GOVERNMENT OF PUERTO RICO
PUERTO RICO PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE: DESPLIEGUE DE INFRAESTRUCTURA DE CARGADORES PARA VEHICULOS ELECTRICOS	**CASE NO. NEPR-MI-2021-0013** **SUBJECT: Submittal of Draft of EV Rate Design Proposal**

MOTION SUBMITTING DRAFT OF EV RATE DESIGN PROPOSAL

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES now **LUMA Energy ServCo, LLC** ("LUMA"), through the undersigned legal counsel, and respectfully states and requests the following:

1. On November 18, 2021, this Energy Bureau of the Public Service Regulatory Board ("Energy Bureau") issued a Resolution and Order (the "November 18th Order") setting forth directives for initiating the electric vehicle ("EV") infrastructure deployment, including principles to guide the adoption of plans, regulations and procedures related to the electric vehicle energy sector in Puerto Rico (the "Principles").

2. In the November 18th Order, the Energy Bureau ordered LUMA to: (a) file with the Energy Bureau, on or before September 1, 2022, a First Phase of an EV Charging Infrastructure Deployment Plan ("Phase I EV Plan") reflecting the Principles and meeting a list of requirements set forth in the November 18th Order (*see* November 18th Order at p. 4); (b) file on or before May 31, 2022 a proposal for "one or more rate designs targeting the customer segments set forth in the [Principles] and envisioned in the Phase I EV Plan" and addressing the requirements in the November 18th Order ("Rate Design Proposal") (*see id*. at pp. 5-9); and (c) attend Compliance Technical Hearings (referred to as Compliance Technical Hearings No. 1, No. 2 and No. 3) every

three months in connection with the Phase I EV Plan preparation, scheduled for February 25, 2022[1], May 31, 2022, and August 31, 2022, respectively (*see id*. at p. 5).

3. After other procedural events, on May 19, 2022, this Energy Bureau issued a Resolution and Order (the "May 19th Order") amending the dates and certain associated tasks established in the November 18th Order, providing for: (i) the filing of a draft of the Rate Design Proposal by May 31, 2022; (ii) the rescheduling of the Compliance Technical Hearing No. 2 to June 15, 2022 at 1:00 pm; (iii) the filing of a final Rate Design Proposal on June 30, 2022; (iv) the filing of a draft of the Phase I EV Plan for September 1, 2022; (v) the rescheduling of the Compliance Technical Hearing No. 3 to September 15, 2022, at 1:00 pm; and (vi) the filing of the final Phase I EV Plan on September 30, 2022.

4. In compliance with the November 18th Order, as amended by the May 19th Order, LUMA herein submits, as Exhibit 1, the draft of the Rate Design Proposal ("Rate Design Proposal Draft"). The Rate Design Proposal Draft contains a proposal to undertake three EV rate pilots which LUMA believes are the most attractive and viable for Puerto Rico in the near- to medium-term- namely, a Residential EV Separate Meter Time of Use ("TOU") Rate Pilot, a Residential EV Subscription Rate with Managed Charging Pilot, and a Public EV Charging Rate Pilot. The enclosed Rate Design Proposal Draft discusses, among others, the context of the rate design proposal, including the principles, requirements and stakeholder feedback considered, the objectives of the rate design proposal and additional considerations for Puerto Rico; the residential EV rate alternatives considered, including consideration of the rate structures, program characteristics and enabling infrastructure; the approach taken by LUMA to identify the most viable rate structures for Puerto Rico; and the roadmap to introduce the proposed EV charging

[1] This First Compliance Hearing was thereafter postponed to and held on March 4, 2022. *See* Energy Bureau's Resolution and Order entered on February 22, 2022.

rates, including the proposed pilot rate suite, the interim rate design process, pilot design and evaluation, and the outline for the rate pilot document. LUMA is proposing that the funding for the pilots be covered through coordination of efforts with Federal and Puerto Rico government agencies implementing EV projects or managing funding for these opportunities, as appropriate. Further engagement is required with such entities to finalize a budget proposal for such purposes.

5. LUMA looks forward to discussing and obtaining input from the Energy Bureau and its consultants on the Rate Design Proposal Draft in Exhibit 1 during the upcoming Compliance Technical Hearing No. 2.

WHEREFORE, LUMA respectfully requests that the Energy Bureau **take notice** of the aforementioned and accept LUMA's Rate Design Proposal Draft in Exhibit 1 herein in compliance with the requirement under the November 18th Order, as amended by the May 19th Order, to submit a draft proposal for the design of one or more EV charging rates.

RESPECTFULLY SUBMITTED

In San Juan, Puerto Rico, this 31st day of May 2022.

We hereby certify that we filed this motion using the electronic filing system of this Energy Bureau and that we will send an electronic courtesy copy of this motion to the attorneys for PREPA, Joannely Marrero-Cruz, jmarrero@diazvaz.law and Katiuska Bolaños-Lugo, kbolanos@diazvaz.law. LUMA understands that other participants or stakeholders in this proceeding will be notified as a result of the publicity of the filings in this process. Notwithstanding, LUMA will send a courtesy copy of the filing to the following stakeholders: agalloza@aggpr.com; alberto.cortes@warrenecm.com; aldo@skootel.com; angel.d.rodriguez@outlook.com; antonio@velocicharge.com; azayas@azeng.net; bigwheelcorp@gmail.com; blazquezmalu@gmail.com; carlosxcedeno@gmail.com; clrivera@caguasexpressway.com; flota@caguasexpressway.com; cnegrette@solrenew.com; CR.Tejera@ddec.pr.gov; dacosta@aggpr.com; daniel.perez@totalenergies.pr; dcordero@group-em.com; divine.energy@hotmail.com; eduardo.pinera@toyota.com; Edwin.Acevedo@ddec.pr.gov; emelyies.torres@toyota.com; epenergypr@gmail.com; erica.cosme@gsonnell.com; Fberrios@peritoselectricistas.org; francisco.berrios@hotmail.com; franciscojrullan@yahoo.com; gerard.berlinski@toyota.com; gerardo_cosme@solartekpr.net; gperez@solrenew.com; hamely@motorambar.net; ialsina@plazalasamericas.com; idiaz@glenninternational.com; info@carlosmatta.com; ismael.diaz@warren-ecm.com; jack@pantekpartners.com; jameauxi@aim.com; jan.rodriguez@toyota.com; javrua@sesapr.org;

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Exhibit 1

Draft of EV Rate Design Proposal

Draft Electric Vehicle Rate Design Proposal

May 31, 2022

NEPR-MI-2021-0013

Contents

1. Executive Summary

Puerto Rico's transportation sector plays a key role in Greenhouse Gas (GHG) emissions and presents a significant opportunity to achieve clean energy and climate goals with the conversion to clean fuel[1]. Puerto Rico's transportation sector is a leading producer of GHG emissions on the island and is expected to continue as a leading GHG emitter in the future[2]. Since most of the GHG emissions in this sector come from gasoline and diesel combustion from on-road vehicles, utilizing clean energy through electrifying those vehicles can significantly contribute to decarbonizing the transportation sector.

Electric vehicle (EV) adoption in Puerto Rico is currently low however, usage is expected to grow rapidly due to several major factors including rising gasoline prices, supportive federal policies for increased EV adoption, and general EV market dynamics with respect to technology advances and improved vehicle offerings. The shift to EVs offers the opportunity to impact cleaner transportation for years to come since average personal-use and fleet vehicles are typically replaced every 10-15 years, implying that internal combustion vehicles purchased today will likely stay in operations through 2037. As with many new technologies, EVs do offer certain complexities that need to be addressed, include planning, operations, and grid integration of electric vehicles. The next few years will lay the groundwork to manage the related complexities and enable the shift to clean transportation at a pace sufficient to support Puerto Rico's clean transportation and climate goals.

A key component of advancing vehicle electrification is providing rate options that help achieve fuel cost savings for drivers, while offering appropriate cost recovery for providing electricity service to those vehicles. LUMA has developed this EV Rate Proposal outlining a suite of EV-specific rate structures to advance EV market growth in Puerto Rico in compliance with the Puerto Rico Energy Bureau's (PREB) Resolution and Order dated November 18, 2021, in Case No. NEPR-MI-2021-0013, *In Re: The Deployment of Electric Vehicle Charging Infrastructure,* on "Principles for Initiating EV Infrastructure Deployment" (the November 18th R&O). This EV Rate Proposal is an integral part of the First Phase of an EV Charging Infrastructure Deployment Plan ("Phase 1 EV Plan") planned to be filed on or before September 1, 2022, in compliance with the November 18th R&O.

Incorporating guidance from PREB, feedback from stakeholders, limitations of Puerto Rico's electric grid, the outlook of the EV market and insights from secondary research, LUMA proposes to undertake three EV rate pilots which are the most beneficial and viable for Puerto Rico in the near-term to medium-term:

1. Residential EV TOU Rate with Separate Meter
2. Residential EV Subscription Rate with Managed Charging
3. Public EV Charging Rate

These rate pilots will be helpful in determining which rate design(s) fit best and are sustainable for EV drivers in Puerto Rico going forward. Moreover, these pilots will provide LUMA with valuable insights into customer preferences and their charging behavior with respect to different price signals. These rate pilots

[1] Act 17-2019 and Act 33-2019

[2] Estado Libre Asociado De Puerto Rico. (2014, September). Puerto Rico Greenhouse Gases Baseline Report - DRNA. https://drna.pr.gov/wp-content/uploads/2017/05/Puerto-Rico-GHG-2014.pdf. Retrieved May 20, 2022.

will also enable LUMA to better understand the effectiveness of the proposed rates and capture lessons learned that will contribute to future rate offerings used to support the growing EV market in Puerto Rico. As informed by the November 18th R&O, LUMA identified six key objectives for these EV rate pilots: (1) focusing on residential and low-income sector and primarily on home EV charging infrastructure; (2) minimizing electricity system impacts of EV charging; (3) addressing the unique needs of and opportunities for customers with distributed generation (DG) and/or battery storage; (4) being synchronized with implementation of residential time-of-use (TOU) rates, to the extent possible; (5) supporting Puerto Rico's climate and energy goals and public policy; and (6) including a fair and equitable cost allocation and recovery mechanism.

To support these objectives, LUMA further evaluated additional considerations to support EV adoption in Puerto Rico, especially for residential customers in low-income communities and those with DG and/or storage to adopt EVs. LUMA does not expect significant EV ownership among low-income customers for a considerable time given the barrier of higher upfront costs of EVs and relatively lower historical vehicle ownership rate among low-income customers. However, these customers would have equitable access to participate in any residential EV rates offered by LUMA on the same terms and conditions as other residential customers.

LUMA also considered the limitations of grid infrastructure in Puerto Rico and the current states of the EV market and available vehicle and charging technologies when assessing the most viable rates to support EV adoption in Puerto Rico. Since all three proposed EV rate pilots require some form of TOU metering, LUMA identified a few alternative options that are being tested by other electric utilities in the US.

2. Introduction and Context

This proposal is filed in compliance with the November 18th R&O. Specifically, the November 18th R&O, established Principles "to guide the adoption of plans, regulations and procedures" related to EV infrastructure deployment (The Principles). In addition, the PREB ordered LUMA to file, on or before September 1, 2022, the First Phase of an EV Charging Infrastructure Deployment Plan to reflect the Principles and in compliance with specified requirements in the November 18th R&O ("Phase 1 EV Plan") and to file, on or before May 31, 2022, an EV rate proposal for one or more rate designs targeting the customer segments set forth in the Principles and envisioned in the Phase 1 EV Plan. This proposal is LUMA's response to the EV Rate Proposal directive in the November 18th R&O. LUMA is currently developing the Phase 1 EV Plan and this rate proposal is intended to form an integral part of the plan.

2.1 Principles and Additional Requirements for Phase 1 EV Plan

The November 18th R&O was issued in Case No. NEPR-MI-2021-0013 under which the PREB commenced a regulatory proceeding regarding the deployment of EV charging infrastructure through a Resolution and Order dated August 21, 2021 (the August 21st R&O). As directed in the August 21st R&O, the PREB held a Stakeholder Workshop on September 23, 2021. The main purpose of the Stakeholder Workshop was to: "*initiate a dialogue on electric vehicle adoption trends and to encourage the deployment of the necessary infrastructure.*"

Following the workshop, the PREB issued the November 18th R&O which, among other things, set out the "Principles". According to the November 18th R&O, the Principles reflect stakeholder feedback from the September 23, 2021, workshop as well as public regulatory documents and proceedings in other jurisdictions related to EV charging infrastructure deployment. The Principles cover key elements of EV charging infrastructure deployment, including:

> **Principle 1: Equipment Siting/Locating**, indicating among other things, that the charging infrastructure deployment shall be sequenced by sector, starting with residential, followed by fleets, transit and, finally, multi-family structures
>
> **Principle 2: Grid Connectivity**, indicating among other things, that rate designs shall encourage customer behavior beneficial to the (electricity) system and, to the extent possible, shall be synchronized with a concurrent implementation of TOU rate for residential customers
>
> **Principle 3: Incentives**, with consideration given to focusing rate design on the pairing of EV charging with distributed generation (DG) and storage
>
> **Principle 4: Charging Technology & Needs**, with existing standards such as ISO 15118 (concerning the interface between EVs and the grid) to direct deployment
>
> **Principle 5: Benefits and Costs**, indicating rate designs to shift EV charging to times when energy, particularly low-carbon energy, is abundant
>
> **Principle 6: Utility Participation in the EV Charging Market**, indicating the utility's participation in this component of the energy sector shall primarily target: a) make-ready infrastructure investments; b) services to hard-to-serve segments; and c) areas where the market does not adequately respond to demands or needs

Principle 7: Charging/Billing those Receiving Electric Service via EV Charging, indicating billing to end users of EV charging stations shall be on a unit ($/kWh) basis, not time-based ($/minute), and that certain third parties operate under an electric tariff that includes discounts/subsidies, which should not necessarily be passed on to EV charging

Principle 8: Government Supplying Land for EV Charging Infrastructure, especially along highways

The Phase 1 EV Plan should reflect these Principles and comply with additional requirements as set out in the November 18th R&O. These additional requirements (the "Requirements") are set out below[3]:

Requirement A: Identifying near-term transportation electrification actions LUMA can take to address barriers to EV adoption in the residential sector

Requirement B: Identifying a portfolio of actions, including investments and infrastructure to support EVs, rate design, programs, and services to contribute to the objectives of Act 17-2019[4] and Act 33-2019[5]

Requirement C: Addressing barriers to the adoption of transportation electrification in the residential and low-income sectors first

Requirement D: Filing a draft proposal for rates related to EV charging and/or load management efforts to control the timing of charging in the residential sector

Requirement E: Addressing disadvantaged communities, such as through programs to enable vehicle charging access to multifamily buildings and renters, low-income customers, and public transit

Requirement F: Minimizing electricity system impacts from increased electrification of the transportation sector

Requirement G: Information relating to the various programs and initiatives LUMA proposes within the Phase 1 EV Plan, such as the current and anticipated impacts resulting from increased transportation electrification and how the programs and initiatives address these system impacts and relate to Puerto Rico's climate and energy goals and public policy, among others.

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[3] Note that the Requirements were listed with lower case lettering in the November 18th R&O but are listed using upper case letters herein to better differentiate them from additional considerations related to EV rates that were also listed in the November 18th R&O with lower case lettering.

[4] Act 17-2019: Set the parameters for a resilient, reliable, and robust energy system with just and reasonable rates for all class of customers; make it feasible for energy system users to produce and participate in energy generation…unbundle and transform the electrical power system into an open system. https://bvirtualogp.pr.gov/ogp/Bvirtual/leyesreferencia/PDF/2-ingles/17-2019.pdf

[5] Act 33-2019: Set forth the public policy of the Government of Puerto Rico on climate change and on the mitigation, adaptation, and resilience processes per sector; establish a greenhouse gas emission inventory… to combat the effects of climate change. https://bvirtualogp.pr.gov/ogp/Bvirtual/leyesreferencia/PDF/2-ingles/0033-2019.pdf

2.1.1 Additional Considerations for EV Rate Filing

In addition to targeting the customer segments set forth in the Principles, the November 18th R&O also set out that the rate filing shall, at a minimum, address the following considerations (the "Considerations"):

Consideration a: The tariff shall be designed to be implemented as a component of the EV charging infrastructure deployment schedule

Consideration b: Enrollment in an EV tariff shall be a prerequisite of installation of EV charging equipment on a customer's premises/property

Consideration c: The proposed tariffs shall include particular focus on customers with DG and/or storage installed on the customer's premise, operation on the customer's side of the meter to mitigate any adverse impact of load growth on the system and to encourage DG and storage deployment

Consideration d: Include projections of impact (energy and capacity) upon load over time

Consideration e: Propose how costs associated with the EV infrastructure asset investments are to be allocated and recovered.

In footnote 13 of the November 18th R&O, the PREB also indicated that the rate proposal "shall not be interpreted or construed as a revision to the approved permanent rate." Rather, the rate proposal should be "targeted and focused on the establishment of new rates for certain specific services and to incentivize certain customer behavior." Lastly, footnote 13 indicated that "evaluation of this filing (the rate proposal) will take place in a separate docket."

2.2 Related Hearings and Workshops

The PREB held Compliance Hearings and Technical Workshops related to the EV rate proposal. LUMA and key stakeholder presented strategies and findings on how to improve EV penetration in Puerto Rico including feedback on rate design strategies.

2.2.1 Stakeholder Feedback Regarding EV Rates

Stakeholders submitted comments for the Stakeholder Workshop on September 23, 2021, regarding the EV adoption trends and deployment of necessary infrastructure. The stakeholder comments informed the November 18th R&O outlining the Principles and requirements for the Phase 1 EV Plan and the additional considerations for EV Rate Design.

Several stakeholders were in favor of developing a TOU rate structure to promote the adoption of EVs and EV charging stations. They also identified key challenges to increase EV adoption and provided recommendations such as developing maps to determine the locations of EV chargers, and technical workshops to educate local workforce on regulations/electrical codes, among other things. Table 2-1 highlights specific stakeholder feedback related to EV rates.

Table 2-1: Summary of Stakeholder Feedback on EV Rates from September 23, 2021, Stakeholder Workshop

Stakeholder	Feedback Summary
Cambio PR	▪ The extent of additional grid storage will depend on incentives through a TOU pricing.
Tesla	▪ Tesla believes that the best and fairest way to charge EV drivers for charging services is on a $/kWh basis. ▪ Best practices for residential TOU rates are to make the peak period short enough, such as 4 hours, so that it is actionable, and that there is enough of a price differential between peak and off-peak periods to incentivize customers to charge their vehicles during off-peak times. ▪ Since many residential customers may be hesitant to enroll their entire home on a TOU rate, making the rate available to a sub-metered EV account is also beneficial.
Colegio de Peritos Electricistas de Puerto Rico	▪ Supports and promotes the integration and deployment of EV charging stations to the grid.
Oficina Independiente de Proteccion al Consumidor (OIPC)	▪ The OIPC supports and promotes the adoption of EV programs. ▪ Recommends various incentives to promote the adoption of EVs and the deployment of charging stations (exemption on property tax, tax incentives to the stations that are powered with renewables, expedite permitting process, etc.).
Public Energy Policy Program of the Puerto Rico Department of Economic Development and Trade	▪ The PPPE position is that they promote, support, and facilitate the integration of EV charging stations to the electrical grid. ▪ Recommends proceeding with the required studies to identify what needs to be done, regarding upgrades, on the Puerto Rico grid to allow the integration of EVs.
Evengo Puerto Rico	▪ The price of all EV charging services inherently incorporates some level of recovery on the fixed costs (i.e., equipment production and installation, infrastructure deployment, labor) and variable costs (i.e., electricity rates) from the operation and management of EV charging infrastructure. ▪ A unit-based pricing approach (i.e., $/kWh) will undermine competition by favoring a certain subset of market players.
Chris Nelder	▪ EV charging should be profitable to be sustainable and cheaper than the cost of gasoline. ▪ EV chargers should be on dedicated tariffs and on separate meters. ▪ Tariffs should offer an opportunity to earn credit for providing grid services through managed charging.

2.3 Objectives of LUMA's EV Rate Proposal

As stated, LUMA intends for this rate proposal to form an integral part of the Phase 1 EV Plan. Accordingly, its development was undertaken concurrently with the development of the Phase 1 EV Plan.

To help provide clarity and focus our efforts, LUMA established the following "objectives" for the rate proposal, as informed by the Principles, Requirements and Considerations set out in the November 18th R&O and listed in the previous section. Given the rate proposal is an integral part of the Phase 1 EV Plan, we believe the Principles and Requirements as set out by the PREB for the Phase 1 EV Plan should also apply to the rate proposal.

Table 2-2 provides LUMA's interpretation of the Principles, Requirements and Considerations expressed as Goals for the rate proposal. For ease of reference, the specific Principle, Requirement or Consideration from the November 18th R&O that each objective supports, or addresses is also set out in the table. However, there is some degree of overlap between some of the Principles, Requirements and Considerations, and not all the Principles and Requirements are directly relevant to the rate proposal. For example, *Principle 8: Government Supplying Land for EV Charging Infrastructure, especially along highways* does not appear to be directly relevant to EV rates. Table 2-2 therefore, only includes Principles, Requirements and Considerations that are related to rate proposal.

Table 2-2: Objectives of LUMA's Rate Proposal

LUMA's Objective	Guiding Principles and Requirements from November 18th R&O
1. Focus on residential and low-income sector and primarily on home EV charging infrastructure	▪ **Principle 1:** …charging infrastructure deployment shall be sequenced by sector, starting with residential… ▪ **Principle 6:** …the utility's participation in this component of the energy sector shall primarily target… b) services to hard-to-serve segments, and c) areas where the market does not adequately respond to demands or needs ▪ **Requirement C:** Addressing barriers to adoption of transportation electrification in the residential and low-income sectors first ▪ **Requirement E:** Addressing disadvantaged communities, such as through programs to enable vehicle charging access to multifamily buildings and renters, low-income customers, and public transit. ▪ **Consideration b:** Enrollment in an EV tariff shall be a prerequisite of installation of EV charging equipment on a customer's premises/property
2. Minimize electricity system impacts of EV charging	▪ **Principle 2:** …rate design shall encourage customer behavior beneficial to the (electricity) system… ▪ **Principle 5:** …rate design to shift EV charging to times when energy, particularly low-carbon energy, is abundant

	▪ **Requirement D:** …draft proposal for rate related to EV charging and/or load management efforts to control the timing of charging ▪ **Requirement F:** Minimizing electricity system impact from increased electrification of the transportation sector
3. Address the unique needs of and opportunities for customers with DG and/or battery storage	▪ **Principle 3:** … consideration given to focusing rate design on the pairing of EV charging with DG and storage ▪ **Consideration c:** …particular focus on customers with DG and/or storage installed on the customer's premise.... and to encourage DG and storage deployment
4. Be synchronized with implementation of residential time-of-use rates, to the extent possible	▪ **Principle 2:** …rate design shall … to the extent possible, be synchronized with a concurrent implementation of time-of-use rates for residential customers
5. Support Puerto Rico's climate and energy goals and public policy	▪ **Requirement B:** portfolio of actions, including… rate design… to contribute to the objectives of Act 17-2019 and Act 33-2019 ▪ **Requirement G:** Information relating to … how the programs and initiatives (within the Phase 1 EV Plan) relate to Puerto Rico's climate and energy policy goals and public policy. ▪ **Consideration d:** …projections of impact (energy and capacity) upon load over time
6. Include a fair and equitable cost allocation and recovery mechanism	▪ **Consideration e:** Propose how costs … are to be allocated and recovered

LUMA recognizes that *Goal 1: Focus on residential and low-income customers* has the effect of limiting market coverage, but also anticipates the development of additional rate proposals over time that address this gap and continues the sectoral sequencing set out in the November 18th R&O ("*… residential, followed by fleets, transit and, finally, multi-family structures*") or as modified by the PREB in the future.

Having established the above objectives for the rate proposal, LUMA set about identifying possible rate structures to address these objectives by reviewing those implemented or proposed in other jurisdictions. LUMA then established screening criteria based on the above objectives to identify the residential EV rate structures that are most responsive to the November 18th R&O and most attractive and viable for Puerto Rico in the near- to medium-term.

2.4 Additional Considerations for Puerto Rico

Compared to most US utilities, LUMA has a relatively high percentage of customers that are low-income households. There is also a large group of residential customers with solar PV operating (some of which also have batteries) under a net metering arrangement. The following sections provide more information on these important customer groups and the potential implications for any residential EV rates that LUMA may introduce.

2.4.1 Low Income Context for Puerto Rico

Puerto Rico has witnessed severe hurricanes and earthquakes including Hurricane Maria, which crippled the economy, infrastructure, and health systems and left vulnerable groups even more susceptible to poverty. The median annual household income in Puerto Rico is $21,058, which is less than the median annual household income of $64,994 across the entire US[6]. Additionally, as shown in Table 2-3, the poverty rate in Puerto Rico is 44.1%, which is significantly higher than Mississippi's poverty rate of 18.7%; the state with the highest poverty rate[7] in the US. Table 2-3 also shows 2021 EV registration and 2021 EV penetration for these jurisdictions. In 2021, the number of reported EV registrations in Puerto Rico was approximately 3,210[8] and 2021 EV penetration rate was at 0.12%[9].

Table 2-3: Poverty Rate and EV Registrations in Puerto Rico and Some US Jurisdictions

State/Territory	2021 Population	Median Household Income ($)	Poverty Rate (%)	2021 EV Registrations	2021 EV Penetration (%)
Puerto Rico	3,263,584	21,058	44.1%	3,210	0.12%
Mississippi	2,949,965	46,511	18.7%	780	0.06%
Louisiana	4,624,047	50,800	17.8%	1,950	0.13%
New Mexico	2,115,877	51,243	16.8%	2,620	0.29%
West Virginia	1,782,959	48,037	15.8%	600	0.13%
Arkansas	3,025,891	49,475	15.2%	1,330	0.13%
District of Columbia	670,050	90,842	15.0%	2,360	2.02%
Kentucky	4,509,394	52,238	14.9%	2,650	0.24%
Alabama	5,039,877	52,035	14.9%	2,890	0.15%
Florida	21,781,128	57,703	12.4%	58,160	0.60%
California	39,237,836	78,672	11.5%	425,300	2.61%
Hawaii	1,441,553	83,173	8.9%	10,670	1.72%

Source: US Census, 2019 EV Adoption, Electrek, PREPA IRP, Guidehouse Insights EV North America

Generally, jurisdictions with higher EV penetration also have higher median household incomes, and vice versa. Except for the District of Columbia, all the states shown with a poverty rate of 15% or more had EV penetration of less than 1% in 2021.

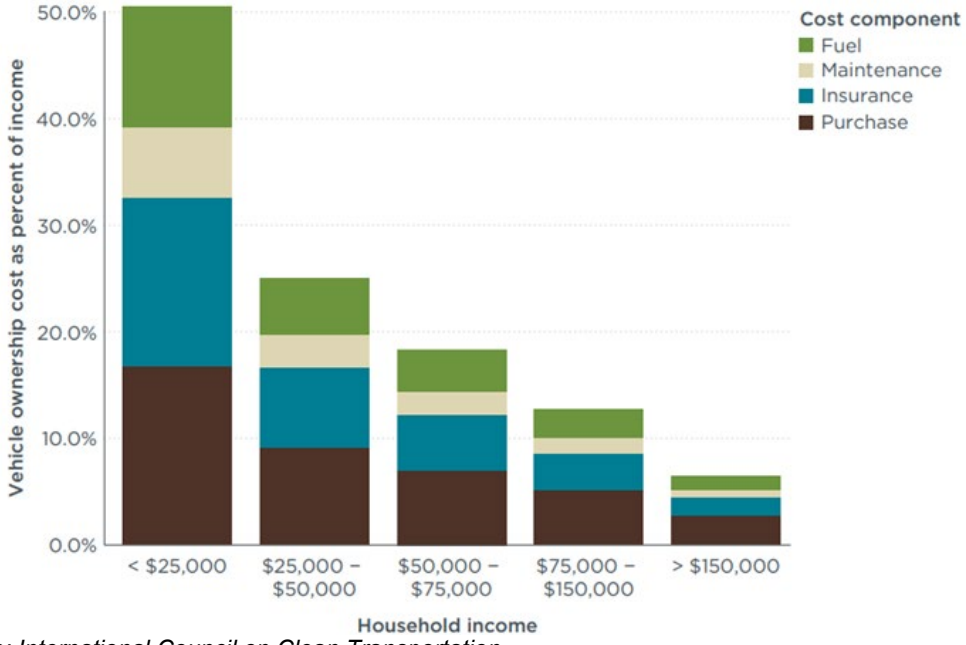
[6] U.S. Census Bureau Quickfacts: Puerto Rico and United States Median Household Income (2020). https://www.census.gov/quickfacts/fact/table/PR/PST045221

[7] The US Census Bureau measures poverty rate by using a set of money income thresholds (the minimum level of income deemed adequate) that vary by family size and composition to determine who is in poverty.

[8] Total EV registration as of Q3/2021 was provided by National Renewable Energy Laboratory (NREL) based on data from Experian.

[9] Percent EV penetration in 2021 is calculated by dividing the number of EVs on the road (5,952) by an estimated total vehicle registration in PR (2,709,206)

Figure 2-1: Vehicle Ownerships Costs by Income Group



Source: International Council on Clean Transportation

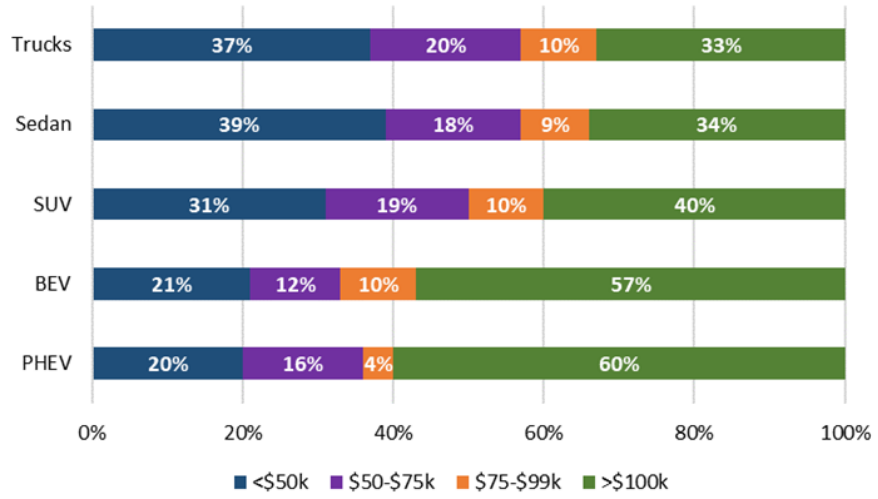
Vehicle ownership represents a significant cost burden for many low-income households. The International Council on Clean Transportation (ICCT) estimates that the cost of vehicle-related expenses (including insurance, fuel, maintenance, and the car purchase) for low-income households could represent up to 50% of their household incomes as shown in Figure 2-1.

Generally speaking, "fuel" costs for an EV are lower than for gasoline-fueled vehicles and would reduce the relative cost burden of vehicle ownership, all other things being equal. However, the other vehicle-related expenses, such as insurance, maintenance, and the car purchase itself would still represent a significant burden for low-income households (almost 40% of household income according to the ICCT). Given the cost burden of vehicle ownership, low-income households would be expected to have lower vehicle ownership rates than higher-income households. Correspondingly, lower income households would also be expected to have a greater reliance on public transportation than higher-income households.

Specifically with respect to EVs, new car buyers with annual household incomes less than $50k represented only 21% of battery electric vehicle (BEV) purchases whereas they represented 39% of sedan with internal combustion engines (ICE) purchases according to the Fuels Institute, as shown in Figure 2-2. In comparison, new car buyers with an annual household income greater than $100,000 represented 57% of BEV purchases, but only 34% of ICE sedan purchases.[10]

[10] EV Consumer Behavior. Fuels Institute. (2021, June). https://www.fuelsinstitute.org/Research/Reports/EV-Consumer-Behavior/EV-Consumer-Behavior-Report.pdf?ftag=YHF4eb9d17

Figure 2-2: Distribution of New Car Buyers by Household Income (2019)

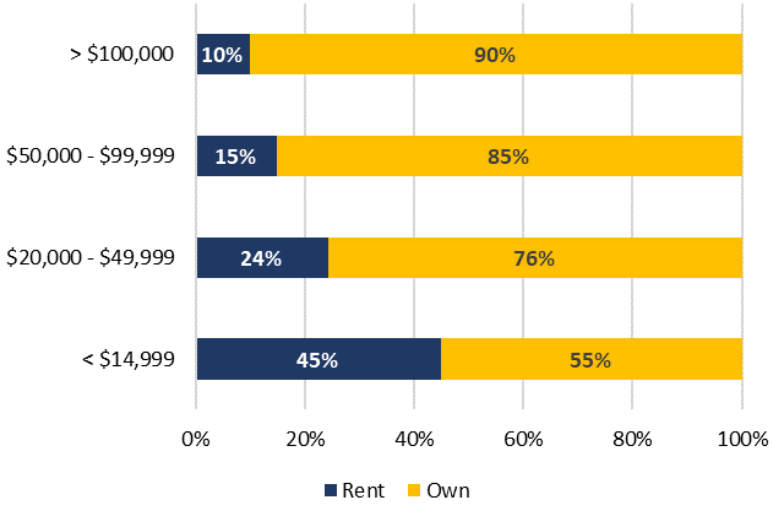


Source: Fuels Institute

This suggests that the vehicle ownership rate among low-income households is expected to be lower than for higher income households. Further, given the price premium for EVs, we anticipate that the EV ownership rate among low-income households, expressed as a percentage of the EV ownership rate among higher income households, would be even lower than for gasoline-powered vehicles.

Low-income households also tend to rent their homes and live in a multi-family dwelling. In Puerto Rico, 45% of households with an income less than $14,999 were renters whereas only 10% of households with an income above $100,000 rented a home as depicted in Figure 2-2. Renters typically cannot install EV chargers and rely on public chargers which limits EV adoption among low-income renters.

Figure 2-3: Puerto Rico housing status by 2020 household income



Source: US Census

To better serve the low-income customer group and build a more customer-focused energy system, LUMA provides special electricity rates for low-income customers through three rate programs:

1) Lifeline Residential Service (LRS),

2) Residential Service for Public Housing Projects (RH3), and

3) Residential Fixed Rate for Public Housing Under Ownership of the Public Housing Administration (RFR).

An estimate of 18%[11] of LUMA's customers are enrolled into a low-income rate program. Table 2-4 shows a comparison between the General Residential Service (GRS) rate program and the three low-income rate programs. The LRS and RH3 were 0.03 and 0.04 cents lower than the GRS monthly charge of 0.05 for the first 425 kWh. The RFR rate program offers a three-tier discounted charge based on the number of rooms in a household. The fixed charges per month are as low as $30 and as high as $50 providing more affordable electricity to households living in public housing.

Table 2-4: Residential Electric General Rate and Low-Income Rates

Electric Rate Program	Eligibility Requirements	Minimum Monthly Charge ($)	First 425 kWh Charge ($)	Customers	Total Annual Consumption (MWh)[12]
General Residential Service	Residential customers for domestic uses	4	0.04944[13]	929,500[14]	5,637,484
Lifeline Residential Service	Residential customers who fulfill the Nutritional Assistance Program criteria	3	0.02054[15]	158,595	595,476
Residential Service for Public Housing Projects	Residential customers of Public Housing Projects supported or subsidized in whole or in part by governmental support	2	0.00694[16]	5,319	20,614

[11] 18% = 209,163 (Customers under RH3, RFR, LRS) / 1,138,663 (Total customers under RH3, RFR, LRS GRS 112)

[12] FY 2020-21

[13] $0.04944 per kWh for the first 425 kWh of monthly consumption; $0.05564 per kWh of additional monthly consumption

[14] Customers under GRS 112 Rate Program

[15] $0.02054 per kWh for the first 425 kWh of monthly consumption; $0.05564 per kWh of additional monthly consumption

[16] $0.00694 per kWh for the first 425 kWh of monthly consumption; $0.05564 per kWh of additional monthly consumption

Electric Rate Program	Eligibility Requirements	Number of Rooms	Fixed Charge per month ($)	Excess kWh Charge ($/kWh)	Customers	Total Annual Consumption (MWh)[17]
Residential Fixed Rate for Public Housing Under Ownership of the Public Housing Administration	Residential customers residing in a housing unit physically located within a housing project owned by Public Housing Administration	1	30	**Excess of 600kWh:** 0.05564	7,282	27,356
		2 or 3	40	**Excess of 800 kWh:** 0.05564	34,246	223,786
		4 or 5	50	**Excess of 1000 kWh:** 0.05564	3,721	35,073

Source: LUMA

LUMA also provides a fuel oil subsidy and equipment discount for residential low-income customers. The Fuel Adjustment Subsidy is available for handicapped, elderly and college students. The subsidy is included in the LRS and RH3 rates where a residential customer's monthly consumption does not exceed 500 kWh. The Life Preserving Equipment Discount is available for customers who need electrical equipment to 'preserve life' and must be qualified as low-income household by the Department of Family.

In addition to providing lower electric rates, subsidies, and discounts for low-income residential customers, LUMA provides information on government assistance programs that can alleviate income challenges, such as the Low-Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP) as shown in Table 2-5.

Table 2-5: Low-income Government Assistance Programs

Government Assistance Programs	Description
Low Income Home Energy Assistance program (LIHEAP)	Helps income qualified households with electric service bills
Weatherization Assistance Program (WAP)	Helps income qualified families achieve a reduction in domestic energy consumption, by replacing old or inefficient equipment with energy saving equipment and measures
Temporary Assistance for Needy Families (TANF)	Helps income qualified families with children achieve economic self-sufficiency
Coronavirus Aid, Relief and Economic Security Act (CARES) Act	Provides economic aid to individuals and businesses that have been impacted by COVID-19

[17] FY 2020-21

Puerto Rico's Rent Payment Assistance Program	Provides rental assistance and utilities to income qualified residents impacted by COVID-19

Source: LUMA

Although LUMA does not expect significant EV ownership among low-income customers for a considerable time given the higher up-front costs for EVs and the relatively low expected EV ownership rate among low-income customers, these customers would be able to participate in any residential EV rates offered by LUMA on the same terms and conditions as other residential customers. If the low-income customers were already participating in one of LUMA's low-income rates and wanted to participate in the EV rate being proposed, it may be possible to preserve the effect and intent of the low-income rate while also offering the potential benefits of the EV rate. The specific details regarding how to "integrate" the low-income rates with any EV rates would be developed in the future rate design filing.

2.4.2 Customers with Solar PV and/or Battery Storage

Since 2010, an increasing number of electricity customers in Puerto Rico have installed solar photovoltaic (PV). Most of these customers are also participating in the net metering program. At the end of January 2022, there were more than 42,000 customers with solar PV (or other renewable generation capacity), which account for about 3.8%[18] of LUMA residential customers, operating under the net metering arrangement[19]. Most of these customers are residential customers who have a bi-directional meter installed to measure the net energy flow into or out of customers' facilities.

The net metering program allows customers to use any solar output in excess of their household load to offset their consumption during periods when the solar output is less than their household load within a fiscal year. Thus, energy exported to the grid within a fiscal year (July 1 to June 30) is valued the same as energy imported from the grid during the fiscal year based on the customer's tariff. In the event that the total amount of energy exported within a fiscal year exceeds the amount that is imported from the grid through the meter, customers receive a bill credit at the end of the fiscal year. The value of this credit to the customer is currently 7.5 cents/kWh which is much lower than the current general residential tariff of 4.9 cents/kWh for the first 425 kWh and an additional ~0.23 cents/kWh for fuel charges, purchase power charges, public lighting charges etc. Thus, there is an incentive for customers with solar PV to size their system appropriately such that the energy produced by the solar PV is less than or equal to their gross household consumption. This incentive is demonstrated by the fact that over the twelve-month period ending June 30, 2021, net metering participants exported approximately half as much energy (136,908 MWh) as they consumed from the grid (282,157 MWh)[20].

Similar to the growth in solar PV installations, there has also been significant growth in the number of battery installations. Operationally, the batteries are likely to have been purchased primarily to provide back-up power in the event of an outage. Thus, most residential batteries must remain partially charged to provide this back-up capacity at any time of day or night. For battery owners who also have solar PV, the remaining battery capacity would be available to shift any solar PV output exceeding the household load

[18] 3% = 51,300 Solar PV customers / 1,350,929 Residential customers under RH3, RFR, LRS and GRS rate

[19] Anejo-2-Datos-Energia-Renovable-NEPR-MI-2019-0016

[20] Anejo-2-Datos-Energia-Renovable-NEPR-MI-2019-0016

to other times when the solar PV output is lower or zero. Strictly speaking, however, there is no financial incentive to do so under the net metering policy that applies to residential PV owners. In fact, given the round-trip losses associated with charging and then discharging a battery (roughly 10% losses), as opposed to simply letting any excess solar PV flow to the grid, there may even be a slight financial disincentive to using the batteries to shift excess solar PV output.

Alternatively, for residential customers who own batteries but do not own solar PV, the batteries could be used to increase consumption during periods of low demand (by charging the batteries) and decrease consumption during periods of high demand (by discharging the batteries) but there is no financial incentive under the current flat rate structure to do so (and there potentially is a slight disincentive given round-trip losses within the battery). However, the size of this customer group is currently small.

With respect to PV ownership and battery ownership, there are four groups based on the possible combinations of these two technologies. While the vast majority of LUMA's residential customers fall into group 4 in Table 2-6 (without solar PV and without batteries), LUMA expects that the distribution of EV owners is skewed more towards groups 1, 2 and 3 (i.e., owning some combination of PV and/or batteries) than residential customers who do not own EVs.

Table 2-6: Solar PV and battery ownership combinations

	With Solar PV (and net metering program)	Without solar PV (with standard tariff)
Own batteries	1*	3
Do not own batteries	2*	4

*Customers under groups 1 & 2 are the prominent ones

LUMA expects there will be some degree of overlap between the ownership of EV, solar PV, and battery storage. With limited information on the actual number of customers in each of the four groups listed in Table 2-6 and which customers own EVs and have EV chargers, LUMA expects that some EV owners will have solar PV and are operating under a net metering arrangement with bi-directional metering (Groups 1 and 2 above). Further, LUMA believes that these customers comprise a not insignificant percentage of EV owners. Accordingly, LUMA believes that these customers need special consideration in the development of an EV rate. To ignore these customers or otherwise preclude them from participating in an EV rate would limit the potential benefits an EV rate has to offer.

In the subsequent sections of this submission follow LUMA's EV rate development approach:

- Section 3 describes the research and review of residential EV rate structures offered by other utilities in the US and considered by LUMA.
- Section 4 presents LUMA's approach in ranking and assessing the possible residential EV rate structures for their responsiveness to the November 18th R&O, including their attractiveness and viability for Puerto Rico.
- Section 5 provides LUMA's proposed roadmap for the implementation of EV rates, starting with timeline and necessary steps to design and implement the proposed rates, including the detailed

design and evaluation of these rates as part of the Phase 1 EV Plan and the development process LUMA intends to follow.

3. Residential EV Rate Alternatives Considered

LUMA conducted comprehensive research on the types of EV rate structures proposed or implemented by utilities across the US who offer their customers EV rate options targeting residential and multi-family dwelling use cases. The focus of the research is on the EV rate structures that drive EV adoption in the residential market, including public EV charging rates.[21]

3.1 Rate Structures and Program Characteristics

A total of 36 rate proposals from 29 different utilities were evaluated based on two criteria that a rate must: (1) serve residential EV customers; and/or (2) aim to drive EV adoption among residential market segments. These rate pilots and programs were further categorized into three main groups of rate structures.

1) **TOU** is a time-varying rate that adjusts the cost per kWh throughout the day, with most offering cheaper rates when electricity demand is lower and higher rates at times of day when demand is higher.

2) ***Fixed Subscription Charge*** is where customers are charged a standard monthly fee, typically with a limit on usage and excess fees.

3) ***Off-Peak Charging Discount*** typically is a rider providing a discount to customers on a regular basis (monthly, quarterly or annually) or per kWh in exchange for customers shifting their electricity usage to off-peak hours.

Table 3-1 provides an overview of the distribution of rate options over the two market use cases – residential and public EV charging. All EV rates reviewed have been offered to customers on an opt-in basis.

Table 3-1: Distribution of EV Rate Structures for Residential and Public Charging

Rate Structure		Program Count		Utility Count
		Residential Rate	Public Charging Rate	
TOU	**Whole-House Meter**	12	-	12

[21] LUMA considers a public EV charging rate as an option to incentivize public charging infrastructure investment and support competition in the private sector. Moreover, a public EV charging rate can also address range anxiety among residential EV drivers and support residential customers who drive taxis and/or ride-sharing platform.

	Separate Meter	8	-	8
	Reduced Demand Charge	-	9	9
	Fixed Demand Charge	-	2	1
Fixed Monthly Subscription Charge		1	-	1
Off-Peak Charging Discount		5	1	5

Among EV rate structures reviewed, TOU pricing is the most common EV rate option for residential EV charging. We further group residential TOU rates based on metering requirement since the impact of price signals on customers' EV charging behavior can vary significantly between a whole-house and separately metered TOU rates. For public EV charging rates, we categorize them based on the variation in demand charges. Similar to residential TOU rates, the off-peak charging discount is essentially a two-period TOU tariff with a different compensation approach for charging during off-peak hours. The following section provides detailed descriptions, features and characteristics of rate structures presented in Table 3-1, including case studies as references.

3.1.1 Residential Charging Rate Structures

1) **Whole-House TOU Rate:** While specifically designed for EV charging, a residential whole-house EV TOU rate is applied to a residence's entire electricity usage. From the utility perspective, this rate structure is the simplest mechanism to incentivize off-peak charging. To benefit most from the whole-house TOU rate, EV owners will want to charge their vehicles during periods of lower demand and shift most of their other energy use to this same time structure. Three of the EV TOU whole-house rate programs reviewed offer a price guarantee (or bill protection) feature where EV owners get credited for the difference in annual electric bills if they pay more than what they would have paid under the standard residential rate. This type of features allows customers to try the TOU rate plan with a guarantee that they will be required to pay no more with TOU rates than their former rates and is typically applicable only to the first year of rate participation.

Case Studies

Con Edison (ConEd) offers a whole-house TOU rate for EV customers. ConEd will install a new advanced metering infrastructure (AMI) meter for customers who sign up at no additional cost, but customers will pay a higher monthly charge for the cost of the TOU meter ($4.11 more than monthly service charge of their standard residential rate). Their TOU rates comprise of supply and delivery rates. TOU supply rates are divided into three periods: off-peak, on-peak, and super-peak. Super-peak periods are a subset of peak hours during the summer and only apply on weekdays. TOU delivery rates have a peak and off-peak time period which apply to all days of the week.

Madison Gas and Electric offers their customers a way to "shift & save" money by charging their EVs at night and on weekends. Customers who participate in the program

will receive discounted rates for electricity used during off-peak hours (9PM-10AM). In exchange, customers pay more during on-peak hours (10AM-9PM). This rate is applied to the entire household electricity usage and not only to EV charging load.

2) **Separate Meter TOU Rate:** This type of EV rate is applied exclusively to EV charging through separate metering, submetering, or an eligible EV charger. A standalone meter for EV usage provides customers with greater control and predictability over when electricity will be utilized, enabling them to pre-plan when to charge that fits best to their schedule and lifestyle. Recently, this rate option has been widely adopted since a separate meter facilitates data gathering, enabling utilities to better understand customers' EV charging behavior and load impacts that EV charging has on the grid.

   Unlike the TOU whole-house rates where utilities typically apply additional cost of TOU meters to customer monthly service charge, installing a second meter to measure the EV charging load presents an additional cost (e.g., electrical work at customer's premise to upgrade electrical panel or install a meter socket) beyond TOU metering which may contribute to lower participation rate. Among TOU rates that leverage the capability of EV chargers to monitor charging usage, customers are typically required to connect their EV chargers with a secure home Wi-Fi and allow the utility to access their EV charging data. Additionally, EV drivers reliant solely on Level 1 charging are unable to participate unless they pay extra for Level 2 charger installation and panel upgrades.

   Case Studies

   Minnesota Power provides residential EV drivers in their service territory with discounted rate for EV charging during off-peak hours (10PM-8AM on Monday-Friday, and all day on weekends and holidays). Service under this rate is separately metered. The energy rate is $0.02391/kWh for off-peak and $0.10251/kWh for on-peak usage, representing more than four times the price differential between on- and off-peak charging. Residential customers participating in this rate will pay an additional monthly cost of $4.25 for the installation of a separate meter.

   Baltimore Gas and Electric (BGE) offers a special TOU rate for residential customers who own EVs and have an eligible Level 2 home charging station. Customers can place their EV charger on this TOU rate while the rest of their house remains on a standard residential rate. The qualified Level 2 charger is used to monitor EV charging load in place of a separate meter. Compared to the standard residential rate, if a customer drive 15,000 miles per year, the customer could save roughly $120 per year by plugging in their EV during off-peak hours (8PM-10AM in the Summer, and 11AM-5PM and 9PM-7AM in the Winter). Additionally, net metering customers are not eligible to enroll in this rate.

3) **Fixed Monthly Subscription Charge:** This option is similar to a cell phone plan where customers sign up for subscription rate. Customers pay a monthly flat fee for EV charging that covers up to a predetermined amount of kWh per month. In exchange for the flat fee, the utility can directly manage chargers to reschedule charging during non-peak periods. For public charging, energy and demand charges are combined into one subscription charge. Rate participants can sign up for subscription level based on their charging usage and expect a consistent month-to-month electric bill.

Equipment similar to an Open Vehicle Grid Integration Platform (OVGIP) will be needed to establish a two-way communication network between the utility and a vehicle's telematics application.

Case Studies

Duke Energy (Duke) has proposed a residential managed charging subscription-based rate, targeting 200 residential EV drivers. Under this 12-month pilot, customers will pay a per-vehicle monthly flat fee of $19.99 and $24.99 for Duke Energy Carolinas and Duke Energy Progress, respectively. The flat rate covers up to 800 kWh per month of EV charging usage. Any participants using more than 800 kWh per month will receive a notice or risk being removed from the pilot. In partnership with BMW, Ford, GM and Honda, Duke intends to test the Open Vehicle Grid Integration Platform (i.e., in-vehicle telematics)[22] which allows Duke to see charging activity, battery state of charge, or call demand response events. Participants will need to have a home EV charging station and drive an approved EV, including a degree of monitoring and hands-on charging management along with their flat-fee EV charging. All rate participants are required to allow Duke to actively charge their vehicles, utilizing vehicle charge management processes. Duke will be able to pause charging for periods of no more than four hours for three times per month. Rate participants will receive twelve hours advance notice that a managed charging event will occur and have ability to opt out two times during the pilot period, otherwise they may be removed from the pilot. The total estimated cost for this pilot with up to 200 participants is no more than $600,000.

4) **Off-Peak Charging Discount:** As an alternative to TOU rates, off-peak charging discount/riders offer residential customers a monthly credit or a discount rate for charging their EVs during off-peak hours, while maintaining standard rates for all other household electricity use. Often offered as a rider, an off-peak charging discount is generally easier to implement and more flexible to develop than TOU rates. An EV rider could provide discounts to the demand charge, the energy rate, the fixed monthly customer charge, or the total customer bill.

Within the off-peak charging discount rates reviewed, there are generally two methods to compensate EV drivers for charging their EVs off-peak: (1) discount per kWh; and (2) fixed monthly or annual credit. Table 3-2 shows the range of the discounts within the two compensation approaches.

Table 3-2: Off Peak Charging Discount Rates

Type	Rate
Discount per kWh	1.7 to 3.3 cents/kWh
Fixed Credit	$48 to $50 annually

[22] The Open Vehicle Grid Integration Platform (OVGIP) is simply in-vehicle telematics designed to allow two-way communication between EVs and the grid using a shared communication protocol. This means utilities could see charging activity, battery percentage or call demand response events for vehicles located in a specific area, regardless of where those vehicles are or what kind of chargers they are using. It typically requires utilities to have an active smart grid system capable of two-way communication and calling demand-side management events.

The disadvantages of an off-peak charging discount include lower charging flexibility and high operating costs to manage demand during the early years of implementation. Customers will need to diligently track off-peak periods and schedule specific times for charging. Based on the rates reviewed under the off-peak charging discount category, customers are typically required to charge their EVs with qualifying Level 2 EV chargers or install an additional meter base and EV meter provided to customers free of charge. However, customers are responsible for hiring an electrician to install the meter base in the EV charging circuit in order to install a Level 2 EV charger or a new EV meter.

Case Studies

Xcel Energy (Xcel) launched the Optimize Your Charge program on August 2021, offering an off-peak charging incentive for customers to charge their EVs during a pre-specified window for at least 25 percent of the time. Xcel provide customers with three charging schedule options that are best for the grid and customers can choose their off-peak charging schedule based on their needs. In return, EV customers receive an annual credit on their electric bill of $50 for each year that their enrollment is active.

Potomac Edison offers an Off-Peak Rewards program where residential EV drivers can earn 2 cents/kWh for net off-peak charging usage by using eligible smart EV charger between 11PM and 6AM and on weekends. Net off-peak usage is the difference between customers' charging usage during off-peak and on-peak hours. Customers participating in this program will receive Off-Peak Rewards as a MasterCard e-gift card with their quarterly earnings. To be eligible to enroll, customers are required to allow Potomac Edison remote access to the charging data generated from eligible smart charger that is connected to Wi-Fi.

3.1.2 Public Charging Rate Structures

A public EV charging rate can serve as a tool to incentivize the deployment of public charging infrastructure to serve EV drivers in Puerto Rico, due to a much more favorable business case. It also enables competition in the Puerto Rico EV market and supports a diverse cross-section of the charging industry by allowing multiple vendors and business models to participate in a public EV charging rate. Additionally, as the public charging network becomes more robust, EV adoption among residential customers with limited access to home charging will likely increase. These customers include the 31%[23] of Puerto Rico's population who rent or reside in public housing or multi-family dwellings. Tenants residing in multi-family dwellings may share common EV chargers and would likely not have equal access to the chargers during lower-priced off-peak time periods.

Given the preponderance of demand charges for non-residential customers, most utilities offer some form of discounted demand charges for public charging facilities, such as:

[23] US Census: Total Population in Occupied Housing Units by Tenure – Table#: B25008. US average value is 34%.

- ***A fixed demand charge*** where participants pay a flat fee for any level of demand charges; and

- ***A reduced demand charge*** where participants receive a discount in demand charge per kW or pay no demand charge for a set number of years, typically during the pilot phase.

The most common variation of demand charge for public charging rate is a reduced demand charge among the utility rate programs reviewed. The reduction in demand charge helps improve the business case for public EV charging while customer utilization is still low but growing. However, the benefit of public EV charging rate will only be realized if it is shared between the charging service providers and end customers.

All public EV charging rates reviewed require a separate meter for EV charging loads. Similar to the residential EV rate structures, there are several examples of utilities offering TOU rates, fixed subscription rates and discounted off-peak charging rates for public charging facilities. However, these rate structures typically apply to the energy (kWh) charge for these facilities only.

Case Studies

Pacific Gas & Electric (PG&E) offers two Business EV Rate Plans. These rates are specifically designed for customers with separately metered EV charging at locations such as multi-family dwelling, workplace, retails, fleets, and fast charging stations. These rate plans include a TOU rate for the energy charge, and two tiers of monthly subscription charge based on customer's expected maximum monthly EV charging kW consumption which can be adjusted throughout the month as often as needed. Customers can choose their subscription level in either: (1) 10kW blocks up to 100 kW with a price of $12.41 per 10kW block; or (2) 50kW blocks starting at 100kW with a price of $95.56 per 50kW block. The accompanied TOU rate has three time periods – off-peak, super-off peak and peak – and they are consistent year-round with no seasonality. Super off-peak period (9AM-2PM) is the most affordable time to charge an EV as this is when PG&E has higher levels of renewable energy generation. The energy charge during peak hours is approximately three times of that during super off-peak hours.

Avista Corporation (Avista) provides an optional commercial EV rate program for non-residential customers taking service for EV charging stations that are separately metered and serve fleet, workplace and public charging. In the case of public DC fast charging (DCFC) sites, eligible participants must serve the general public, and include at least one DCFC charger. Under this program, there are two rate schedules with on- and off-peak pricing with no demand charge, servicing small and large load customers.

3.1.3 Rate and Program Characteristics

1) **TOU Periods:** The majority of utilities that have TOU EV rate structures offer two main usage periods (on- and off-peak). Those with more than two TOU periods offer a shoulder, super-off or mid-day period. Peak window duration ranges from 4 to 16 hours with 5 and 8 hours being the most typical among the TOU rates reviewed.

An important aspect of TOU rate design is the determination of on-peak and off-peak hours of the day. Most utilities set TOU periods based on the need of the electric grid, while benefiting customers to use electricity supply when it is ample and reduce use when supply is limited. Utility regulators generally support TOU structures that provide clear price signals to shift EV charging load to periods where marginal cost of electricity generation is lowest. However, even with a strong price signal, customers may find it difficult to shift their demand from on-peak to other time periods under a restrictive TOU rate structure in which the on-peak period is relatively long or lower-priced period does not coincide with customers' preferred time to charge their EVs.

Case Studies

Hawaiian Electric Company (HECO) offers both whole-house and separate meter options for their residential EV TOU rate (TOU-RI) that is consistent with the solar generation availability and electric system generation cost. The on-peak period is delayed until later in the evening when solar output drops, and generation must otherwise ramp up quickly to balance the system. So, the low mid-day price (lower than the standard residential rate) is used to incentivize EV drivers to charge their vehicles when renewable generation is most abundant. Under this rate, customers pay more during the on-peak and off-peak periods, compared to their standard residential rate. With the separate meter TOU option, customers will need a licensed electrician to work with the utility to install new service for EV charging only and this work will require a city building permit. This rate proposal received a tremendous support from stakeholders including the Hawaii Public Utilities Commission. However, this rate does not incentivize EV adoption because the lowest rate period is during the day when a large proportion of residential customers are away from home, and during other hours, the cost to charge is higher than the standard residential rate.

2) **Price Differentials:** Another important determining factor for a customer's change in behavior is the on- to off-peak price ratio. EV drivers need to notice that there is a substantial difference in prices during these two periods to change their charging patterns. A sufficiently large price differential can effectively encourage customers to shift their EV charging needs to benefit the grid, while saving money on their electric bills.

Table 3-3 illustrates price differentials of energy charges between on- and off-peak as well as seasonal differentiation.

Table 3-3: Price and Season Differentials

Periods / Seasons	Summer	Winter
On- and Off-Peak	1.5x to 14x	2.5x to 11x

Seasons / Periods	On-Peak	Off-Peak
Winter and Summer	0.4x to 1.3x	0.7x to 1.3x

Price and seasonal differentials shown in Table 3-3 are for the volumetric charge only. Among TOU rates reviewed, over 75% have an on-peak and off-peak price ratio between 1.5 and 4. The average

price difference between on-peak and off-peak hours is approximately 12.5 cents/kWh, with a minimum of 4.5 cents/kWh and a maximum of 23.7 cents/kWh.

3) Other Characteristics:

Low Income Participation Target: To provide equitable access to EV charging and reduce barriers to EV adoption in low-to-moderate-income communities, some utilities in the US provide incentives to drive EV adoption through infrastructure rebates and EV-specific tariffs and increase awareness and participation through targeted education and outreach. For example, Ameren Illinois Company offers an EV Rider (Rider EVCP) designed for residential and non-residential customers. Any non-residential customers who are served under Ameren's Standard Commercial Rate DS-2 will receive a monthly bill credit of $15 per month for the first twelve consecutive monthly billing periods the customer remains on the Rider. This Program is limited to 600 multi-family facility, of which no more than 300 can be located outside of low-to-moderate-income areas, 150 education facility, and 15 transit facility customers.

Marketing, Education and Outreach (ME&O): A greater focus on ME&O is important for pilot rate offerings since it enables customers to make well-informed decisions and avoid being surprised by certain features of the pilot. Most utilities leverage their general EV ME&O for programmatic efforts like rate pilots and programs. Pacific Gas & Electric (PG&E), for example, launched EV Charge Network program website and online application to facilitate customer enrollment, while providing programmatic information to customers. PG&E also utilizes community events and newsletters to spread the information about the program to customers.

Managed Charging: Generally, utilities have two options for managed customers' EV charging usage – passive and active. Passive managed charging relies upon customers to shift their charging behavior. To incentivize passive managed charging, several utilities employ EV TOU rates with strong price signals to influence when customers should charge their EVs. As the effectiveness of this type of charging depends solely on customers' responses to price signals, many utilities begin to consider active managed charging programs as a component on EV rate offerings. Active managed charging (or direct load control) leverages communication signals to directly control charging schedules. These dispatch signals typically come from a utility or distributed energy resource aggregator and are sent to an EV or EV charger. Generally, utilities implement active managed charging as an event-based control to manage charging load for a limited number of events during a pilot phase and/or within a specified period of time. The ability to control EV charging load actively enables utilities to realize greater grid benefits. The latest residential fixed monthly subscription rate by Duke Energy, for example, requires participants to allow Duke to pause charging for periods of no more than four hours for three times per month with twelve hours advance notice. Within the twelve hours prior to a managed charging event, participants will have the ability to opt out but only for two times during the pilot phase. Any participant who opts out of more than two managed charging events may be removed from the pilots.

3.2 Enabling Infrastructure to Support Residential EV Rates

The enabling infrastructure or technologies required to implement EV rates will depend on the rate structures and associated features offered. For example, TOU rates will generally require AMI infrastructure with separate metering for the EV chargers. TOU rates will also require the capability to calculate and generate TOU bills, or TOU line items, on a customer bill. In its simplest form as a separate,

flat, non-time varying, EV-specific rate that differs from the standard residential rate, the “enabling infrastructure” would generally be a separate meter.

With respect to managed charging, there is a wide range of capability among the charging infrastructure providers and other supporting service providers. The simplest form of managed charging is called “passive” managed charging which relies on customer behavior to affect charging patterns, typically through TOU rates. An EV driver may manage their charging behavior by delaying when they plug in their EV or by setting an automated charge start time using software enabled options on the vehicle or charger.

While separate metering and AMI infrastructure would generally be required for the above EV rate structures, some utilities are leveraging the capability of EV charging infrastructure to provide EV charger consumption information (by time period if necessary) to the utility. This allows the utility to avoid the cost of separate metering and AMI infrastructure until such infrastructure is more widely available or until a decision is made regarding wide-spread deployment of EV rates following successful pilots. However, this approach can potentially limit the options for customers as they are required to install only qualifying smart Level 2 EV chargers in order to participate in a rate program.

More sophisticated “active” managed charging could eventually treat EV charging infrastructure as a distributed energy resource (DER) and allow the utility to use this resource to manage local system constraints, generation outages, minimize generation costs and optimize network operations. Typically, this type of managed charging relies on: (1) communication signals from a utility or aggregator to be sent to an EV or EV charger to control charging events; (2) a communication signal via Wi-Fi, cellular, or vehicle telematics; and (3) a messaging protocol or standard that can help the device understand and execute the instructions.

Currently, LUMA does not have the necessary AMI infrastructure and billing capabilities to accommodate TOU rates. To support possible EV rate offerings in the interim period until LUMA develops this capability, LUMA is exploring the services available from third-party vendors. For example, LUMA could potentially contract with an EV charging software solutions company to enable EV rates by leveraging vehicle telematics data in the short term. These technology solutions, however, are currently at a nascent stage and can still present challenges integrating with utility billing systems. In the long-term, LUMA will install AMI in EV residential households as AMI will enable better management of energy demand, provide dynamic pricing, reduce the cost of electricity delivery, and improve customer service.

4. Approach to Identifying Most Viable Rate Structures for Puerto Rico

Based on research conducted and described in Section 3, LUMA identifies five rate structures that are most attractive for the residential EV market in Puerto Rico. These rate structures include:

1) ***Residential TOU Rate with Separate Meter*****:** A three-period TOU rate with clear price signals and a separate meter dedicated for EV charging load.

2) ***Off-Peak Charging Discount*****:** A discount rider rate providing savings for EV drivers who charge their EVs during off-peak hours.

3) ***Fixed Monthly Subscription Charge with a Preferred Time Window and Managed Charging*:** A monthly flat fee charged to customers who are committed to charge their EVs during a preferred time window specified by LUMA with an additional managed charging component.

4) ***Fixed Monthly Subscription Charge with Managed Charging*:** Similar to the previous rate structure but without a preferred time window. Customers can charge their EVs at any time of day for a fixed monthly charge with a managed charging component.

5) ***Public Charging TOU*:** A TOU rate with demand charge that is reduced from the typical demand charge on a standard commercial rate.

In order to identify the most viable EV rate structures for Puerto Rico, LUMA developed ranking and screening criteria building off the objectives for the EV rates as described in Section 2.3.

1) **Objective #1: Focus on residential and low-income sector and primarily on home EV charging infrastructure**

   To address barriers to EV adoption in residential and low-income markets, LUMA plans to focus on providing EV rates that best serve these markets, while bringing value to the grid.

2) **Objective #2: Minimize electricity system impacts of EV charging**

   LUMA identified four screening criteria used to support ranking and prioritization of EV rate structures that minimize grid impacts from EV charging. These criteria include:

   - Contribute to lower GHG emissions from the grid
   - Deliver appropriate and clear price signals to EV drivers
   - Incentivize customer behaviors beneficial to the system
   - Support load management efforts to control the timing of charging

3) **Objective #3: Address the unique needs of and opportunities for customers with DG and/or battery storage**

   With respect to the third objective, LUMA identified a screening criterion of “supporting optimization of DG and storage capacity” to prioritize rates that align charging with grid needs and make use of increased DG and battery resources.

4) **Objective #4: Be synchronized with implementation of residential time-of-use rates, to the extent possible**

   In order to be harmonized with implementation of residential TOU rates, LUMA identified two screening criteria to ensure the alignment of the TOU rate structure with respect to periods and rates across TOU rates available for residential customers. These criteria include “Ease of implementation” and “Scalability”. Rate structures that are easy to implement and highly scalable will be prioritized resources.

5) **Objective #5: Support Puerto Rico's climate and energy goals and public policy**

To support Puerto Rico's climate and energy goals, two screening criteria were created to rank EV rate structurers that result in an alignment with policy objectives related to supporting EV adoption and reducing fossil fuel use in transportation.

- Address barriers to the adoption of EVs
- Address barriers to the adoption of EV charging infrastructure

6) **Objective #6: Include a fair and equitable cost allocation and recovery mechanism**

The last objective – fair and equitable cost allocation and recovery mechanism – is primarily related to how an EV rate is established with regard to the other permanent rates available to LUMA customers, but there are some differences between the candidate residential EV rate structures that require a separate ranking and screening criteria for this objective.

Having established these ranking and screening criteria, LUMA then ranked the various candidate residential EV rate structures offered elsewhere as described in Section 3. The ranking and screening were based on LUMA's assessment as to whether the candidate rate addresses each of the specific criteria:

- ● Fully addresses;
- ◑ Partially addresses; or
- ○ Minimally addresses

LUMA took a near- to medium-term view in its assessment to reflect additional growth in the EV market and further maturity and sophistication of the EV charging infrastructure and, particularly, the capability of managed charging capabilities. This near- to medium-term view is intended to identify what residential EV rates would be most appropriate and viable for Puerto Rico circa 2027. The resultant ranking of the candidate EV rates best served residential EV market is shown in Table 4-1.

Table 4-1 displays the ranking of each EV rate structure based on Objective #2. For each screening criteria, we evaluate each rate structure individually and also across all five rate structures. Based on the first criterion (deliver appropriate and clear price signals to EV drivers), residential TOU and off-peak charging discount are ranked highest as they have the greatest potential to provide a strong and clear price signal to EV drivers. Fixed monthly subscription with preferred time partially address this criterion as the price signals are less clear and customers are compensated differently compared to the first two options. The last two rate structures minimally address this criterion. Under fixed monthly subscription, customers receive no price signals as they can charge at any time of day for a flat price. Under public TOU rate, the price signals will have an impact on customers' charging behavior only if the charging service providers set their prices based on the TOU rates.

For the second criterion, Residential TOU rate structure is ranked higest as TOU periods are generally designed to maximize the need of the grid. Fixed monthly subscription with preferred time window and managed charging is best to support load management efforts to control the timing of charging since it

provides the right incentive to shift charging behavior to the preferred time window and the managed charging component that fully addresses this criterion.

Table 4-1: EV Rate Structure Ranking to Support Objective #2

EV Rate Objectives	Screening Criteria	Residential Charging				Public Charging
		TOU *(Price Signal Only)*	Off-Peak Charging Discount *(Price Signal Only)*	Fixed Monthly Subscription *with Preferred Time & Managed Charging*	Fixed Monthly Subscription *With Managed Charging*	TOU *(Price Signal Only)*
Minimize electricity system impacts of EV charging	Deliver appropriate and clear price signals to EV drivers	●	●	◑	○	○
	Incentivize consumer behaviors beneficial to the system	●	◑	◑	◑	◑
	Support load management efforts to control the timing of charging	◑	◑	●	◑	○

In Table 4-2, we rank the five rate structures based on their likelihood to address Objective #3 with a screening criterion that a rate shall "support optimization of local DG and storage capacity". With the potential to design TOU periods to align with the optimal generation from DG and the use of storage, residential TOU rate fully addresses this criterion. The same rationale applies to the public charging TOU rate but since LUMA will likely have no control over how the end-use pricing is set, we concluded that the public charging TOU rate partially addresses this criterion.

Table 4-2: EV Rate Structure Ranking to Support Objective #3

EV Rate Objectives	Screening Criteria	Residential Charging				Public Charging
		TOU *(Price Signal Only)*	Off-Peak Charging Discount *(Price Signal Only)*	Fixed Monthly Subscription *with Preferred Time & Managed Charging*	Fixed Monthly Subscription *With Managed Charging*	TOU *(Price Signal Only)*
Address the unique needs of and opportunities for customers with DG and/or battery storage	Support optimization of local DG and storage capacity	●	◑	◑	○	◑

The ranking of rate structures for Objective #4 can be seen in Table 4-3, public charging TOU rate is ranked highest. It is easy to implement and administer due to the potential size of participation and has highest potential to scale further into other non-residential customer segments. Since the two fixed monthly subscription rates have managed charging component, LUMA will likely need to require participants to install eligible Level 2 chargers and integrate any necessary software to leverage managed charging capability. Due to the need for AMI meter and the potential size of participant target, TOU and off-peak charging discount are rank lowest in terms of ease of implementation.

Table 4-3: EV Rate Structure Ranking to Support Objective #4

EV Rate Objectives	Screening Criteria	Residential Charging				Public Charging
		TOU *(Price Signal Only)*	Off-Peak Charging Discount *(Price Signal Only)*	Fixed Monthly Subscription *with Preferred Time & Managed Charging*	Fixed Monthly Subscription *With Managed Charging*	TOU *(Price Signal Only)*
Be synchronized with implementation of residential TOU rates, to the extent possible	Ease of implementation and administration	○	○	◑	◑	●
	Scalability	◑	◑	◑	◑	●

For Objective #5, Table 4-4 shows that all rate structures address all the screening criteria. However, when evaluating them against each other, we concluded that since TOU rate can be designed in a way that optimizes the use of renewable energy, residential TOU rate has the highest potential to contribute to lower GHG emissions from the grid than others. From the perspective of customers, fixed monthly subscription with managed charging is relatively easier to understand than others, resulting in a higher ranking for this rate structure under the second criterion. Similarly, public charging TOU rate can drive the investment in EV charging infrastructure, creating a more robust network of public charging. As a result, the public charging infrastructure supported by a TOU rate is viewed to fully address one of the key barriers to EV adoption – range anxiety.

Table 4-4: EV Rate Structure Ranking to Support Objective #5

EV Rate Objectives	Screening Criteria	Residential Charging				Public Charging
		TOU *(Price Signal Only)*	Off-Peak Charging Discount *(Price Signal Only)*	Fixed Monthly Subscription *with Preferred Time & Managed Charging*	Fixed Monthly Subscription *With Managed Charging*	TOU *(Price Signal Only)*
Support Puerto Rico's climate and energy goals and public policy	Contribute to lower GHG emissions from the grid	●	◑	◑	◑	◑
	Address barriers to the adoption of EVs	●	●	●	●	●
	Address barriers to the adoption of EV infrastructure	●	●	●	●	●

Table 4-5 illustrates the ranking to support Objective #6. Since Level 2 chargers are typically needed to implement managed charging under the two fixed monthly subscription rates, a subset of EV drivers who can rely solely on Level 1 charging to serve their driving needs and/or have no access to home charging or are unable to install Level 2 chargers will be less likely to participate in such rates. Therefore, these two subscription rates with managed charging can potentially limit the participation for certain groups of residential customers.

Table 4-5: EV Rate Structure Ranking to Support Objective #6

EV Rate Objectives	Screening Criteria	Residential Charging				Public Charging
		TOU *(Price Signal Only)*	Off-Peak Charging Discount *(Price Signal Only)*	Fixed Monthly Subscription *with Preferred Time & Managed Charging*	Fixed Monthly Subscription *With Managed Charging*	TOU *(Price Signal Only)*
Include a fair and equitable cost allocation and recovery mechanism	Ensure equitable access to EV charging infrastructure	●	●	◑	◑	●

Based on this assessment, LUMA believes that the three most attractive and most viable EV rates for residential customers in the near- to medium-term are:

1. Residential EV TOR Rate with Separate Meter
2. Residential EV Subscription Rate with Managed Charging
3. Public Charging TOU Rate

The residential EV rates will provide customers with flexibility to take advantage of either "self-managed charging" whereby customers can control their EV charging based on utility price signals provided through the TOU rates or "externally-managed charging" (fixed subscription rate with managed charging). Additionally, LUMA would optimize the operation of the EV charger in response to system price signals, system constraints, generation outages as part of the fixed monthly subscription rate with additional customer flexibility to operate their chargers as needed on a limited basis. Both rates would also enable some degree of optimization of local DG and battery storage.

The public charging rate will incentivize EV charging infrastructure investment from the private market and as a result, enable a charging network that is sufficient to address range anxiety, and provide charging alternatives for residential customers who cannot conveniently charge at home or need a charge to complete a trip.

With respect to the TOU rates (both residential and public), LUMA believes that a three-period TOU rate would be more effective than a two-period TOU rate. Even though it may be less easy to understand, the use of three-period TOU rates for EV charging has the several advantages, including:

1) More flexibility compared to two-period TOU rates
2) Matching three TOU periods with the underlying costs and allocations through the functionalization process allows for greater price differentials between on-peak and off-peak as compared to two-period rates
3) Enables shorter focused on-peak and off-peak periods to drive customer behavior as compared to two-period TOU rates

In comparing the two rates that LUMA's ranking determined were less attractive and less viable for PR in the near- to medium-term:

- LUMA believes that an off-peak charging discount (either per kWh or an annual fixed amount) offers less pricing flexibility than a three-period TOU rate and implicitly requires a relatively long duration "higher priced period". Further, an off-peak charging discount does not allow for any higher-than-normal pricing periods. Together, LUMA believes that these factors would limit the overall effectiveness of off-peak charging discount as compared to three-period TOU rates.

- LUMA believes that a fixed monthly subscription rate with a preferred time window would not be as attractive to customers, particularly given that one of the key value propositions of the managed charging that would be integral to any fixed subscription rate offered by LUMA would be "*simply plug your EV into the charger, and let us take care of the rest to ensure you always have a fully charged EV when you need it*". This type of managed charging will ultimately enable flexibility for LUMA to control charging in response to price signals, emission-intensity, local system constraints and generation outages. Having this capability only available within a preferred time window will limit the effectiveness of such a rate.

As customers are far from homogenous, LUMA believes that providing a menu of rate options over time will allow different types of customers to find price structures that best suit their varied needs, resulting in

increased EV adoption and EV infrastructure investment. The following section provides considerations, key activities and timeline for EV rate design and implementation.

5. Roadmap for Introduction of Residential EV Rates

The EV market in Puerto Rico is in its infancy but is expected to develop rapidly. The impact of EVs on PR's electricity system is currently limited but will increase over time. Similarly, the capability and sophistication of enabling technology such as EV charging infrastructure and its ability to support managed charging – to mitigate grid impacts, respond to price signals and/or minimize greenhouse gas emissions from EV charging – is growing rapidly. There are also many unknowns in regard to residential customer EV charging behavior and the degree to which EV rates can modify charging behavior (i.e., charging times) or encourage greater EV adoption.

For these reasons, LUMA proposes to undertake up to three EV rate pilots as part of the Phase 1 EV Plan. These rate pilots address the goals set out in Section 2 and are directly responsive to the November 18th R&O and represent LUMA's perspective on the most attractive and viable EV rates for PR in the near- to medium-term (i.e., with significantly higher EV penetration and greater sophistication and capability in enabling technology). The specific EV rate pilots LUMA is proposing are as follows:

1) **Residential EV TOU rate with Separate Meter:** A time-varying tariff with three TOU periods at a minimum, requiring a separate meter used exclusively for the purpose of residential EV charging

2) **Residential Subscription Rate with Managed Charging:** A fixed monthly price for EV charging up to a certain amount of kWh per month with managed charging capability on a separate meter used exclusively for the purpose of residential EV charging.

3) **Public EV Charging Rate:** A TOU volumetric rate with a reduced demand charge feature for publicly accessible EV charging.

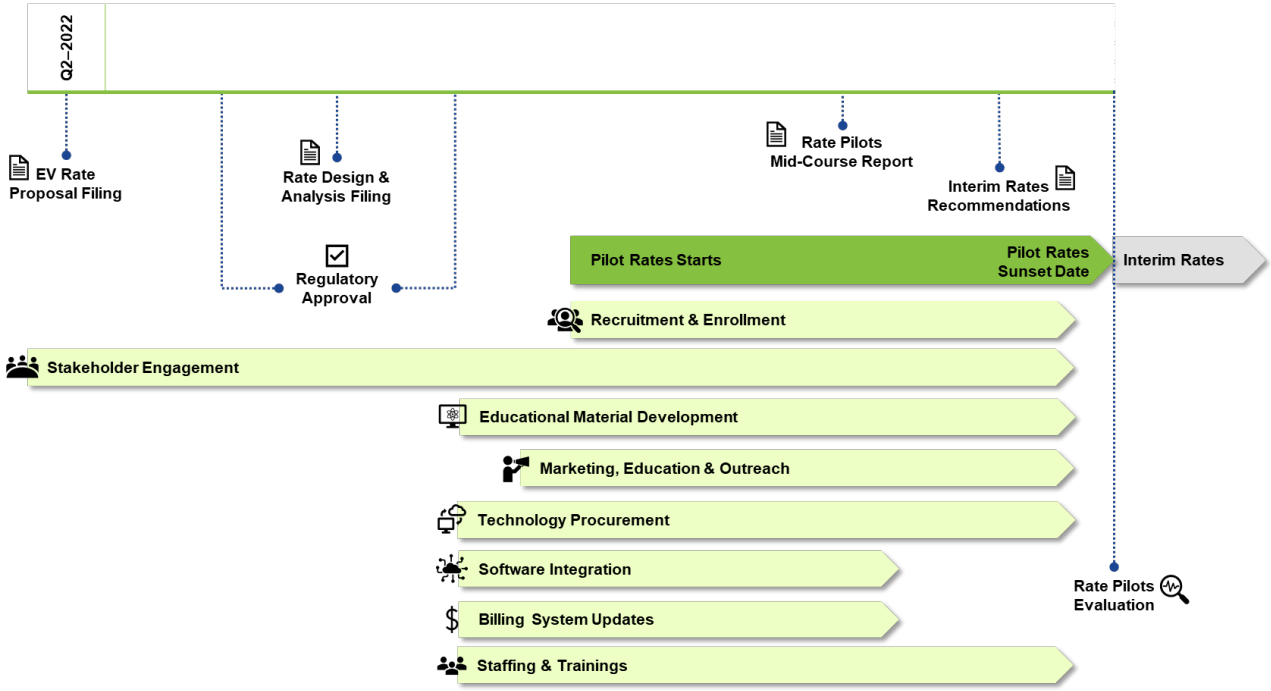
The rate pilots will be helpful in determining which rate design is the best fit for EV drivers in PR. These pilots will help LUMA to better understand customer preferences and their charging behavior with respect to different price signals, and further enable LUMA to learn more about the effectiveness of the proposed rates. We anticipate that the lessons learned in the rate pilots will contribute to future rate offerings that will be made available to all of LUMA's residential customers at a time when EV penetration is higher, potential grid impacts are greater and more sophisticated, "smarter" EV charging infrastructure is available. LUMA stands ready to develop additional EV rate proposals covering other market sectors at the direction of the PREB.

The roadmap for introducing residential EV rates is shown in Figure 5-1, which is part of the larger EV Phase 1 plan. It starts with the draft EV rate proposal submission on May 31, 2022. After an approval from the PREB (estimated to be six months after the final EV rate proposal submission) on the specific rate structures, LUMA will incorporate PREB and stakeholder feedback into the rate design and analysis filing which will be submitted to the PREB.

Prior to implementation, LUMA will need to assess implementation technologies, integrate necessary software, set up billing system updates, train staff and develop educational material templates. Once the

PREB provides approval for the rate design and analysis filing, LUMA will start to implement the pilot rates, create marketing, educational and outreach campaigns, recruit and enroll participants to the pilot.

Figure 5-1: Roadmap for Introduction of Residential EV Rates



After year 1 of the pilot, LUMA will conduct a limited evaluation of the pilot(s) and identify key challenges and successes, by submitting an annual report documenting each pilot rate results, lessons learned and alignment to meet the rate objectives and the Principles outlined on the November 18th R&O. The pilot rates will continue into the second year (assuming a 24-month term for rate pilots). Prior to the sunset date, LUMA will leverage key results and lessons learned from the pilots to identify appropriate next steps and considerations for interim rates. At the end of the pilot on Q3 – 2025, a final pilot evaluation will be conducted.

Although it is not feasible to introduce these rates immediately, LUMA believes it would be valuable and prudent to support residential EV market segments by introducing a suite of pilot rates to reflect these attractive EV rate structures to:

1) inform future rate design,
2) mitigate the impact of residential EV charging on the electricity system, and
3) provide financial and environment opportunities to EV owners.

If successful, LUMA anticipates expanding the scope of these rate offerings more broadly and ultimately to all LUMA residential customers

5.1 Proposed Interim EV Rate Design Process

As noted by the November 18th R&O[24], LUMA understands that any EV rates introduced in the short-term in response to the November 18th R&O should: 1) not be interpreted or construed as a revision of the permanent rate; and 2) be targeted to specific services and focused on incentivizing certain customer behavior. LUMA understands the "specific services" to be targeted through the EV rate will be EV charging.

If an EV rate or any other new rate proposed by LUMA were to be considered as a revision of the permanent rate, LUMA would expect the rate to be subject to the same comprehensive cost allocation process, and considered on the same basis, as all the other permanent rates. Although this process will not apply to the EV rates to be developed in response to the November 18th R&O, LUMA believes it is important to follow this process to the extent possible for establishing these "interim" EV rates. The reasoning for this is straightforward: the pilot is an experiment, and the more the conditions of the experiment match the conditions in the "real-world" (wider implementation), the more useful the pilot findings will be in understanding customer responses to the experimental treatments. Our proposed approach is as follows:

There are two key components to a TOU rate: (1) the time periods; and (2) the prices. The time periods should be based on the times in which the system loads are highest and lowest. This is easily expressed visually using a load heat map that shows the system loads on an hourly and monthly basis. While not directly considered in this proposal, a heat map can also indicate if seasonal rates are justified.

The price component of the TOU rate is based on the embedded cost and incremental increase in costs to serve the new EV load within each time period. An easy way to conceptualize what costs belong in which period is to think of the periods as reflecting Peak, Demand, and Base costs.

- Peak costs include fixed and variable costs that are allocated according to a coincident peak allocator – generation costs, transmission costs, and substation costs are examples of Peak costs.

- Shoulder costs reflect fixed and variable costs that are allocated via a non-coincident peak allocator for each class.

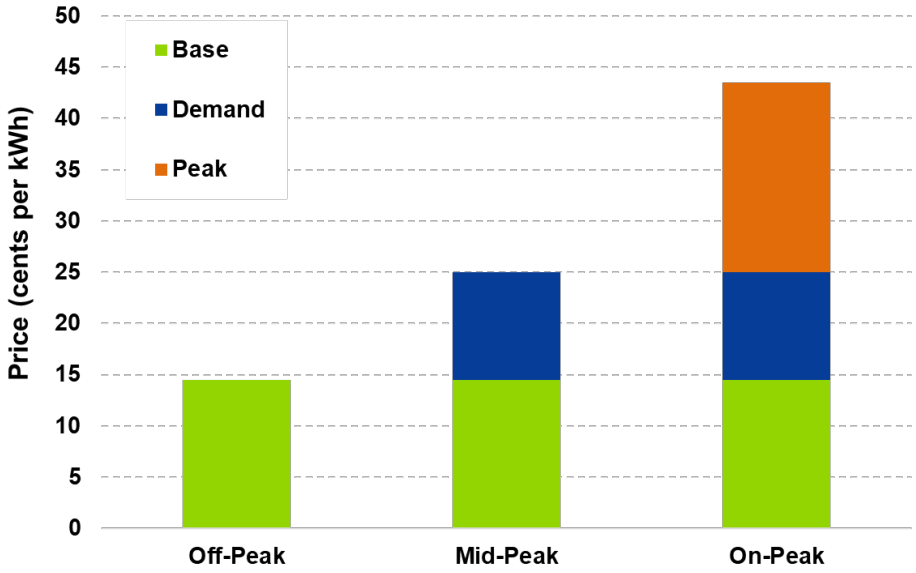
- Base costs are those fixed and variable costs that are customer-classified and administration and general costs. Energy-classified costs are incorporated using an 8760 analysis of energy costs and are treated effectively as a pass-through for each time period.

Under this approach, the prices in each time period reflect a stacked approach of the relevant cost categories described above. The cost categories get translated into rates based on forecasted sales during the time periods. Figure 5-2 below shows an ***illustrative example*** of how this methodology works in practice. Assume that the Base costs are $0.145/kWh, Demand costs are $0.105/kWh, and Peak costs are $0.065/kWh. This would result in rates of:

[24] November 18th R&O, page 6

- On-peak hours: 43.5 cents/kWh
- Mid-peak hours: 25 cents/kWh
- Off-peak hours: 14.5 cents/kWh

Figure 5-2: Illustration of Cost Allocation Approach

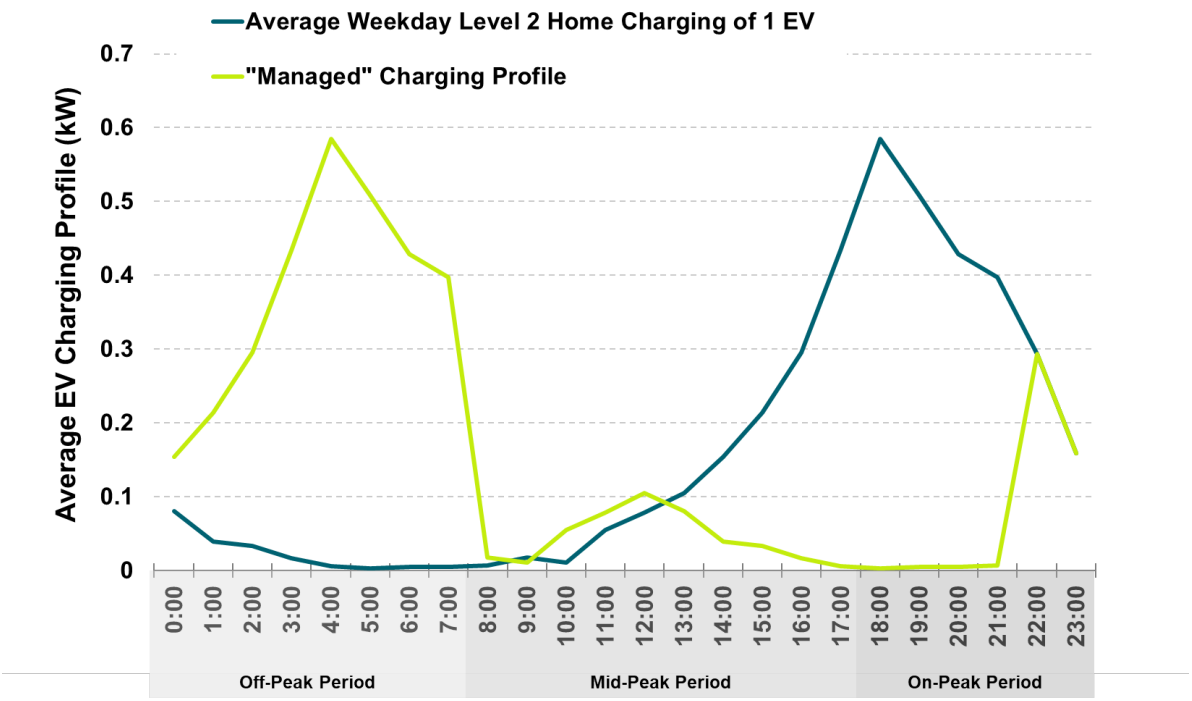


LUMA proposes to develop three-period TOU prices with the pricing for each period to be established using the process described above, and with the time periods for each of the TOU periods to be established based on peak system times and reflective of the underlying cost drivers within the cost allocation model. Subject to further consideration, our preliminary thinking regarding the TOU time periods is as follows:

- On-peak period: 6PM to 12AM on Monday – Friday
- Mid-peak period: 8AM to 6PM on Monday – Friday
- Off-peak period: 12AM – 8AM on Monday – Friday, all day on weekends and holidays.

Figure 5-3 illustrates how most of the current residential EV charging would fall into the on-peak period and, through shifting charging to “as late as possible” in the early morning hours would shift this consumption to primarily occur in the off-peak period.

Figure 5-3: Illustrative EV Charging Profile



For illustrative purposes only, assume the following interim TOU rates were developed through the above process:

- On-peak hours: 43.5 cents/kWh
- Mid-peak hours: 25 cents/kWh (assume unchanged from current flat rate)
- Off-peak hours: 14.5 cents/kWh

The three-times price differential between on-peak and off-peak rates would be sufficient to influence customer EV charging behavior, while still allowing LUMA to recover its costs. LUMA further proposes that the TOU rates would be used as “deemed” rates in the determination of the fixed monthly subscription rate along with an assumption about the degree to which managed charging would be able to shift consumption from the on-peak period to the off-peak period. Thus, uncontrolled and managed charging by the EV customer would be “deemed” to be at the TOU rates, and the difference in costs under these rates would be reflected in the subscription rate.

As a simple example, assume monthly EV charging consumption of 200 kWh (2400kWh annually) at a flat rate of 25 cents/kWh. This would cost the customer $50 (200kWh x 25 cents/kWh) per month. Under the illustrative TOU rates set out above and assuming for simplicity that if all residential EV charging occurs during the on-peak period, the monthly deemed cost using the TOU rates would be $87 (200kWh x 43.5 cents/kWh), but if all EV charging could be shifted to off-peak period through managed charging, then the monthly deemed cost would be $29 (200kWh x 14.5 cents/kWh), resulting in a cost differential between the uncontrolled charging scenario and maximum managed charging scenario of $58 per month

($87 - $29). Of course, not all uncontrolled charging would occur during the on-peak period and managed charging would not be able to shift all EV charging to the off-peak period, so it would be appropriate to incorporate some form of discount on this most favorable scenario when establishing the subscription rate. For illustrative purposes only, assume a discount of 65% was applied, the monthly savings would be reduced to approximately $20.30 (discounted 65% off $58).

For the purpose of establishing the fixed monthly subscription rate, LUMA could offer participating customers a fixed monthly subscription rate of $30, representing $50 that they would have paid under the flat rate less of $20 savings attributed to the impact of managed charging under the “deemed” TOU rates. In LUMA’s view, it is more appropriate to consider the default revenue from the EV owner (i.e., $50 under the flat rate) as the starting point from which the savings associated with the shift in consumption would be subtracted. Customers will be moving to this rate from the default, so that should be the appropriate benchmark for the deemed price.

LUMA would further need to consider establishing an upper limit on monthly consumption to ensure the subscription rate is fair and equitable to non-participating customers. Any consumption above the upper limit would be charged at the TOU rate. The average monthly consumption of an EV is estimated to be 135kWh in PR based on a daily vehicle mile travelled (VMT) of 15 miles and EV fuel economy of 0.3kWh per mile. This consumption covers all sources of EV charging – home, public and workplace charging – so an upper limit for consumption under the fixed monthly subscription rate would need to be some multiple higher than the average home EV charging load.

In summary, LUMA proposes to establish an interim three-period EV TOU rate targeted to residential EV charging infrastructure using the same cost of service model as used in the development of the current permanent rates. This interim three-period EV TOU rate would be used as a deemed rate in the determination of the monthly subscription rate as described above.

5.2 Proposed Pilot Design and Evaluation

This section describes the proposed experimental design for the pilot. Utility pilots are a form of experiment, designed to test the effectiveness of one or more treatments (in this case TOU rates and managed charging) and identify the impact of these treatments on an outcome variable of interest (participant EV consumption behavior). Careful and deliberate design is essential to ensure a robust evaluation that can deliver actionable insights.

The two sub-sections below lay out the proposed experimental design for each of the two residential EV pilots and identify the evaluation-driven reasons for the selection of the various features recommended. In each case, the preferred – and most robust – experimental design is modified, though in both cases compromises in the design are identified should the preferred design be impossible to implement.

5.2.1 Residential EV TOU Rate Pilot with Separate Meter

The Uniform Methods Project[25] notes that "t*he optimal evaluation scenario for a consumption data analysis is a randomized control trial (RCT) experimental design."* An RCT is an experimental design in which a sample drawn from a known population is randomly assigned to a treatment group (to which the experimental treatment is applied) and a control group (to which the treatment is not applied). This ensures that the expected value of the treatment effect is equal to the true value in the population from which the sample is drawn.

One form of RCT often applied in energy efficiency, demand response, and rate-based evaluations enlists a sampling strategy known as "recruit-and-deny". The procedure works in the following manner: applicants to a rate are either enrolled in the rate (and so become treatment participants), or else denied enrollment (sometimes by being wait-listed – "recruit-and-delay") and so act as control customers. Consequently, the underlying population to which estimates of the treatment effect apply are those customers with an interest in enrolling in the rate.

Consequently, the proposed enrollment strategy for this pilot is to solicit applications from EV driving customers on the understanding that of those that apply approximately 300 customers[26] will be enrolled in the pilot, either as participants or control customers. All customers enrolled in the pilot will be equipped with TOU metering equipment and provided with some form of incentive to ensure that they agree to its installation.

All enrolled applicants would continue to be subject to standard rates for a 12-month baseline period. In this period none of the enrolled customers would be subject to TOU rates. In the 10th month of the baseline period the evaluator would perform a stratified (e.g., by charging type, vehicle model, etc.) random allocation of enrolled applicants to participant and control group and validate the allocation.[27]

After the 12-month baseline period the treatment (the TOU rate) would be applied to the customers allocated to the participant group. Following an additional 12-month treatment period, impacts could be estimated using a lagged dependent variable (LDV) regression analysis. An LDV regression analysis is a special case of the difference-in-difference estimator that takes advantage of additional covariates (e.g., seasonal patterns) to improve estimated precision. This estimator is consistent (unbiased in repeated

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[25] National Renewable Energy Laboratory, *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures – Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*, April 2013. https://www1.eere.energy.gov/wip/pdfs/53827-8.pdf

26 This sample is ambitious – approximately 5% of the approximately 5,952 EVs on the road in PR in 2021 (data received during the second technical workshop) – and may not be attainable. The proposal directly addresses contingencies to be applied should customer enrollment fall materially below that targeted.

This initial sample size has been suggested by LUMA's consultant and evaluator, Guidehouse, based on that firm's prior experience in evaluating rate pilots (particularly those targeted to EVs) in North America. No power analysis has been proposed to estimate the sample size required to attain (for example) statistically significant impact estimates under assumed pilot outcome conditions. The value of such an exercise would likely be quite low, given the input data that would need to be used for such an analysis are sufficiently inappropriate (in terms of geography, rate design, metering style, etc.) that any conclusions it would offer would be relatively low confidence.

[27] The experimental design can be validated by estimated the "impacts" of the pilot on the participant group during a portion of the baseline period using the same regression model specification as will be applied for the treatment period evaluation. If the estimated treatment effect in the baseline period is trivially small and not statistically significant, the evaluator can have a high degree of confidence that the final estimated impacts will also not be biased.

samples) and effectively controls for contemporaneous impacts from non-treatment exogenous effects (e.g., the introduction of public health measures, extreme weather events, etc.) ensuring very robust estimated impacts.

Should enrollment be lower than expected, smaller sample sizes could be used, though such sample sizes will affect the precision of the estimated impacts and make it more challenging to estimate robust impacts for sub-groups of interest (e.g., Level 1 versus Level 2 charging). A shorter baseline period (than 12 months) may be considered; however, this could introduce additional uncertainty and may potentially bias the analysis if there exists significant seasonal variation in demand patterns.

5.2.2 Residential EV Subscription Rate with Managed Charging Pilot

As with the TOU pricing pilot, the managed charging pilot should be deployed as an RCT, though some details of implementation will differ significantly due to the equipment deployed to participants. A recruit-and-deny approach should be used for this pilot as for the TOU pilot, though incentives to applicants may be lower as the "denied" customers (those not selected for treatment) will not require any additional metering[28] and are controls principally for the purposes of any process evaluation or survey/focus group analysis.[29]

LUMA plans to target the recruitment of at least 100 customers into this pilot (and so – ideally – receive applications from 200 customers).[30] The impacts of managed charging on participant EV charging behavior will be estimated using a linear fixed effects model, but the program will still be evaluated as an RCT. This will be enabled by assigning all participants to a sequence of paired, mutually exclusive groups. So, for example, all participants are split equally (but randomly) between Group A1 and A2, and then again between Group B1 and B2, etc. In this way a single participant may be part of (for example) groups A1, B2, C2, and D1, but *not* both B1 and B2.

These sets of groups form the basis for the RCT. Over the course of the pilot, as managed charging events are deployed, they are – over pre-specified time intervals (e.g., a week at a time, three days at a time, etc.) – applied only to one of the two mutually exclusive groups. So, for example in week 1, only Group A1 is subject to managed charging, in week 2, only Group A2 is, in week 3, only Group B1 is subject to managed charging, etc. This ensures that for every series of managed charging event there is an appropriate comparison group for the controlled participants. Thus, an RCT is possible, and the availability of contemporaneous controls substantially eliminate the risk of model specification bias (an issue when using event-like non-event days for baseline estimation).

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[28] The embedded assumption here is that the goal of evaluation is the estimation of the impact of managed charging on EV charging demand of customers subject to a subscription-based rate. It there is a secondary goal of understanding what impact adoption of subscription-based pricing has on participants, meters should be deployed to those participants not enrolled in the managed charging element of the pilot.

[29] For process evaluation the same considerations apply when considering an experimental design: survey responses of participants in a voluntary rate or program should – ideally – be compared only to the survey responses of other customers that volunteered for – but not enrolled in – that program. This eliminates questions of selection bias from the interpretation of results.

[30] As above, this enrollment goal is ambitious given the size of the underlying population of EV drivers. The pilot could proceed with reduced enrollment though some compromises might be required – e.g., eliminating the recruit-and-deny aspect. This would make survey analysis more challenging but would ensure the desired sample for the impact analysis. Even lower enrollment could be mitigated through increased numbers of test events for managed charging or a longer pilot period.

5.2.3 Public EV Charging Rate Pilot

Since the charging behaviors can differ significantly depending on whether the customer is charging at home or at a public station and the type of EVs they drive, the design and evaluation of public charging rate pilot will differ from that of rate pilots of residential rates.

In this rate pilot, LUMA plans to target both existing and potential publicly accessible Level 2 and DC fast charging stations. LUMA will measure the actual savings realized by participating in this rate pilot and evaluate against the potential savings estimated when designing this rate.

Additionally, participating customers will be required to share the pricing structure charged to end users. This coupled with charging data received from TOU metering will enable LUMA to better understand how EV drivers charge their vehicles at public charging stations in response to different end-use pricing. In order to better understand customers' behavior and preference to public charging, LUMA will plan to conduct a brief survey with EV drivers to gauge and assess, at a minimum, charging habits, understanding of pricing, and influence of charging station availability.

5.3 Proposed Outline for Rate Pilot Document

LUMA anticipates that the detailed design will include the following information for each pilot:

1) Pilot Description
2) Pilot Objectives and Key Performance Metrics
3) Target Customers
4) Eligibility Requirements and Enrollment Plan
5) Marketing, Education and Outreach Plan & Recruitment
6) Pilot Duration
7) Pilot Budget
8) Cost-Effectiveness
9) Risks and Mitigants
10) Implementation Plan
11) Evaluation Plan

6. Approval Sought

LUMA hereby requests:

1) Approval from the PREB to proceed with development of the three pilots as proposed in this EV Rate Design Proposal.

2) That the funding for the pilots be covered through coordination of efforts with Federal and local government agencies implementing EV projects or managing funding for these opportunities, as appropriate. Further engagement is required with such entities to finalize a budget proposal.

7. Exhibits

Table 7-1 shows a list of EV rate programs and pilots reviewed by LUMA and described in Section 3.

Table 7-1: List of EV Rates Reviewed

Electric Company Name	Program Name	Rate Structure	Residential / Public Charging Rate
Appalachian Power Company (Virginia)	Off-Peak Charging Rate (RS-PEV)	TOU - Whole House Meter	Residential
Con Edison	Residential TOU with Price Guarantee and Reduced Monthly Customer Charge	TOU - Whole House Meter	Residential
Delmarva Power	Residential Whole House TOU Rate	TOU - Whole House Meter	Residential
Duquesne Light Company	WholeHome EV Rate	TOU - Whole House Meter	Residential
Evergy (Kansas Central)	Residential EV Rate	TOU - Whole House Meter	Residential
Madison Gas & Electric	Shift & Save TOU Rate	TOU - Whole House Meter	Residential
New York State Electric & Gas	Residential EV TOU Rate	TOU - Whole House Meter	Residential
Orange & Rockland Utilities	SC 19 EV TOU Rates with Price Guarantee	TOU - Whole House Meter	Residential
Potomac Electric Power Company	Residential Whole House TOU Rate	TOU - Whole House Meter	Residential
Public Service Company of Oklahoma	Residential Service Plug-In EV Rate (RSPEV)	TOU - Whole House Meter	Residential
Rochester Gas and Electric Corporation	Residential EV TOU Rate	TOU - Whole House Meter	Residential
Baltimore Gas and Electric	Evsmart Vehicle Charging TOU Rate	TOU - Separate Meter	Residential
Delmarva Power	Plug-In Vehicle Rate Plan	TOU - Separate Meter	Residential
Evergy (Missouri Metro)	Residential TOU Rate	TOU - Separate Meter	Residential

Georgia Power Company	Plug-In EV Rate	TOU - Separate Meter	Residential
Hawaiian Electric Company	Residential Interim TOU Service (Schedule TOU-RI)	TOU – Whole House & Separate Meter	Residential
Minnesota Power	Residential EV Rate	TOU - Separate Meter	Residential
Public Service Gas and Electric (New Jersey)	Residential EV Distribution Only (Schedule RS)	TOU - Separate Meter	Residential
Atlantic City Electric	Rate MGS-SEVC	TOU - Reduced Demand Charge	Public
Avista Utilities	Commercial EV Rate (Schedule 23)	TOU - Reduced Demand Charge	Public
Baltimore Gas and Electric	Rider 5 - EV Charging Distribution Demand Credit	TOU - Reduced Demand Charge	Public
Central Maine Power	Rate B-DCFC Optional Targeted Service Rate	TOU - Reduced Demand Charge	Public
Florida Power & Light	DCFC Public Charging Demand Limiter	TOU - Reduced Demand Charge	Public
Hawaiian Electric Company	Commercial Public EV Charging Facility Service Pilot (EV-F)	TOU - Reduced Demand Charge	Public
PECO	Pilot Discount for Fast Charging Infrastructure	TOU - Reduced Demand Charge	Public
Public Service Company of Oklahoma	Commercial EV Fleet Rate (CEVF)	TOU - Reduced Demand Charge	Public
Public Service Gas and Electric (New Jersey)	Commercial Distribution Demand Charge Rebate (Schedule GLP)	TOU - Reduced Demand Charge	Public
Pacific Gas & Electric Company	Business EV Rate (BEV1)	TOU - Fixed Demand Charge	Public
Pacific Gas & Electric Company	Commercial EV Rate (BEV2)	TOU - Fixed Demand Charge	Public
Alabama Power Company	Rate Rider PEV Plug-In Electric Vehicle	Off-Peak Charging Discount	Residential
Ameren Illinois	Residential EV Rate Program	Off-Peak Charging Discount	Residential

Ameren Illinois	Optional EV Charging Program (Rider EVCP)	Off-Peak Charging Discount	Residential/ Multi-Family
Appalachian Power Company	Residential Off-Peak Charging Rate	Off-Peak Charging Discount	Residential
Potomac Edison	Off-Peak Rewards Program	Off-Peak Charging Discount	Residential
Public Service of Colorado	Optimize Your Charge	Off-Peak Charging Discount	Residential
Duke Energy	Residential EV Managed Charging Pilots	Fixed Monthly Subscription Charge	Residential