].
	TOU-EV-6	Business	x	x	x	x		x	Charging on a premises or public right of way; separate SCE meter is required; maximum demand >500 kW [11].
PG&E	EV Rate A, B	Residential	x	x		x			Rate B: applies to customers with separately metered BEV or PHEV recharging outlet [12]. Rate A: applies to all EV customers unless they choose B [12].
LADWP		Residential	x					x	Separate meter required [13].
HECO	TOU-EV (Molokai, Lanai, Maui)	Residential	x	x					Applicable to customers who combine home power usage in a single-family dwelling unit, metered and billed separately, with charging of EVs; limited to 1000 meters [14-17].
	EV-U (Molokai, Lanai, Maui)	Public	x						DC fast charging service at company-operated public electric vehicle charging facilities [18-21].
	EV-F (Molokai, Lanai, Maui)	Business	x	x					Public charging facilities no greater than 100 kW; charging load is separately metered from all other commercial loads [22-25].
GA Power	TOU-PEV-6	Residential	x	x		x			Residential customer in a separately metered dwelling unit [26].
IPL	EVX	Residential	x			x			Customers concurrently served under Rate RS, SS, SH or SL [27].
	EVP	Public							Customers charging their EVs at certain public charging facilities (the company will own, operate charging and metering equipment) [28].

**Table 2-2 (continued)**  
**Summary of rate structures by utilities and rate options**

Utility	Rate Schedule	Customer Class	Rate Structure Characteristics						Eligibility, Special Conditions, Participation Cap
			TOU	Monthly/Daily Fixed Charge	Demand Charge	Seasonal Differentiation	Separate rate, fee, rider	Discount	
KU	EVC	Public							Charging at a company-owned charging station [29].
	EVSE	Business		x					Customers being served under Rate GS, AES, PS, TODS, TODP, RTS and FLS; company will furnish, own, install, maintain charging unit; Customer shall be responsible for the charging equipment installation costs [29].
	EVSE-R	Business		x			x		Customers being served under Rate GS, AES, PS, TODS, TODP, RTS and FLS; customer installs and owns facilities on its side of the point of delivery [29].
	RTOD-Energy	Residential	x	x		x			Customers on Rate GS who demonstrate power delivered to detached garage is consumed, in part, for EV charging [29].
LG&E	EVC	Public							Charging at a company-owned charging station [30].
	EVSE	Business		x					Customers being served under Rate GS, AES, PS, TODS, TODP, RTS and FLS; company will furnish, own, install, maintain charging unit; Customer shall be responsible for the charging equipment installation costs [30].
	EVSE-R	Business		x			x		Customers being served under Rate GS, AES, PS, TODS, TODP, RTS and FLS; customer installs and owns facilities on its side of the point of delivery [30].
	RTOD-Energy	Residential	x	x		x			Customers on Rate GS who demonstrate power delivered to detached garage is consumed, in part, for EV charging [30].
PepCo	EV	Residential		x		x			All qualified Pepco residential customers with a PEV; applied to entire home [31].

**Table 2-2 (continued)**  
**Summary of rate structures by utilities and rate options**

Utility	Rate Schedule	Customer Class	Rate Structure Characteristics						Eligibility, Special Conditions, Participation Cap
			TOU	Monthly/Daily Fixed Charge	Demand Charge	Seasonal Differentiation	Separate rate, fee, rider	Discount	
BG&E	EV	Residential	x	x		x			Customers who charge their EVs on a single TOU meter that is also used to measure consumption at the whole house level [32].
Consumers Energy	PEV charging	Residential	x			x			Used with the existing smart meter and applies to all of household electric usage [33].
DTE	D1.9 option1	Residential	x	x					Separately metered circuit and approved charging equipment required; Installation must conform with Company's specifications [34].
	D1.9 option 2	Residential		x					
	D1.9 Retail access	Business		x					
Xcel	REVS	Residential	x	x		x			Separately metered charging; the customer shall supply a suitable location for meters and equipment for billing. Installations must conform to the Company's specifications [35].
Minnesota Power	"28"	Residential	x	x					Customers who also take residential service under the General, Space Heating or Seasonal rate; total off-peak load <=100 kW; Separately served and metered [36].
ConEd	Smart Charge Rewards	Residential	x	x		x		x	Customers own or lease an EV and charge it within ConEd service territory [37].
Pacific Power	"5"	Residential		x	x				Single-family consumers; separately metered [38].
	"45"	Public	x			x			Nonresidential consumers taking service for EV charging stations separately metered from other service whose loads <1000kW [39].

**Table 2-2 (continued)**  
**Summary of rate structures by utilities and rate options**

Utility	Rate Schedule	Customer Class	Rate Structure Characteristics						Eligibility, Special Conditions, Participation Cap
			TOU	Monthly/Daily Fixed Charge	Demand Charge	Seasonal Differentiation	Separate rate, fee, rider	Discount	
DVP	EV	Residential	x	x					Applicable in conjunction with Schedule 1, to the separately metered charging; limited to 750 participants [40].
	1EV	Residential	x	x		x			Separately metered and billed service for use in (a) a single-family residence, (b) a combination farm and one occupied single-family residence, or (c) a private residence with <= 1 cooking installation <= 10 bedrooms, or (d) detached accessory buildings appurtenant to residential dwellings; limited to 750 participants [41].

# 3

## REGULATORY FINDINGS

### Overview of Findings

In reviewing the regulatory assessments and findings, EPRI found that the disputed issues were frequently raised regarding usage periods, cost recovery and ratepayer protection. Table 3-1 summarizes key regulatory findings sorted by decisions and commission discussion issues in relation to rate constructs in representative rate design cases. Information on regulatory findings for specific utilities was compiled from a variety of regulatory documents, which are referenced specifically later in this section.

### *Usage Periods*

Commissions generally supported Time-Of-Use structures based on the rationale that they reflect cost differentiation and provide a market signal to shift electric consumption. It was agreed that the off-peak hours and/or super off-peak hours encouraged customers to charge their EVs overnight when electricity rates were low. For utilities that considered photovoltaic generation availability in the rate design, such as HECO, the commissions also commented positively on the consistency of the TOU periods and the generation cost that accounts for photovoltaic generation availability.

### *Cost Recovery*

An important attribute to commission approval was the demonstration of a good mechanism of cost recovery. As EV rate plans were often a part of an EV pilot program, incorporating the program cost into the rate design was evaluated positively. The cost-effectiveness analysis and rate impact test were often the disputed issues that led to commission discussion issues. Low participation rate was a red flag for disapproval of EV programs extensions, because the low enrollment was considered as attributable to additional expense. Also, the low participation indicated that the program did not achieve the goal of incentivizing EV adoption.

### *Ratepayer Protection*

The issue of ratepayer protection was often brought up with the cost recovery issue. The failure to avoid spreading revenue shortfall onto other ratepayers was a key reason for disapproval. The discussion of ratepayer protection also included concerns about the absence of a rate plan designed for customers who are significantly involved or impacted in the EV market, for example, EV fleet operators.

**Table 3-1  
Summary of key commission findings sorted by decisions and discussion issues in relation to rate constructs in representative rate design cases**

<b>Decisions</b>	<b>Commission discussion issues</b>	<b>Representative Decision Rationales and Findings</b>	<b>Rate constructs in relation to commission findings</b>	<b>Representative Case (with rate class)</b>
<b>Approved</b>	Usage periods	Time/pricing signals could be effective to shift electric consumption to non-peak periods [42].	TOU	APS: ET-EV TOU (residential)
		The adoption of three time-of-use periods is consistent with the photovoltaic generation availability and generation cost [43].	TOU	HECO: EV-F (business), EV-U (public charging)
	Cost recovery, Cost effectiveness	Transiting from fixed rate to volumetric rate aligns better with charging session cost; Incorporating program costs into rate design aligns better with system costs [43].	Volumetric rate	HECO: EV-F (business), EV-U (public charging)
		The approval of the tariffs based on that they appropriately reflect off-peak vs. on-peak cost differences, and include a mechanism to recover appropriate cost, and incorporate the cost of metering or sub-metering [44].	TOU, per-kWh charge	Xcel Energy: REVS (residential)
		Staff concerned that the removal of demand charges may undermine the cost recovery. This concern has been alleviated by the transition over nine years to a rate schedule designed for cost recovery [45].	Demand charges	PAC: Schedule 45 (public charging)
	Ratepayer protection	There will be no impact on current IPL customers as the rate EVX is designed to be revenue neutral [46].	Revenue neutral design	IPL: EVX (residential)
		The participation limit is an important ratepayer protection in preventing spreading the revenue shortfall onto other customers [45].	Participation limit	PAC: Schedule 45 (public charging)
	Transparent billing	Staff raised concern of the transparency of the tariff. This concern has been alleviated by explicitly indicating the percentage of transition discounts and the length of time that the discounts will be offered in the tariff language [45].	Tariff language	PAC: Schedule 45 (public charging)

**Table 3-1 (continued)**

**Summary of key commission findings sorted by decisions and discussion issues in relation to rate constructs in representative rate design cases**

<b>Decisions</b>	<b>Commission discussion issues</b>	<b>Representative Decision Rationales and Findings</b>	<b>Rate constructs in relation to commission findings</b>	<b>Representative Case (with rate class)</b>
<b>Directed to review or modify</b>	Usage periods	Customers cannot reduce facilities-related demand component by shifting load. Peak-related demand charges or volumetric TOU rates are recommended [47].	TOU, Demand charges	SCE: TOU-EV-6 (business)
	Cost recovery	Staff does not believe that the incremental revenues from the EV program offset the associated costs [48].		GA power: TOU-PEV
		Participation in the rate option was lower than forecast and the cost and benefit analysis had not been performed. Another extension beyond 2018 will not be granted unless the cost effectiveness of the program can be established [49].		DVP: Schedule EV
	Ratepayer protection	No unique small commercial rate is available for EV fleet operators, which may expose them in demand charges in medium/large commercial rates [50].	Demand charges	SDG&E: 2017 rate design
<b>Disapproved</b>	Cost recovery & Ratepayer protection	Despite the program designed to be self-funded, the cost of installation and maintenance of public charging infrastructure will be born from all ratepayers [51].		APS: EV-PS (public charging)
		The low number of participants appears attributable to the additional expense and effort [52].		HECO: EV-R (residential), EV-C (business)

### **Utility-specific Findings**

Additional detail regarding commission findings are shown below, organized by state and utility.

#### **Arizona**

Arizona Public Service (APS)

##### *Proposal Overview*

In 2011, APS proposed a three-year EV-Ready Study project, which consisted of a residential TOU rate that incents customer charging of EVs during off-peak hours (rate ET-EV), and a public TOU charging offering on a point-of-sale basis (rate EV-PS) [42].

### *Regulatory Findings/Conclusions*

The Commission, having reviewed the application and commission staff's memorandum dated August 23, 2011, approved the EV-Ready Study and the Experimental Rate Schedule ET-EV. In its report, staff indicated that "the proposed electric vehicle-only ET-EV TOU rate schedule could be an effective method of shifting electric consumption to non-peak periods through the use of time/pricing signals" (Decision on EV pilot program 2011, Decision No. 72582) [42]. APS was ordered to work with the federally-funded EV infrastructure contractors for the first year of the study and informed that if they identify a gap in charging infrastructure deployment under that effort, they can request approval of a public point-of-sale rate in APS' first annual report of Study findings to the Commission.

The Experimental Rate Schedule EV-PS, however, was not approved, citing that "although the proposed public point-of-sale rate EV-PS has been designed to self-fund the installation and maintenance of public charging infrastructure... the estimated costs will be ultimately born by all ratepayers [42]."

### **Salt River Project (SRP)**

#### *Proposal Overview*

SRP proposed a residential EV rate schedule E-29, which employed traditional Time-Of-Use on-peak and off-peak periods, and also a super off-peak period from 11:00 pm to 5:00 am [52].

#### *Regulatory Findings/Conclusions*

The Board of Directors retained Sussex Economic Advisors, LLC to review and evaluate the proposed plan among other proposed adjustments to standard electric price plans in 2015. According to the review, the E-29 plan is appropriately designed to reflect the lower cost of electric service during the nighttime, and to provide an incentive for overnight EV charging. This rate is consistent with the EV rate offered at other companies. The review also recognized that SRP has the tracking and reporting systems in place to monitor the impact of the rate plan. Therefore, the review concluded that the proposed plan should be approved (Review of Proposed Adjustment to Salt River Project's Standard Electric Price Plan, December 12, 2014) [52].

There was no discussion in the Board Resolution approving SRP's rate schedule E-29, dated February 26, 2015.

### **California**

#### **Los Angeles Department of Water and Power (LADWP)**

The Board Resolution approving LADWP's rate schedule does not include specifics regarding the EV rate option. However, in a follow-up call with LADWP staff, EPRI was informed that the rate has been in place for a long time and since the underlying structure hasn't changed, there has been no specific reference to the cost basis or other documentation regarding the basis of the construct.

## Southern California Edison (SCE)

### *Proposal Overview*

SCE proposed residential Schedule TOU-EV-1 that requires separate metering and applies only to EV load. Two commercial rates were also available: TOU-EV-3 for customers with demand  $\leq$  20 kW and TOU-EV-4 for customers with demand between 20-500 kW. These EV schedules were approved before 2016. In 2016, SCE designed Schedule TOU-EV-6 for commercial customers who have EV demand  $>$ 500 kW and who request a separate meter to serve charging facilities [47].

### *Regulatory Findings/Conclusions*

Schedule TOU-EV-6 was found to align with the principle of revenue-neutral rate design and to be consistent with State and Commission EV policies. The Commission further indicated that Schedule TOU-EV-6 better aligns with the Commission's policy of using time-varying rates to reflect cost of service than the otherwise applicable rate option [47].

However, since “the distribution facilities-related demand component of TOU-EV-6 is not time-based, therefore customers cannot reduce this component of their bills by shifting their charging load, even to super-off-peak hours” (Resolution E-4831, March 23, 2017) [47]. Because the Commission has expressed interest in continuing to move toward more time-based rates, SCE was directed to review Schedule TOU-EV-6 in its next General Rate Case Phase 2 to “consider whether it should (1) convert the majority of its distribution facilities-related demand charges to peak-related demand charges and/or volumetric TOU rates and (2) exempt super off-peak charging from distribution facilities-related demand charges. [47]”

## San Diego Gas & Electric (SDG&E)

### *Proposal Overview*

In *Application of SDG&E for authority to update marginal costs, cost allocation and electric rate design in 2017*, SDG&E proposed no changes to residential rate design but introduced an optional electric vehicle rate with a \$16 monthly service fee [50].

### *Regulatory Findings/Conclusions*

The commission found the residential and small commercial rate design proposal represented a reasonable approach towards adopting rates based on cost causation, while providing stability, simplicity, and customer choice, and therefore the proposal should be approved (Decision 17-08-030, August 24, 2017) [50].

However, the commission raised the concern that SDG&E did not propose a unique rate for EV fleet operators, who may be moved from small commercial status (under 20 kW) to Medium/Large commercial rates due to the increase in demand of vehicle charging, and will be newly exposed to demand charges in Medium/Large commercial rates. Considering transportation electrification, a critical aspect of meeting California's climate goals, the commission further determined that temporary relief from demand charges was needed and directed SDG&E to offer a three-year temporary exemption on the small commercial load limit accounts with EV fleet charging (Decision 17-08-030) [50].

## Sacramento Municipal Utility District (SMUD)

### *Proposal Overview*

SMUD developed its original EV rate RTEV in 1993. This rate did not adequately reflect the potential impact and cost of PEV charging on neighborhood transformers. In 2015, SMUD proposed to offer lower price for charging EVs between midnight and 6:00 am in order to shift charging load to lower usage hours when the service cost is low (Chief Executive Officer and General Manager's Report and Recommendation on Rate and Services, Volume 1, April 2, 2015) [53].

### *Regulatory Findings/Conclusions*

SMUD's Board of Directors voted to discontinue RTEV and transfer the customers to the time-of-use rate effective January 1, 2016 (Chief Executive Officer and General Manager's Report and Recommendation on Rate and Services, Volume 1, 2015) [53]. The Resolution in 2017 required SMUD to close the 4:00 to 7:00 p.m. peak rate option to customers without a plug-in electric vehicle or eligible renewable electrical generation facility. It became the standard rate for PEV and NEM customers. TOD (5:00 to 8:00 p.m.) Peak Rate is also available to any new or existing residential customer with a PEV and replaces RPEV 1 and 2. Separate electric vehicle meters are no longer required and were ordered to be removed (Resolution No. 17-06-09, June 15, 2017).

## **Georgia**

### Georgia Power (GA Power)

#### *Proposal Overview*

In 2014, GA Power began implementation of an EV pilot program that included an education campaign and infrastructure components for residential, workplace and community charging. The EV pilot program was included in the filing of the 2015 Annual Retail Surveillance Report [48].

#### *Regulatory Findings/Conclusions*

Commission staff found that the company's current rates do not reflect the cost of the EV pilot program (Staff Annual Surveillance Report and commission order, 2015, Docket No. 36989) [48]. Consequently, this program reduces what would otherwise be company earnings. Staff does not believe that the incremental revenues from the EV program offset the program costs, and therefore the program does not pass the Rate Impact Measure ("RIM") test. Staff advised Georgia Power in its May 11, 2015 correspondence that the EV costs were under review by Staff for potential disallowance for recovery from ratepayers. Notably, only when sharing is involved would it impact customers and only to the extent there are refunds for earning above the approved earnings band. The Commission approved Staff's report and recommendations [48].

## **Hawaii**

### Hawaiian Electric Company (HECO)

#### *Proposal Overview*

In 2015, HECO applied to extend its EV pilot program to 2020 (Docket No. 2015-0342) [51], including residential rate TOU EV, EV-R and commercial rate EV-C.

In 2016, HECO applied for approval of Schedule EV-F (which intends to support start-up charging services, and Schedule EV DC (which allows HECO's ownership and operation of public DC fast charging facilities (Docket No. 2016-0168) [43].

#### *Regulatory Findings/Conclusions*

In reviewing the enrollment of the EV pilot rates program, the commission found that the majority of enrollment was in TOU-EV. The pilot program was found not to have fully achieved its intended objectives of encouraging EV charging during off-peak periods and incentivizing EV adoption. Consequently, the commission denied an extension on a long-term basis. The commission approved HECO's request to extend Schedule TOU EV, approved the request to terminate EV-C and denied the request to extend Schedule EV-R. The extension of TOU EV is subject to the commission's adoption of a different rate design as part of its review of other related proceedings involving time-of-use rates. The commission suspended HECO's request to establish their proposed Schedules TOU EVD, EV-RD, and EV-CD, pending the commission's decision-making in the HECO's Distributed Generation Interconnection Plan Proceeding or Integrated Demand Response Portfolio Plan proceeding (Decision and Order No. 33165) [51].

The Commission found HECO's revised rate structures EV-F and EV-U to be just and reasonable, based on the rationales on three revised structures: 1) the transition from flat charging session rate to volumetric rate; 2) the adoption of three time-of-use periods to be consistent with the photovoltaic generation and generation cost; 3) the incorporation of certain program costs into the rates. Consequently, the commission approved Schedules EV-F and EV-U (Docket No. 2016-0168) [43].

### **Indiana**

#### **Indianapolis Power & Light (IPL)**

##### *Proposal Overview*

In 2012, as a result of the Smart Grid Investment Grant funding expiring, IPL requested new customers to be served under rate EVX for EV charging stations at their homes responsible for funding the installation costs associated with the charger, wiring and meter base (Memorandum with staff recommendation, October 1, 2012, Filed Pursuant to Commission Order No.43960) [46].

The Experimental Service for Electric Vehicle (EV) Charging on Public Premises (Rate EVP) tariff was approved on January 19, 2011. The initial service charge is a flat fee of \$2.50 per charging session. IPL requested to revise the anticipated term for this rate two years; beginning on January 1, 2013.

##### *Regulatory Findings/Conclusions*

Staff recommended approval of rate EVX, as there will be no impact on current IPL customers. Customers must volunteer and apply to be served under rate EVX and all the necessary equipment installation (charger, wiring, and meter base) is paid for by the requesting customer (Memorandum with staff recommendation, October 1, 2012, Filed Pursuant to Commission Order No. 43960) [46].

Staff recommended approval of the rate EVP expiration extension. The rates and charges for Rate EVP were designed to be revenue neutral. The requested change only serves to push out the

anticipated date of Rate EVP's expiration to December 31, 2016. Staff recommends approval (Memorandum with staff recommendation, October 31, 2014, Filed Pursuant to Commission Order No. 43960) [55].

## **Kentucky**

Louisville Gas & Electric / Kentucky Utilities

### *Proposal Overview*

In 2015, LG&E and KU each requested approval of three tariffs related to electric vehicle charging stations: Electric Vehicle Supply Equipment Rider ("EVSE-R"), Electric Vehicle Supply Equipment ("EVSE"), and Electric Vehicle Charging ("EVC"). Through the EVSE-R and EVSE tariffs, LG&E/KU propose to give their non-residential customers the opportunity to host charging stations. Under Tariff EVC, LG&E/KU would themselves provide charging stations that would offer electric vehicle charging services for the public [56].

### *Regulatory Findings/Conclusions*

Rates were approved with commission revisions. EVSE-R and EVSE gives non-residential customers the opportunity to host charging stations. Energy under EVSE is not metered. An assumed amount of energy is included in the monthly fee and there is a choice of single charger or dual charger options. The site host pays installation costs and commits to host for five years. LG&E / KU owns and maintains all the stations. The rate is adjusted annually for the fuel adjustment clause and annual reports must be filed for the first three years (April 11, 2016, Case 2015-00355) [56].

## **Maryland**

Potomac Electric Power Co (PEPCO) / Baltimore Gas & Electric (BG&E)

### *Proposal Overview*

On April 22, 2016, PEPCO filed its revised tariff pages for Residential and Non-Residential customer, both Type I and Type II, for Standard Offer Service ("SOS"). Schedule EV was included for Type I – Non-Residential customers [57].

### *Regulatory Findings/Conclusions*

The revised rates are consistent with the bill impacts that Staff presented to the Commission on April 21, 2016. This tariff reflects the results of bidding concluded on April 18, 2016 and approved by the Commission on April 22, 2016 by Order No.87506 (Case Nos. 9056 and 9064) [57]. "Staff recommends that the Commission accept for filing Baltimore Gas and Electric Company's revisions to its Residential, Type I, Type II, PL, and Electric Vehicle SOS energy rates and its revised SOS transmission rates and administrative charge with an effective date of June 1, 2017" (Case No. 9056, No. 9064) [57].

## **Michigan**

Consumers Energy

### *Proposal Overview*

On August 30, 2010, Consumers Energy Company filed an application requesting that the Commission approve its proposed experimental electric vehicle tariff.

Three options were proposed: Option 1 provided a home and EV rate, Option 2 provided a separate-metered EV rate, and Option 3 provided a separate-metered service at a fixed monthly fee for the first 300 kW. The proposal also offered reimbursement of up to \$2500 for the first 2500 qualifying customers through December 31, 2012 for the cost of installing the separately metered circuit (Case No. U-16446., September 14, 2010) [58].

In 2012, Consumers Energy proposed to extend the reimbursement offering through December 31, 2014, and terminate rate option 3 in the experimental electric vehicle tariff (Case No. U-17158, January 17, 2013) [59].

#### *Regulatory Findings/Conclusions*

The Commission found that the proposed experimental electric vehicle tariff is reasonable and in the public interest, and should be approved. The Commission found that approving the proposed tariff does not result in any change in the rates or cost of service to other customers” (Case No. U-16446., September 14, 2010) [58].

The Commission agreed with the rationale of Consumers that the EVSE reimbursement offering has been a popular incentive for participation in the program, while Option 3 has not been utilized at all. The Commission found that Consumers’ proposed amendments to the Experimental Residential Plug-In Electric Vehicle Charging Program are reasonable and in the public interest, and should be approved. The Commission found that approving the company’s application does not result in any change in the rates or cost of service to customers. Therefore, the application was approved (Case No. U-17158, January 17, 2013) [59].

#### **Detroit Edison (DTE)**

##### *Proposal Overview*

In July 2010, DTE requested the approval of its experimental electric vehicle tariff, which was made available on an optional basis to a maximum of 2,500 residential customers seeking separately-metered service for the sole purpose of EV charging. Two rate options were included: one that provides a lower rate for charging during off-peak hours, and another that provides for a monthly flat fee [60].

##### *Regulatory Findings/Conclusions*

The Commission found that the proposed tariff is reasonable and in the public interest, and should be approved. However, the monthly flat-fee option shall be limited to 250 customers. A statistically significant sample of the customers receiving the flat-fee option shall receive demand meters for purposes of analyzing charging patterns. The Commission finds that approving the proposed tariff and accounting authority does not result in any change in the rates or cost of service to other customers. Thus, the tariff was approved (Case No. U-16406, August 10, 2010) [60].

At the October, 25, 2017 meeting, in the matter of collaboratively considering issues of EV charging facility deployment, the Commission has both near-term and long-term roles in addressing regulatory barriers and providing regulatory guidance. Near-term actions include: reassessing the sale for resale requirements; ensuring sufficient and accurate consumer education; examining changes to existing PEV tariffs and potential new rate design options. Longer term actions include evaluating the role of the Commission and regulated electric utilities

related to PEVs. Priority topics include: rate design including the role and effectiveness of demand charges as well as the use of time-varying or dynamic rates to shift behavior; consumer education; whether it is necessary for a customer to need a second meter installed; the potential grid impact of charging infrastructure and PEV adoption at various locations (Case No. U-18368, October 25, 2017) [61].

## **Minnesota**

### **Xcel Energy / Minnesota Power**

#### *Proposal Overview*

A 2014 Minnesota law (1 Minn. Stat. § 216B.1614) requires Northern States Power Company d/b/a Xcel Energy and Minnesota public electric utilities to file a tariff “solely for the purpose of recharging an electric vehicle” (an EV tariff). The law requires these tariffs to: contain either a time-of-day or off-peak rate, as elected by the public utility; offer a customer the option to purchase electricity: from the utility's current mix of energy supply sources; or entirely from renewable energy sources; and make their terms available to the residential customer class. To meet the law requirement, Xcel Energy and Minnesota Power each filed a residential tariff and requested approval in 2015 [44].

#### *Regulatory Findings/Conclusions*

The Commission concluded that the utility filings meet the requirements of Minn. Stat. § 216B.1614 and reasonably provide a rate option for electric vehicle owners. The Commission also concluded that the tariffs appropriately reflect off-peak versus on-peak cost differences; include a mechanism to allow the recovery of appropriate costs (including costs to inform and educate customers, to publicly advertise and promote participation); provide for clear and transparent customer billing statements; and incorporate the cost of metering or sub-metering. Thus, the tariffs were approved (Order approving Tariffs and Requiring Filings June 22, 2015, Docket No. E-002/M-15-111, Docket No. E-015/M-15-120) [44].

## **New York**

### **Consolidated Edison (ConEd)**

#### *Proposal Overview*

In April 2017, ConEd introduced the Smart Charge New York Program (as part of the Company's new system peak load reduction program approved in the Company's 2016 electric rate case) to help PEV owners reduce the cost of charging their plug-in electric vehicles (PEVs) and improve grid system efficiency by incentivizing off-peak charging. Electric rates were designed to recover the costs of the Energy Efficiency Program, system peak reduction program, and the equipment portion of the EV Program over 10 years, including the overall pre-tax rate of return on such costs. Electric rates are designed to recover the rate incentive portion of the EV Program through base rates as an expense (Consolidated Edison's “Smart Home Rate” program in “Reforming the Energy Vision,” Case 14-M-0101, February 1, 2017) [62].

#### *Regulatory Findings/Conclusions*

ConEd staff determined that the proposed Smart Home Rate Project complies with the objectives set forth in the Commission's *Order Adopting Regulatory Policy Framework and Implementation Plan*, issued February 27, 2015, as well as the Smart Home Rate objectives defined in the *Order*

*Adopting a Ratemaking and Utility Revenue Model Policy Framework*, issued May 19, 2016 (Joint Proposal, September 19, 2016, Case 16-E-0060, 15-E-0050, 16-E-0196) [63].

## **Oregon**

Pacificorp (PAC)

### *Proposal Overview*

On December 27, 2016, PAC filed an advice filing with the Commission for approval of a new schedule, Schedule 45/745, and accompanying rates. The purpose of this rate option is to accelerate transportation electrification by offering a new, optional transitional rate for electric vehicle direct current (DC) fast chargers (Advice No. 16-020 filed on April 14, 2017) [64]. Schedule 45/745 offers a discount to Schedule 28 (a rate designed to recover revenue requirements and approved in 2014). There will be an under-recovery of revenue requirement, assuming no changes in usage or number of customers occur.

### *Regulatory Findings/Conclusions*

Staff raised two primary concerns in the previous filing, both of which have been addressed by PAC: 1) Removal of demand charges may undermine cost recovery. This concern has been alleviated by transitioning the tariff into the full Schedule 28 demand charge over nine years; 2) the transparency of the tariff. This concern has been alleviated by explicitly indicating the percentage of transition discounts and the length of time that the discounts will be offered in the tariff language. The Staff commented that PAC's revised tariff simultaneously achieves both accelerating transportation electrification and protecting ratepayers. Staff considered that the participation limit is an important ratepayer protection in preventing spreading the revenue shortfall onto other customers (Advice No.16-020 and Order No.17172, May 16, 2017) [45].

## **Virginia**

Dominion Power

### *Proposal Overview*

In 2011, the Commission granted Dominion the right to examine experimental rate structures through a pilot program. Rate Schedule EV serves as a companion tariff in conjunction with Rate Schedule DP-R. All participants in the EV Pilot Program are required to have a second meter and/or monitoring equipment, installed at the Company's expense.

### *Regulatory Findings/Conclusions*

The Commission required a cost benefit analysis and a control group be established to confirm whether the rate option should extend beyond the pilot period. No lost revenue recovery was allowed and a program cost cap was established (Case No. PUE-2011-00014, July 11, 2011) [49]

Dominion requested an extension of the pilot program four years later. Participation in the rate option was lower than forecast and the CBA had not yet been performed. The Commission approved an extension through November 2018. Another extension will not be granted unless the cost effectiveness of the program can be established [65].



# 4

## CONCLUSION

The initial intention of this research paper was to assess the pervasiveness of electric vehicle rates and determine, if possible, whether the underlying rate designs are being developed to reflect the underlying cost basis to serve this customer class. In our research, while not exhaustive, we readily found several rate schedules among U.S. electric utility companies, geared specifically for electric vehicles, for both commercial and residential customer applications. The rates of 12 utilities were found to be reflective of the cost to serve.

The results of this catalogue of rate schedules provide a current inventory of adopted residential and commercial EV rates. Commissions generally supported TOU structure for residential EV charging to incentivize off-peak charging. Demand charges were not used pervasively. Many commissions were cautious to ensure the recovery of cost and the protection of ratepayers were often brought to discussion.



# 5

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# A

## **RATE PRICING COMPARISON MATRIX**

(Appendix is provided in the attachment “Appendix\_A\_rate\_pricing\_comparison\_matrix.xlsx”)

**The Electric Power Research Institute, Inc.** (EPRI, [www.epri.com](http://www.epri.com)) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety and the environment. EPRI members represent 90% of the electric utility revenue in the United States with international participation in 35 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

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