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

IN RE: PERFORMANCE TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO.: NEPR-AP-2020-0025** **SUBJECT:** MOTION TO SUBMIT EXPERT TESTIMONY

MOTION TO SUBMIT EXPERT TESTIMONY

TO THE PUERTO RICO ENERGY BUREAU:

COME NOW, Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, and Sierra Club and its Puerto Rico chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "LECO"), by and through their legal counsel, respectfully set forth and pray:

1. Submission of this motion with two expert testimonies of:

    A. Agustín Irizarry-Rivera, *Professor at the University of Puerto Rico Mayagüez Campus (UPRM)*
    B. José Alameda, *Professor at the University of Puerto Rico Mayagüez Campus (UPRM)*

WHEREFORE, it is respectfully requested from the Energy Bureau to receive the testimonies submitted in accordance with applicable timetable.

RESPECTFULLY SUBMITTED, on this 17th day of November 2021.

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CERTIFICATION OF SERVICE

I hereby certify that on November 17th, 2021, I caused this Information Request to be served upon the following parties:

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- LUMA Energy LLC and LUMA Energy ServCo LLC: mmercado@mercado-echegaray-law.com; margarita.mercado@us.dlapiper.com; yahaira.delarosa@us.dlapiper.com

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

IN RE: PERFORMANCE TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO.: NEPR-AP-2020-0025**

EXPERT TESTIMONY OF AGUSTÍN A. IRIZARRY-RIVERA ON BEHALF OF LOCAL ENVIRONMENTAL AND CIVIL ORGANIZATIONS

Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, and Sierra Club and its Puerto Rico chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "LECO").

NOVEMBER 16, 2021

I. Background and Qualifications

Q: Please state your name, position, and business address.

A: My name is Agustín Alexi Irizarry-Rivera. I am a Professor in the Electrical and Computer Engineering (ECE) Department at the University of Puerto Rico Mayagüez Campus (UPRM, for its Spanish acronyms). My business address is Road 348, km. 9.9, Poblado Rosario, San Germán, Puerto Rico, 00683.

Q: On whose behalf are you testifying in this proceeding?

A: I am testifying on behalf of the following organizations: Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, and Sierra Club and its Puerto Rico chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "LECO").

Q: Please summarize your qualifications and work experience.

A: I obtained my bachelor degree, Magna Cum Laude, at the University of Puerto Rico, Mayagüez Campus (UPRM) in 1988; a masters at the University of Michigan, Ann Arbor in 1990; and a Ph.D. at Iowa State University, Ames in 1996 all in electrical engineering. I have been a licensed professional engineer in Puerto Rico since 1991, and a member of the Institute of Electrical and

Electronics Engineers (IEEE). Since 1997, I have been a Professor at the Electrical and Computer Engineering (ECE) Department at UPRM where I teach graduate and undergraduate courses such as: Electric Systems Analysis, Fundamentals of Electric Power Systems, Power System Analysis, Electric Machines, Electrical Systems Design, Advanced Energy Conversion, Power Systems Dynamics and Control and Transmission and Distribution Systems Design.

I have been elected member of the Electrical and Computer Engineering Department Personnel Committee and the School of Engineering Personnel Committee in three occasions and have served as President of both Committees twice. I have been elected as Academic Senator to represent the School of Engineering in the Academic Senate. Additionally, I have served as Assistant Dean of Academic Affairs UPRM and Associate Director for Academic Affairs of the Electrical and Computer Engineering Department at UPRM.

I have conducted research in the topic of renewable energy and how to adapt the existing power grid to add more of these resources in our energy portfolio. I had a research internship at Plataforma Solar de Almería, Tabernas, Spain from 2008 to 2009 to study concentrated solar thermal systems. I contributed to the development of dynamic models to simulate the interaction between these plants and the electric grid. I have served as a consultant on renewable energy and energy efficiency projects to Puerto Rico's government agencies, municipalities, private developers, and consulting firms, both in and outside Puerto Rico. I have

also served as an expert witness in civil court cases involving electric hazard, shock or electrocution.

I am an author or coauthor of over 50 refereed publications, including two book chapters (see complete list in the CV section), and have organized local and international conferences such as the Tenth International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) in Rincón, Puerto Rico. PMAPS Conferences provide a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.

I have also received several awards and honors: Distinguished Engineer 2013 from Puerto Rico's Professional Engineers Society (CIAPR) and Distinguished Electrical Engineer 2005 from the Electrical Engineering Institute of CIAPR in recognition of services rendered to the profession and outstanding professional achievements in electrical engineering, the 2009 Distinguished Alumni Award from UPRM Alumni Association, the 2004 Professional Progress in Engineering Award from Iowa State University, in recognition of outstanding professional progress and personal development in engineering as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership position and the 2003-2004 ECE Outstanding Faculty Award from UPRM's School of Engineering.

In May 2012, I was elected, by the consumers, to the Board of Directors of the Puerto Rico Electric Power Authority, in the first election of this kind in Puerto Rico, to represent the interests of consumers. I was President of the Board's Audit Committee and an active member of the Engineering and Infrastructure, Legal and Labor Affairs and Consumer's Affairs Committees. In 2013, Board Members elected me as Vice President of the Board and I served in this capacity until September 2014 when my term expired.

I am a member of the Board of Directors, in the Interest of Consumers, of PREPA Holdings, LLC, a company registered in Delaware, whose sole owner is PREPA. PREPA Holdings owns PREPANET a communications network infrastructure provider that uses an optical network platform in Puerto Rico to provide wholesale telecommunication services.

Q: Please summarize your testimony and key findings.

A: I have been asked to assess the actual "performance metric" structure proposed by LUMA and how it compares with performance-based incentives in the electric utility business. I have also been asked to assess if the proposed Performance Targets will "transform the Puerto Rico energy system into a modern, sustainable, reliable, efficient, cost-effective, and resilient system" which are the goals of Law 120-2018. Law 120-2018 is the law that gives rise to the LUMA contract.

The goals presented in this report, and the metrics put forward, fit well within the transformation required by Law 120 and Law 17-2019.

I encourage the Puerto Rico Energy Bureau to follow the same path other regulators have followed and open a truly participative process to determine specific, measurable, objectives and propose metrics to measure progress toward these objectives. These metrics should incorporate both rewards for exceeding expectations and penalties for not achieving the expected.

Based on the comparison of what LUMA proposes and actual best practices I present a series of examples of performance-based incentives that are currently in used in other jurisdictions. Finally, I study and evaluate the performance metrics proposed by LUMA, with emphasis on reliability indices.

My main conclusions are:

Conclusion 1 – LUMA's performance metrics, if achieved, would only result in reasonable 20th century utility service for Puerto Rico. Additional metrics are necessary to incentivize the transformation required by Law 17, Law 120, and the Transmission and Distribution Operations & Maintenance Agreement, to achieve a 21st Century electric grid.

Conclusion 2 – LUMA's metrics, in contrast to performance metrics in other jurisdictions, include no penalties for underperformance, which is particularly problematic given that service deterioration is already

evident in certain areas. With respect to some metrics, LUMA proposes to be rewarded for meeting basic expectations.

My recommendations are:

Recommendation 1 – The Bureau should consider additional metrics to incentivize the transformation to a "modern, sustainable, reliable, efficient, cost-effective, and resilient system." I recommend the adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

Recommendation 2 - I also recommend that the Bureau open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives.

Recommendation 3 – In developing metrics, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. LUMA itself has acknowledged the possibilities of errors and biases affecting the calculation of reliability indices. At a minimum, the Bureau should require public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

Recommendation 4 – Penalties should be included in performance metrics that would be triggered if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.

Recommendation 5 - I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. Instead, a failure to stay within budget should reduce or eliminate LUMA's ability to achieve incentives in other categories.

Recommendation 6 - I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

Recommendation 7 – The PREB should adopt metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" from the Long Island Power Authority's contract with PSEG in the performance-based mechanism to be applied to LUMA.

Recommendation 8 - If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant**

financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.

Recommendation 9 - Finally, I recommend that performance metrics adopted by the PREB should be true performance based, where rewards and penalties are clearly defined. This should be adopted regardless of the "fix fee + additional fee" structure of the existing Contract between LUMA and PREPA. A "fixed fee" compensation structure is contradictory to the purpose of a rewards and penalties system, since a fixed fee structure promotes underachievement.

Q: Why are performance metrics important?

A: The people of Puerto Rico have goals that we want to achieve sooner rather than later.

Goals are general guidelines while objectives define strategies or implementation steps to attain the identified goals. Objectives are specific, measurable, and have a defined completion date.

A well-structured "Performance Incentive Mechanism" may help to define objectives, and execute actions, to achieve our goals sooner rather than later.

Performance-based regulation is a regulatory framework that recognizes that the traditional utility business model incentivizes capital investment and increased sales, which is not necessarily aligned with public policy objectives, the interests of consumers or

environmental protection.[1]

How is performance-based regulation new? It is new because it departs from the way utilities were compensated in the 20th Century. The 20th Century electric utility industry was limited to one technological solution that was economic: centralized generation and long transmission lines to deliver energy to the distribution system where citizens were using electricity. This required large capital investment that could only be financed through public investment (public power or municipal entities) or cooperative arrangements (coop power, ultimately publicly financed by federal loans[2] in the United States) or private investment. But private investment, and public power when investment was done via issuing bonds, was only available if investment was a "pass through" via pre-approved rates that would cover the debt with investors (or bond holders) and offer a private utility an opportunity to earn a rate of return for shareholders (a structure very close to "cost plus").

This private financing structure requires strict government regulation to ensure achievement of several key goals: adequacy of energy supply,[3]

[1] "Performance-based Regulation: Aligning Utility Incentives with Policy Objectives and Customer Benefits" B. Stafford and L. Frantzis, https://blog.aee.net/performance-based-regulation-aligning-utility-incentives-with-policy-objectives-and-customer-benefits Oct 11, 2017.

[2] Rural electric cooperative power plants financed almost exclusively by loans from the Rural Utilities Service (USDA).

[3] The North American Reliability Corporation (NERC) traditional definition of "reliability" was ubiquitous throughout the electric utility industry, and consists of two fundamental concepts: adequacy and operating reliability: Adequacy is the ability of the electric system to supply the aggregate electric power

reliability, affordability of electric service and protection of the consumers from the monopoly power of the, usually one, energy provider. The utility revenues are collected through pre-approved recovered costs. Since rates are set on a per unit of energy sold utilities are incentivized to drive up energy consumption to increase revenue and profit.

In the 21st Century utility the traditional goals of adequacy, reliability, affordability of electric service and protection of the consumers from the monopoly power of the energy provider continue but we add specific outcomes defined by stakeholders and policymakers. Some of these outcomes are at odds with the traditional utility goals of maximizing utility-owned capital investment and increasing sales. The financial structure used to compensate the utility needs to change, and incentives must be designed to achieve objectives, thus the performance-based regulation and performance-based metrics.[4] Incentives may be structured as positive (bonus) or negative (penalty).

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and energy requirements of the electricity consumers at all times, considering scheduled and reasonably expected unscheduled outages of system components. Operating reliability is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system components. "Operating reliability" is a new term, as in the past this was called "security". NERC had used the term "security" until September 2001 when security became synonymous with US homeland protection in general and critical infrastructure protection in particular. Source: North American Electric Reliability Corporation (NERC), Definition of "Adequate Level of Reliability", Operating Committee and Planning Committee, December 2007.

[4] Performance-based Regulations: Aligning Utility Incentives with Policy Objectives and Customer Benefits, B. Stafford and L. Frantzis, Advanced Energy Perspectives, https://blog.aee.net/performance-based-regulation-aligning-utility-incentives-with-policy-objectives-and-customer-benefits.

Figure 1. Performance-based metrics zones.

Performance-based mechanisms encompass three basic "zones": penalties for underperformance ("does not meet expectations"), a deadband[5] around adequate performance ("meets expectation" or doing your job), and incentives for excellence ("exceed expectations"). **As discussed in the second half of my testimony, LUMA suggests receiving a bonus by achieving the expected and not being penalized if it fails to meet expectations – as it has failed to do in numerous metrics to date.**

Experience from other jurisdictions may serve as a guideline for designing performance-based incentives in Puerto Rico.[6] In particular, Hawaii is implementing performance-based regulation,[7] and

[5] PREB describes this concept as follows: "Deadbands create a neutral zone ... in which the utility does not receive a reward or penalty." PREB May 21, 2021 Resolution and Order, PREB Docket NEPR-MI-2019-0007, pp. 5-6.
[6] David Littell et al, Next-Generation Performance-Based Regulation: Volume 3 (Innovative Examples from Around the World), May 30, 2018, https://www.raponline.org/knowledge-center/next-generation-performance-based-regulation-volume-3-innovative-examples-from-around-the-world/.
[7] Public Utilities Commission Docket 2018-0088 Decision and Order 37787 "Instituting a Proceeding To Investigate Performance-Based Regulation".

performance-based incentives are also included in the operation & maintenance agreement of the Long Island Power Authority, often held up as a model for the PREPA T&D privatization.[8]

I encourage the Puerto Rico Energy Bureau to follow the same path other regulators have followed and open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives. These metrics should incorporate both rewards for exceeding expectations and penalties for not achieving the expected.

II. Law 120-2018 goals and performance metrics

Q: What is the relationship between Law 120 and performance metrics?

A: Puerto Rico Law 120 was enacted with the objective to transform the Puerto Rico energy system "into a **modern, sustainable, reliable, efficient, cost-effective, and resilient to the ravages of nature**".[9] The contract between LUMA and PREPA on its Recitals quotes the purpose of Law 120 that gives rise to the contract:[10]

> **WHEREAS**, in accordance with Act 120, Owner[11] desires to transform Puerto Rico's energy

[8] Appendices to Amended and Restated OSA, https://www.lipower.org/wp-content/uploads/2016/10/Appendices2-14.pdf.
[9] Act No. 120-2018, also known as Puerto Rico Electric Power System Transformation Act, Statement of Motives.
[10] Transmission and Distribution System Operation and Maintenance Agreement, June 22, 2020, at p. 1.
[11] In the contract PREPA is identified the "Owner". *Id.*

system into a modern, sustainable, reliable, efficient, cost-effective and resilient system;

The Puerto Rico Legislature recognized that performance-based mechanisms could help achieve this transformation, and in law 17-2019 set forth the following criteria to evaluate performance-based mechanisms:

the volatility and affordability of the electric power service rates;

2. the economic incentives and investment payback;
3. the reliability of the electric power service; customer service and commitment, including options to manage electric power costs available to customers;
4. customers' access to the electric power companies' information systems including, but not limited to, public access to information about the aggregated customer energy and individual consumers' access to the information about their electric power consumption;
5. compliance with the Renewable portfolio standard and rapid integration of renewable energy sources, including the quality of the interconnection of resources located in consumers' properties;
6. compliance with metrics to achieve the energy efficiency standards established in this Act;

7. infrastructure maintenance.

In this section, I examine the goals of Law 120 and possible performance metrics to measure progress towards those objectives, considering also the additional criteria outlined by Law 17-2019.

Q: What should a modern electric system look like?

A: In a traditional, 20th Century, electric power system the architecture was based on large-scale generation; centralized, a one-way control strategy of the system; and passive loads. The traditional system was not designed to meet many emerging trends, such as greater adoption of relatively low inertia generation sources, increasing penetration of distributed generation resources, and the need for greater resilience due to climate change.

A modern electric power system must be flexible, robust, agile. It must have the ability to dynamically optimize grid operations and resources, rapidly detect and mitigate disturbances, integrate diverse generation sources, on both the supply and demand sides, integrate demand response and energy-efficiency resources, enable consumers to manage their electricity use, and provide strong protection against physical and cyber risks.[12]

A modern electric power system must include more distributed

[12] Quadrennial technology review: An assessment of Energy Technologies and research opportunities, Chapter 3: Enabling Modernization of the Electric Power System, September 2015.

control, two-way flows of electricity and information, more energy storage, more energy justice, more sustainable sources of energy, and consumers as energy producers through assertive deployment of resilient and distributed renewable energy resources and as participants of demand management and efficient use of electricity programs.[13]

Utilities must work to increase ***the value of the services they provide to citizens***. Effective grid modernization will increase the perceived value of the electricity service for customers, reducing the likelihood they want to take their demand elsewhere by going off-grid. This value comes from enabling the platform functionalities that increase efficiency, allowing storage and renewables to enter the market, and facilitating customer bill control.

Regardless of personal preferences the "power system of the future" has been driven by a complex set of trends. Among these are: renewable energy cost reductions, including for distributed generation and battery storage; energy security, reliability, and resilience goals; evolving customer engagement; the trend of decreasing energy needs for many utilities (decreasing demand forecast); local and global environmental concerns; energy justice imperatives; innovations in data, intelligence, and system optimization; revenue and investment

[13] International Energy Agency. "Technology Roadmap: Smart Grid." OECD/IEA. Paris, France, 2011. https://iea.blob.core.windows.net/assets/fe14d871-ebcb-47d3-8582-b3a6be3662ba/smartgrids_roadmap.pdf.

challenges.[14]

Q: What are some examples of Performance Areas?

A: Traditional performance areas are:

performance dimension	Purpose
Reliability	service is reliable and interruptions are remedied quickly
Employee Safety	employees are not subjected to excessive risks
Public Safety*	the public is not subjected to excessive risks
Customer Satisfaction	the utility is providing adequate levels of customer service
Costs	Indicates the cost of supply side resources

Table 1. Traditional performance areas[15]

* Notably absent from the performance metrics proposed by LUMA

Most of LUMA's proposed metrics fall into this "traditional" categories rather than modern performance areas.

Modern performance areas[16] also include:

[14] "Power Systems of the Future", National renewable Energy laboratory (NREL) Technical Report NREL/TP-6A20-62611 February 2015.
[15] See Utility Performance Incentive Mechanisms: A Handbook for Regulators, Synapse Energy Economics, Table 3, Traditional Performance Areas. https://www.synapse-energy.com/sites/default/files/Utility%20Performance%20Incentive%20Mechanisms%2014-098_0.pdf. ("Synapse Handbook"). Attached as Exhibit 3.
[16] These are in addition to traditional performance areas which still apply.

performance dimension	Purpose
System Efficiency	the utility system as a whole is being operated more efficiently
Customer Empowerment	customers are participating in demand- side programs or installing demand-side resources
Network Support Services	customers and third-party service providers have access to networks and utility information
Environmental Goals	the utility and its customers are reducing environmental impacts, particularly related to climate change
Resiliency	Modern technological options, such as distributed renewable energy plus storage, are used, and even encouraged, by the utility to provide continuity of basic electric services under stressed grid conditions

Table 2. Modern performance areas[17]

Within these modern performance areas, other jurisdictions are proposing new metrics to measure how well utilities meet evolving customer needs. Examples of existing or proposed performance metrics in other jurisdictions are:

[17] See Table 4 of the Synapse Handbook, *supra*.

Metric	adopted, or considered, by
Peak load reductions	Illinois
Stakeholder engagement	Illinois, Hawaii
Customers accessing energy usage portals	Illinois
Effective resource planning	Hawaii
System load factor	Illinois
Line loss reductions	UK, Illinois
Distributed generation interconnections	UK, Illinois, Hawaii
Cost of renewable energy	California
Carbon intensity	Hawaii
Renewable energy curtailments	Hawaii

Table 3. Existing or proposed performance metrics in other jurisdictions

Metrics from Hawaii are especially relevant here, as PREB has determined that Hawaii Electric Light Company and Hawaiian Electric Company share several elements with PREPA and should be considered a useful peer utility.[18]

Q: What is a sustainable electric system?

A: The most often quoted definition of sustainability comes from the UN World Commission on Environment and Development: "sustainable

[18] PREB May 2021 Resolution and Order on Final Performance Baseline data and Benchmarks, Docket NEPR-MI-2019-0007, p. 8.

development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[19]

The US Environmental Protection Agency (EPA) states "To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations."

Therefore, the use of energy is considered sustainable if it meets the needs of the present without compromising the needs of future generations.

Sustainability objectives may include:

- Compliance with robust energy efficiency and demand response targets. Simple yet significant changes such as high-efficiency appliances and lighting, like LED light bulbs, which use between a fifth or a sixth of the energy of a comparable incandescent bulb, have been embraced by consumers. PREB has recognized this objective and set metrics to achieve it – for example, the amount and percentage of customers with advanced meters, and savings from energy efficiency programs.[20] Metrics could also include steps to raise customer awareness of energy efficiency and demand response programs, perhaps by including information in the bills that

[19] "Our Common Future" (Brutland Report) United Nations World Commission on Environment and Development, October 1987.
[20] PREB May 21, 2021 Resolution and Order, Attachments B and C.

customers receive each month from LUMA.

- Rapid integration of renewable energy, particularly rooftop photovoltaic (PV) solar panels which require much less distribution infrastructure than centrally located power stations. Law 17-2019 requires PREB to consider renewables integration when setting performance-based penalties and incentives for LUMA – and specifically highlights "the quality of the interconnection of resources located in consumers' properties."[21] To meet this requirement, PREB's May Order set a baseline of 3% generation from renewable power purchase agreements, and a benchmark of 40% by 2025 – including distributed renewables.[22] Beyond 2025 - grid modeling has demonstrated the feasibility of integration of 75% distributed renewable energy in Puerto Rico with only modest improvements to the distribution system.[23] Rapid integration of distributed solar resources is currently being stymied by LUMA's failure to both rapidly process new interconnection applications and to deal with the backlog of rooftop solar plus storage systems awaiting interconnection. PREB has recognized interconnection as a problem that could be solved through performance-based penalties and incentives – PREB has sent LUMA several requests of information in this proceeding related to LUMA's work to reduce the backlog.[24] LUMA's efforts should be measured through a performance metric –

[21] Law 17-2019 Section 5.21(e).
[22] PREB May 21, 2021, Resolution and Order, Attachment A.
[23] "Estudio de Integración de Recursos Eléctricos Distribuidos", Informe Final. *Available at* https://cambiopr.org/solmastechos/#downloads.
[24] LUMA's Responses and Objections to PREB's First Request for Information are attached as Exhibit 4.

and penalized if both the backlog is not resolved in a timely fashion and a new, expedited, process to manage new applications is not quickly implemented by LUMA.

- Deployment of electric vehicle charging infrastructure. Along with increased energy sales, utilities may sell charging *as a service*, whether through ownership the EV charging infrastructure, buying and selling the energy that powers the vehicles, or as a platform for optimizing EV charging. Again, LUMA could aid these efforts by making customers aware of these services through information in monthly bills.

Another essential dimension of sustainability is public safety. As detailed further below, public safety measures are absent in LUMA's proposal of performance metrics.

Since the standard business model for private utilities revolves in part around building new capital-intensive infrastructure, sustainability measures that reduce the need for such infrastructure means lower revenues and less profit for investors. For this reason, a private entity may not fully embrace sustainable solutions. A significant number of electric utilities are not moving toward a sustainable future since they are not adapting to disruptive technologies that may significantly reduce customers' dependence on electric utilities.[25] LUMA's contract does not prohibit subcontracting federal funds to its affiliate companies,

[25] "Sustainability in the Electric Utility Industry; How Electric Companies Can Become Sustainable", November 2018. https://www.fleetcarma.com/sustainability-electric-utility-industry-electric-companies-can-become-sustainable/.

which are mainly transmission and distribution system construction companies, not renewable energy companies; thus, LUMA too has an incentive not to pursue sustainable solutions. In fact, LUMA's parent company plans to seek contracts in Puerto Rico for its affiliates.[26] Performance-based incentives are needed to realign utility business practices in favor of sustainable technologies.

Q: What are examples of metrics to achieve the goal of a sustainable electric system?

A: Integration of renewable energy, energy efficiency and demand response:

Integration of renewable energy, energy efficiency, demand response, public safety and environmental metrics are essential to achieve a sustainable electric system. Table 4, below, shows examples of metrics to achieve a sustainable energy system.

[26] Quanta Services and ATCO-Led Consortium Selected by the Puerto Rico Public-Private Partnership Authority for the Operation and maintenance of Puerto Rico's Electric Power Transmission and Distribution System, June 22, 2020: "Quanta believes there is opportunity for it to compete for work associated with Puerto Rico's electric T&D system modernization efforts that are separate from its ownership interest in LUMA." See https://investors.quantaservices.com/news-events/press-releases/detail/277/quanta-services-and-atco-led-consortium-selected-by-the.

metric	purpose	metric formula
Energy efficiency	Indication of participation, energy and demand savings, and cost effectiveness of EE programs	Percent of customers per year Annual and lifecycle energy savings[27] Annual and lifecycle peak demand savings (MW) Program costs per MWh energy saved
Demand response	Indication of participation and actual deployment of DR resources	Percent of customers per year Number of customers enrolled MWh of DR provided over past year Potential and actual peak demand savings (MW)
Distributed generation	Indication of the technologies, capacity, and rate of DG installations, and whether net metering policies are supporting DG growth	Number of interconnections per year Net metering installed capacity (MW) Net metering MWh sold back to utility Net metering number of customers MW installed by type (PV, CHP, small wind, etc.)
Energy storage	Indication of the technologies, capacity, and rate of customer sited storage installations and their availability to support the grid	Number of interconnections per year MW installed by type (thermal, chemical, etc.) Percent of customers with storage technologies enrolled in demand response programs
Electric vehicles	Indication of customer adoption of EVs and their availability to support the grid	Number of additions per year Percent customers with EVs enrolled in DR programs
Information availability	Indicator of customers' ability to access their usage information and monitor their own consumption[27]	Number of customers able to access daily usage data via a web portal Percent of customers with access to hourly or sub-hourly usage data via web
Time-varying rates	Indication of saturation of time varying rates	Number of customers on time-varying rates

Table 4. Examples of metrics to achieve a sustainable energy system[27]

PREB's May 2021 Order[28] set includes Generation from RPS-eligible PPOAs as a metric, with a baseline of 3% and benchmark of 40% by 2025

[27] See Table 12 of the Synapse Handbook, *supra*.
[28] See Footnote 18.

(including distributed resources). LUMA's obligation to complete distributed generation interconnections, and to clear the massive backlog of systems waiting to be interconnected, is directly related to this metric. I recommend that PREB impose interconnection of distributed generation resources as a metric, with a penalty if LUMA fails to clear the backlog in a timely manner.

Public safety:

metric	Purpose	metric formula
Incidents, injuries, and fatalities	Indicator of incidents, injuries, and fatalities associated contact with the electric system by members of the public	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by type of activity
Emergency response time	Indicator of speed of response to emergency situations involving the electric system	Percent of electric emergency responses within 60 minutes each year*
Enhancing vegetation management	reduce voltage fluctuations, improve public safety, eliminate damage to lines during storms	electric lines miles annually subjected to tree trimming/total electric line miles

Table 5. Examples of metrics to achieve public safety[29]

*This is not CAIDI which the average time it takes the utility to restore service after an outage. This is the time it takes the utility to respond to an emergency.

Q: Can you speak about environmental performance metrics?

[29] See Table 7 of the Synapse Handbook, *supra*.

A: While reducing environmental impacts is a key part of sustainability, many of the metrics related to environmental performance (e.g. emissions of SO2, NOx and CO2) are generation-related issues outside of the control of LUMA. For a transmission and distribution system operator, minimizing the use of polluting sources of generation – through the rapid integration of distributed renewables, improvements in energy efficiency and demand response, see Table 4, and reduction in line losses – is key to achieving environmental goals. More examples of metrics to achieve better environmental performance are shown in Table 6.

metric	Purpose	metric formula
System losses	Indication of reductions in losses over time	Total electricity losses / MWh generation, excluding station use Technical losses as % of net generation, and Technical loss reduction as % of net generation[29] Reduction in network line losses

Table 6. Examples of T&D metrics to achieve better environmental performance[30]

LUMA proposed reduction in network line losses in Annex IX in its June 2020 T&D OMA, but removed it from the proposed Annex IX. LUMA witness Don Cortez explains that although the metric does provide a measure of LUMA's success in reducing line losses overall, LUMA chose not to include it. Direct Testimony of Don Cortez lines 196-202. I

[30] See Table 11 of the Synapse Handbook, *supra*.

recommend that PREB impose this metric, and require LUMA to provide regular reports of System Losses and LUMA's plan to reduce system losses.

Q: What is a reliable electric system?

A: The North American Electric Reliability Corporation (NERC) defines the reliability of the interconnected bulk power system (BES) in terms of three basic and functional aspects as follows[31]:

Adequacy: The ability of the electric system to supply the aggregate electric power and energy requirements of electricity consumers at all times while considering scheduled and reasonably expected unscheduled outages of system components.

Operating Reliability: The ability of the electric system to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system components.

Regarding adequacy, **system operators such as LUMA**, can and should take controlled actions or introduce procedures to maintain a continual balance between supply and demand within a balancing area (formerly known as a control area). **Emergency actions** in a capacity deficit condition **include public appeals** and the following: interruptible demand that the end-use customer makes available to its load-serving entity via contract or agreement for curtailment, voltage reductions

[31] 2021 State of Reliability: An Assessment of 2020 Bulk Power System Performance, August 2021, NERC.

(often referred to as "brownouts" because incandescent lights will dim as voltage is lowered, sometimes as much as 5%), rotating interruptions/outages where a preplanned set of distribution feeders is interrupted for a limited time and put back in service and another set is interrupted, thus, "rotating" the outages. While LUMA has employed rotating interruptions in recent months, it has made no efforts at public appeals for conservation or implementing demand response with large customers.

NERC offers a set of Reliability Standards to deliver an adequate level of reliability. Adequate Level of Reliability is defined as the state that the design, planning, and operation of the BES will achieve when the following reliability performance objectives are met with the following considerations:

- The BES does not experience instability, uncontrolled separation, cascading, and/or voltage collapse under normal operating conditions when subject to predefined disturbances.
- The BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined disturbances.
- The BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined disturbances.

Severe voltage fluctuations, a phenomenon normally not seen while PREPA managed the electric grid, has been reported under LUMA

operation in all regions in Puerto Rico. LUMA has not explained the frequency nor the severity of this conditions that often results in permanent damage to customers' appliances and deterioration of electric equipment. Many Puerto Ricans have been forced to replace food or medicine that spoiled when refrigerators were unpowered. I recommend that PREB require LUMA to implement a system where customers can obtain restitution from LUMA for financial losses caused by problems with the T&D system that LUMA operates.

- Adverse reliability impacts on the BES following low-probability disturbances (e.g., multiple contingencies, unplanned and uncontrolled equipment outages, cyber security events, or malicious acts) are managed.
- Restoration of the BES after major system disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

Q: What are reliability indicators for the transmission system?

A: NERC specifies definitions, calculations, rating levels, and purpose for the reliability indicators for the BES. Reliability indicators tie the performance of the BES to a set of reliability performance objectives defined by NERC. Reliability performance objectives are established and defined using NERC's definition of Adequate Level of Reliability. Each reliability indicator is mapped to a specific performance objective and is then evaluated to determine whether the actual performance of the system meets expectations.

Appendix A "Reliability Indicator Ratings and Descriptions" of the **2021 State of Reliability: An Assessment of 2020 Bulk Power System Performance**, August 2021 report by NERC could be adapted as shown in the following table (considering that LUMA only operates transmission and not generation) to provide adequate reliability metrics to measure LUMA's performance on keeping the reliability of the bulk electric power system.

Q: What are examples of transmission system reliability performance metrics?

A:

metric	Purpose	metric formula
Transmission-related events resulting in loss of load	Identify transmission system events that result in load shedding	Number of non-weather-related events that result in a certain level of load shedding
Transmission Outage Severity	Identify the extent (amount of affected customers) and duration (minutes of interruption) of a transmission related outage	Amount of affected customers/total number of customers Interruption time times the number of affected customers
Automatic AC Transmission Outages	Identify prevalence of high-risk transmission failure modes	Number of transmission element outages caused by failed protection system, human error, failed AC substation equipment, or failed AC circuit equipment
Automatic AC Transformer Outages	Identify prevalence of high-risk transformer failure modes	Number of outages (per transformer) due to failed protection system, human error, or failed AC substation equipment
Transmission element unavailability	Identify overall level of transmission element and transformer availability	Percentage of transmission system elements unavailable for service due to automatic and non-automatic outages
Load shed due to transmission outage	Minimize/mitigate load shed due to transmission outages	number of transmission related load-shed events amount of distributed generation available under contract in the event of an emergency

Table 7. Examples of transmission system reliability performance metrics

Q: Can you provide additional reliability indicators? And how does LUMA propose to use these?

A: LUMA proposes to use SAIDI and SAIFI to measure reliability of service. LUMA proposes to eliminate CAIDI claiming "it is limited as a performance metric". I strongly disagree with this claim. CAIDI is the average restoration time, or the time it takes to the electric utility to restore service once an interruption occurs. It is probably the most understandable and thus meaningful metric to the general public of all reliability indices. I strongly recommend that PREB maintain CAIDI as a metric.

SAIDI is the "System Average Interruption Duration Index". SAIDI is the average, non-momentary[32], outage duration for each customer served over a defined period of time (usually 1 year) and is usually measured in minutes or hours. The average SAIDI during 2019 for US electric utilities was 92 minutes. This SAIDI does not consider major interruption events caused by hurricanes, earthquakes, etc. Through the NEPR-MI-2019-0007 proceeding to set baselines and benchmarks, PREB set a SAIDI benchmark of 102 minutes – significantly higher than the average for mainland utilities. LUMA, however, proposes benchmarks that would allow for significantly longer interruptions: 1,119; 932, and 749 minutes for Years 1, 2, and 3, respectively. Those SAIDI statistics would not provide reliability anywhere close to the U.S. average – I recommend that PREB reject the proposed benchmarks and stay with its SAIDI benchmark of 102 minutes.

[32] A momentary service interruption last for less than 5 minutes.

SAIFI is the "System Average Interruption Frequency Index". SAIFI is the average number of interruptions that a customer would experience over a defined period of time (usually 1 year) and is usually measured in interruptions per customer. In the US the average SAIFI is 1.1 interruptions per year without including major events.

CAIDI is the "Customer Average Interruption Duration Index". CAIDI gives the average outage duration that any given customer would experience over a period of time, usually 1 year. CAIDI can also be viewed as the average restoration time, the time it takes the electric utility to restore service once an interruption occurs. In the US the average CAIDI is about 82 minutes (81.6 minutes).

MAIFI is the "Momentary Average Interruption Frequency Index". MAIFI gives the average number of momentary interruptions that a customer would experience over a period of time, usually 1 year. We consider a momentary interruption to be an outage of less than 5 minutes in duration. Hawaii reports an average MAIFI between 0.55 and 0.88 interruptions.[33]

IEEE Standard 1366 defines the calculation of these indices. Given previous controversy over PREPA's methodology in calculating these indices, as well as overall lack of public trust in LUMA's and PREPA's

[33] From https://www.hawaiianelectric.com/about-us/key-performance-metrics/service-reliability Oahu reports 0.7 to 1.1 interruptions, Maui county reports 0.3 to 0.7 interruptions, and Hawaii island reports 0.65 to 0.85 interruptions from Q3-2019 through Q2-2021.

operations, I urge the Bureau to require LUMA to make public their raw outage data, in addition to the indices. This would follow Law 17-2019's requirement that PREB's review in this proceeding consider "public access to information about … aggregated customer energy…".

Electric power quality is the degree to which the voltage, frequency, and waveform of a power supply system conform to established specifications.[34] Good power quality is a steady supply voltage that stays within the prescribed range, steady A.C. frequency very close to the rated value, and smooth voltage curve waveform that closely resembles a sine wave.

We have seen an increase in voltage fluctuations, thus a decrease in power quality, under LUMA's operation of the electric power system. Voltage fluctuations are described by IEEE as systematic variations of the voltage waveform envelope, or a series of random voltage changes, the magnitude of which falls outside the voltage limits set by ANSI C84.1.[35] ANSI C84.1 establishes nominal voltage ratings and operating tolerances for 60 Hz electric power systems above 100 V.

At the residential service voltages, the allowed voltage range for 120 V nominal is 126 V (maximum) to 114 V (minimum) and the allowed voltage range for 240 V nominal is 252 V (maximum) to 228 V

[34] Dugan, Roger C.; Mark McGranaghan; Surya Santoso; H. Wayne Beaty (2003). Electrical Power Systems Quality. McGraw-Hill Companies, Inc.
[35] American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hz) ANSI C84.1-2020.

(minimum). The Standard indicates that occurrence of service voltages outside these limits should be infrequent and that such conditions should be limited in extent, duration and frequency. Corrective measures shall be undertaken within a reasonable time to bring back voltages within allowed limits.

Q: Can you provide examples of transmission and distribution performance reliability metrics?

A:

metric	purpose	metric formula
System Average Interruption Duration Index (SAIDI)	Indicator of sustained interruptions experienced by customers	Total customer minutes of sustained interruptions / total number of customers
System Average Interruption Frequency Index (SAIFI)	Indication of how many interruptions are experienced by customers	Total number of customer interruptions / total number of customers
Customer Average Interruption Duration Index (CAIDI)	Indicator of the length of interruptions experienced by customers	Total minutes of sustained customer interruptions / total number of interruptions
Momentary Average Interruption Frequency Index (MAIFI)	Indicator of momentary interruptions experienced by customers	Total number of momentary customer interruptions per year / total number of customers

Power quality	Indicator of voltage changes, which can cause damage to end use equipment and frequency deviations	Numerous metrics indicating changes in voltage including transient change, sag, surge, undervoltage, harmonic distortion, noise, stability, flicker and others.
Enhancing vegetation management*	reduce voltage fluctuations, improve public safety, eliminate damage to lines during storms	electric lines miles annually subjected to tree trimming/total electric line miles[T]

Table 8. Examples of additional reliability performance metrics[36]

*Enhancing vegetation management is also in the public safety category.

PREB recognized the value of enhanced vegetation management, and PREB's 6th Request of Information asked several discovery questions related to this issue: specifically, for planned trim miles, trim acreage, and widening miles for FY 2022, 2023, and 2024, and for LUMA's steady-state preventative vegetation maintenance plan.[37] LUMA has thus far refused to provide that information. I recommend that PREB require that information to be provided and set penalties for failure to fulfill the planned tasks.

[36] See Table 5 of the Synapse Handbook, *supra*.
[37] *In re: Performance Targets for LUMA Energy ServCo, LLC*, NEPR- AP- 2020-0025; PREB's 6th Requirement of Information, Sep. 24, 2021.

Q: What constitutes and efficient and cost-effective electric system?

A: Although the term "efficiency" is typically associated with how energy is consumed at the point of end use the concept of efficiency can also be applied to how energy is produced and distributed. Also, a simple cost-benefit analysis to justify efficiency is fairly straightforward: using less energy means paying less for energy, but this simplistic approach overlooks important additional benefits that efficiency brings, such as:

- environmental – the easiest ton of CO2 to remove from the atmosphere is the one that is not emitted in the first place. Greater energy efficiency in the T&D system means lower emissions in generation to deliver the same amount of consumed energy.
- energy autonomy - fuel conservation reduces Puerto Rico's dependence on foreign fuel supplies—oil, natural gas and coal—which can be replaced by endogenous resources.
- reduced grid costs – reduced energy demand reduces the need for T&D investments.

The U.S. Energy Information Administration (EIA) estimates that electricity transmission and distribution (T&D) losses equated approximately 5% of the electricity transmitted and distributed in the United States in 2015 through 2019.[38] T&D losses are significantly higher in Puerto Rico[39].

[38] U.S. Energy Information Administration, https://www.eia.gov.
[39] T&D losses are estimated to be 15% to 17% of total generation in Jennifer Jiménez's electrical engineering master thesis: Jennifer Jiménez, "Benefits of Electric Generation Displacement Using Solar Thermal Water Heating", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

The US Energy Information Administration (EIA) also informs that utility distribution spending has risen 54% since 1997, from $31 billion to $51 billion annually, costs which are included in our utility rates. Cost effective alternatives to traditional infrastructure – including energy efficiency and distributed renewable energy resources plus storage - must be used to achieve system savings. Moreover, effective resource planning, is essential to achieve cost effective solutions. In effective resource planning stakeholder input is incorporated early, the process is designed to consider all relevant resources as well as the use of appropriate assumptions and modeling tools.

Q: In addition to the energy efficiency and demand response metrics presented in Table 4, are there any possible performance metrics?

A: In addition to the energy efficiency and demand response metrics presented in Table 4, possible performance metrics include:

metric	Purpose	metric formula
Total energy delivery costs	costs of delivering energy to consumers	All T&D expenses (including administrative expenses) per net kWh sold
Effective resource planning	Indicator of efficacy, breadth, and reasonableness of resource planning process	Numerous metrics regarding incorporation of stakeholder input, consideration of all relevant resources, use of appropriate assumptions and modeling tools, etc.
Load factor	Indication of improvement in system and customer load factors over time	Sector average load / sector peak load Monthly system average load / monthly system peak load
Usage per customer	Indication of customers' energy consumption changes over time	Sector sales / sector number of customers
System losses	Indication of reductions in losses over time	Total electricity losses / MWh generation, excluding station use

Table 9. Examples of performance metrics for efficient and cost-effective system[40]

Q: What does resiliency mean in the context of a power system and why is it needed now?

A: In the context of a power system, resiliency includes the ability to ensure electric service continuity—and quickly recover from—high-impact, low-frequency events. Recent extreme weather events—including Hurricanes María, Katrina and Sandy, the February 2021 blackouts in Texas, and the Tohoku earthquake and tsunami in Japan—have demonstrated the need for resiliency.[41] Enhanced resiliency of the power system is based on three elements—damage prevention, system recovery, and survivability, elements that align closely with sustainability: the environmental, social, and economic performance of electric power companies and impacts on their stakeholders.

Why is resiliency needed now? The North American Electric Reliability Corporation (NERC) reported that the number of so-called major disturbances increased dramatically from 1992 to 2009.

Q: What is enhanced power system resiliency based on?

A: Enhanced power system resiliency is based on three elements:

- Damage prevention: the application of engineering designs and

[40] See Tables 10 and 11 of the Synapse Handbook, *supra*.
[41] *See* Electric Power System Resiliency: Challenges and Opportunities, Electric Power Research Institute (EPRI), (February 8, 2016) https://www.epri.com/research/products/000000003002007376.

advanced technologies that harden the power system to limit damage. Hardening of the electric system should be well aligned to sustainability goals such as hardening that ensures more distributed renewable energy.

- System recovery: advanced tools and techniques to restore service as soon as practicable
- Survivability: the use of distributed resources – in the case of Puerto Rico, rooftop solar and storage - to aid consumers, communities, and institutions in continuing some level of normal function without complete access to their normal power sources

Q: What are some examples of performance metrics toward a resilient electric system?

A: In addition to metrics described in previous sections, metrics to incentivize a move towards a more resilient power system include:

metric	purpose	metric formula
Distributed generation	provide basic electric service continuity during system outages	interconnections per year
Distributed storage	provide basic electric service continuity during system outages	interconnections per year
Hardening existing power plants and substations against storm damage	reduce exposure to damage due to storms	
Targeted distribution system investment	Strengthening the distribution system to allow more distributed renewable generation	Incremental miles of distribution circuits operating at 13.2 kV Millions of dollars invested in strengthening distribution system to achieve more distributed renewable generation

Table 10. Examples of other resiliency performance metrics

III. Performance metrics and performance-based mechanisms examples from Hawaii

Q: Why are Performance metrics and performance-based mechanisms from Hawaii important?

A: This section summarizes examples of performance-based mechanisms used in Hawaii. All of these were established following a stakeholder engagement process ordered by the Hawaii Public Utility Commission.

These examples show two key characteristics of performance-based mechanisms: they include both rewards and penalties and provide rewards only for hard-to-reach objectives.

Q: What does the Interconnection Approval Performance Incentive Mechanism seek?

A: The Interconnection Approval Performance Incentive Mechanism (Interconnection Approval PIM) aims to promote the reduction of total interconnection time for distributed energy resources (DER) under 100 kW in capacity. The Public Utility Commission of Hawaii issued Decision and Order (D&0) 37787 defining the metric as:

> Metric: The metric will be the mean (average) number of business days it takes the Companies to complete all steps within the Companies' control to

> interconnect DER systems <100kW in size, in a calendar year. The PIM will be applied to each of the Companies' performances, respectively. The time within the Companies' control for each installation used to determine the average will be capped at two standard deviations above the mean (the "updated adjusted average").

Decision and Order 37878 follows D&O 37507 which established "three tiers of targets to earn financial rewards and three tiers of targets that will incur financial penalties." Upside targets were set at or above the annual thresholds included in Table 7[42] of the below, with corresponding financial rewards.

Thresholds and Potential Reward Level	**2021**	**2022**	**2023**	**2024**	**2025**
TIER 1: +$1,050,000 HECO +$225,000 HELCO/MECO	21	18	15	12	9
TIER 2: +$700,000 HECO +$150,000 HELCO/MECO	24	21	18	15	12
TIER 3: +$350,000 HECO +$75,000 HELCO/MECO	27	24	21	18	15

D&O 375071 Table 7: Interconnection Approval PIM Reward Targets

*Targets shown in average number of business days with outliers excluded

[42] Tables in this section, numbered Table 7 and Table 8, follow the original numbering of the Decision and Order from Hawaii.

The targets were "designed to incent incremental improvement on existing interconnection approval times working backwards from a desired end-state that reflects national exemplary performance." The downside targets "should be at or below the annual thresholds included in Table 8".

Thresholds and Potential Penalty Level	**2021**	**2022**	**2023**	**2024**	**2025**
TIER 1: -$315,000 HECO -$67,500 HELCO/MECO	42	39	36	33	30
TIER 2: -$210,000 HECO -$45,000 HELCO/MECO	39	36	33	30	27
TIER 3: -$105,000 HECO -$22,500 HELCO/MECO	36	33	30	27	24

D&O 375071 Table 8: Interconnection Approval PIM Penalty Thresholds

*Targets shown in average number of business days with outliers excluded.

The tables from the Decision and Order from Hawaii are examples. I recommend opening a public participation process to define the targets, penalties and incentives that PREB should impose to LUMA.

PREB's initial orders measured performance using total days waiting for interconnection, rather than averages.

Q: What is the low to moderate income (LIM) Energy Efficiency PIM?

A: The low to moderate (LIM) income energy efficiency performance-based mechanism was set by the Hawaii PUC to promote the utilities collaboration with Hawaii Energy[43] to deliver savings for LMI customers. D&O 37787 establish three (3) metrics:

Metric 1 ("Energy Savings"): Residential Hard-to-Reach ("RHTR") Energy (kWh) Savings Beyond Hawaii Energy's Target

The metric is based on "**verified kWh energy savings**, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

The threshold to qualify for an incentive is **"100% of Hawaii Energy's kWh target energy savings as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

Metric 2 ("Peak Demand Reduction"): Residential Hard to Reach Peak Demand (kW) Reduction Beyond Hawaii Energy's Target

[43] Hawai'i Energy program's mission is "... to empower island families and businesses to make smarter energy choices to reduce energy consumption, save money, and pursue a 100% clean energy future." Hawai'i Energy (last visited November 15, 2021),https://hawaiienergy.com/about.

The metric is based on "**verified peak demand reduction**, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

And again, the threshold to qualify for an incentive is **"100% of Hawaii Energy's kW target peak demand reduction as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

Metric 3 ("Program Participation"): A&A Customers[44] Served Beyond Hawaii Energy's Target

The metric is based on "The sum of program participants each year ("customers served") in Hawaii Energy Residential A&A, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

And again, the threshold to qualify for an incentive is **"100% of Hawaii Energy's kW target peak demand reduction as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

[44] Residential A&A Programs are: Single & Multifamily Direct Install, Water Heating Direct Install, Bulk Appliance programs. *See*, Hawai'i Energy (last visited November 15, 2021), https://hawaiienergy.com/for-homes.

The total reward for the PIM is capped at $2 million, annually, across all three metrics combined and is set to be "comprehensibly revisited" after three years.

The "hard to reach" label aligns with PREB's directive that "Targets of Levels for which an incentive may be proposed, shall be tied to difficult tasks, and not easy to fix areas."[45] LUMA has not adequately evaluated whether its proposed incentives are tied to difficult tasks, or easy to fix areas.[46]

IV. LUMA's proposed performance metrics:

Q: Can you summarize LUMA's proposed performance metrics?

A: Table 11 summarizes LUMA's proposed performance metrics:

Category	LUMA's proposed metrics
Customer service	J.D. Power Customer Satisfaction Survey (residential)
	J.D. Power Customer Satisfaction Survey (business)
	Average Speed of Answer
	Customer Complaint Rate
	Abandonment Rate
Technical, Safety & Regulatory	OSHA Recordable Incident Rate
	OSHA Fatalities
	OSHA Severity Rate
	OSHA DART Rate
	SAIFI
	SAIDI
	Distribution Line Inspections & Targeted Corrections
	Transmission Line Inspections & Targeted Corrections
	T&D Substation Inspections & Targeted Corrections

[45] *In Re* Performance Targets for LUMA Energy Servco, LLC, Resolution and Order, NEPR-AP-2020-0025, at 6 (December 23, 2020), https://energia.pr.gov/wp-content/uploads/sites/7/2020/12/20201223-AP20200025-Resolution-and-Order.pdf.

[46] LUMA's Responses and Objections to First Discovery Request by LECO, *In Re* Performance Targets for LUMA Energy Servco, LLC, NEPR-AP-2020-0025, question 3 (September 10, 2021). LUMA's responses to LECO's First Request of Information are attached as Exhibit 5.

Financial Performance	Operating Budget
	Capital Budget: Federally Funded
	Capital Budget: Non-Federally Funded
	Overtime
	Days Sales Outstanding - General Customers
	Days Sales Outstanding - Government Customers

Table 11. Performance metrics proposed by LUMA

PREB rejected the J.D. Power Customer Satisfaction Survey metrics in the NEPR-MI-2019-0007 proceeding, stating that LUMA would have to provide "a more thorough analysis" before these metrics could be included.[47] This analysis is not currently possible because, as LUMA witness Jessica Laird acknowledges "[t]here is no previous data from [PREPA] to compare."[48] Instead, it appears that LUMA used an email survey of about 4,000 customers and 163 companies.[49] An email survey omits a massive percentage of Puerto Rican customers – and the responses omit the concerns of less tech-savvy customers. I recommend that PREB strike any incentive tied to these metrics, until a more thorough set of data is available, using survey-taking means more inclusive than an email survey.

Act 57-2014 Sections 6.26 and 6.27 give customers the right to file complaints regarding electric company billing or service, and requires

[47] *In Re* The Performance of the Puerto Rico Electric Power Authority, Resolution and Order, NEPR-MI-2019-0007, at p. 15 (May 21, 2021).
[48] Direct Testimony of Mrs. Jessica Laird, *In Re* Performance Targets for LUMA Energy Servco, LLC, NEPR-AP-2020-00025, at lines 86-90 (August 18, 2021), https://energia.pr.gov/wp-content/uploads/sites/7/2021/08/Exhibit-1-Pre-Filed-Testimonies-on-LUMAs-Performance-Metrics-Targets.pdf.
[49] *Id.*, at lines 69-70.

electric companies to create a procedure to address all complaints. PREB's NEPR-MI-2019-0007 proceeding to set baselines and benchmarks set a Customer Complaint Rate metric, which properly counted all initial complaints filed by customers under Act 57-2014. PREB set a baseline of 841 complaints per 10,000 customers. LUMA did not challenge that conclusion, but now proposes a very different Customer Complaint metric, which omits the vast majority of customer complaints, and only counts the small percentage of these complaints that become formal complaints to be decided by PREB. I recommend that PREB include both metrics: both initial complaints and formal complaints: and impose a penalty on LUMA if the actual initial complaints in FY2020 exceed the baseline figure set by PREB of 841 per 10,000 customers.

LUMA also proposes several "Major Outage Event" metrics related to its preparations, operational response and communications before and during a major outage.

When compared to Table 1 it is clear that LUMA's proposed performance metrics are focused on traditional utility performance areas. The implicit goal is to achieve a reasonable 20th century utility service.

Despite the LUMA contract's reiteration of Law 120's goals, key elements of the transformational vision of Law 120 and Law 17 are entirely absent from LUMA's proposed performance metrics.

The purpose of employee safety (labor safety) is to ensure that employees are not subjected to excessive risks. It is a very bad idea to provide a financial incentive to a company for merely complying with basic moral, legal and ethical obligations such as employee safety. If there are a metrics that truly calls for penalties, and only penalties, if minimum standards are not met, these are the labor safety metrics.

I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

For the Operating Budget metric: PREB's May 2021 Order set the Fiscal Year 2021 Baseline as 80.4% - meaning that PREB expects LUMA's FY2021 actual operating expenses to stay under 80.4% of the operating budget.[50] LUMA did not challenge that PREB conclusion, but now proposes to increase the baseline to either 100% or 102%, and seeks an incentive and an award of full base points just for staying within its budget.[51]

[50] *In Re* The Performance of the Puerto Rico Electric Power Authority, *supra* note 46, Attachment A.
[51] *Supra*, note 10, Annex IX, Section D.
See also LUMA's Responses and Objections to Fourth Discovery Request by LECO, In Re Performance Metrics Targets for LUMA Energy Servco, LLC, NEPR-AP-2020-00025, question 7 to LECO Information Request 4-7. LUMA's responses to LECO's Fourth Request of Information are attached as Exhibit 6. LUMA's November 10th submission of additional responses in LECO's Fourth Request of Information are attached as Exhibit 7.

I recommend that PREB reject LUMA's proposal and stay with the 80.4% baseline for the Operating Expenses metric.

PREB's May Order also includes a metric for "Capital expenses vs. Budget – Transmission & Distribution" and sets a baseline for a 9.9% ratio of T&D capital expenses to operating budget.[52]

I recommend that PREB impose this metric on LUMA, with a penalty for failure to keep T&D capital expenses under 9.9% of the operating budget.

Additionally, I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. I recommend that all budget metrics: Operating Budget, Capital Budget: Federally Funded, Capital Budget: Non-Federally Funded, and Capital expenses vs. Budget – Transmission & Distribution be used only to impose penalties if minimum standards are not met. Instead, a failure to stay within budget should reduce or eliminate LUMA's ability to achieve incentives in other categories.

Q: Can you provide recommendations of additional metrics?

A: Based on the discussion in Section III, above, of potential metrics that could be used to incentivize the transformation towards a "modern, sustainable, reliable, efficient, cost-effective, and resilient system", as mandated by Law 120, as well as public safety, I recommend the

[52] *Supra*, note 49.

adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

In addition, and following Law 17-2019's emphasis on the importance of public information disclosure, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. At a minimum, this should include public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

Q: Do LUMA's metrics lack penalties? Do they include incentive payments for achieving what should be expected?

A: LUMA's proposal includes only incentives for achieving certain targets, but no penalties if a given level of performance is not maintained. The failure to include penalties is particularly concerning given that electric service has deteriorated in key areas since LUMA took control of the electrical system. For example, LUMA's performance in SAIDI and SAIFI has deteriorated relative to PREPA's performance, which was used to establish the performance metrics baseline.

Additionally, LUMA proposes that it should be awarded 25% of its incentive in the category of financial performance. Three of the metrics within this category simply represent LUMA's ability to stay within its budget. This is a basic expectation that should not result in incentive

compensation. It is worth noting that in the Long Island Power Authority's transmission & distribution operation and maintenance agreement with PSEG, achievement of performance metrics in the "Cost Management Performance" category (staying within its operating and capital budgets) is a prerequisite to PSEG being able to achieve full incentive compensation. That is, PSEG does not earn any incentive for meeting the cost management metrics; instead, if it fails to one or both of the metrics, it is eligible for only 50% or 0% of the maximum possible incentive based on its performance in the other categories.[53] This is one of the revised LIPA contract's "Gating Performance Metrics" discussed in the next section.

Finally, if LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.

I recommend:

- Removing any incentive payment if LUMA stays within its capital and operating budgets. Instead, following the model of the LIPA contract, failure to stay within budget should reduce LUMA's ability to achieve incentives in other categories.

[53] Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a/ LIPA and PSEG Long Island LLC Dated as of December 31, 2013, Appendix 9.

- Including penalties if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.
- If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.**

Q: Can you offer examples of other metrics that will limit, or eliminate, incentives?

A: Yes. I will like to present "Gating performance metrics" and "Default performance metrics" as discussed in the Long Island Power Authority management services contract.

The Long Island Power Authority (LIPA) announced on November 9, 2021 a revised management services contract and settlement with PSEG Long Island. LIPA indicated that "the revised management agreement includes reforms designed to drive performance and accountability, while providing an unprecedented level of oversight of PSEG Long Island's operations"[54].

[54] Paul Ciampoli, *LIPA And PSEG Long Island Reach Agreement On New Reformed Contract*, AMERICAN PUBLIC POWER ASSOCIATION (November 10, 2021), https://www.publicpower.org/periodical/article/lipa-and-pseg-long-island-reach-agreement-new-reformed-contract.
See also: Second Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a LIPA and PSEG Long Island LLC,

Appendix 4.3(C) of this revised contract include two interesting types of metrics that should be considered by PREB. These metrics are: "Gating Performance Metrics" – metrics that, if not achieved, reduce the overall ability to receive incentive compensation and "Default Performance Metrics" – failure to achieve these metrics gives LIPA the right to terminate the entire contract.

From the revised LIPA/PSEG Long Island contract "The Service Provider's failure to achieve a Gating Performance Metric in any Contract Year results in a percentage reduction to the Variable Compensation Pool for that Contract Year by the percentage specified in the Gating Performance Metric and, accordingly, reduces the amount that may be earned across all Scope Function-Specific Performance Metrics for that Contract Year".

Gating Performance metrics listed in the revised contract are:

- Cost Management: If PSEG is not within 102% of the capital budget and/or within 102% of the operating budget, the possible incentive compensation pool is reduced by 50% (for failure to achieve 1 metric) or 100% (for failure to achieve both). This is the same as the previous contract.
- Customer Satisfaction: Starting in 2024, failure to achieve a result in the 3rd quartile for either residential or business customers for two consecutive years will result in a 15% reduction in the incentive

https://www.lipower.org/wp-content/uploads/2021/11/Changes-in-DRAFT-2021-AR-OSA-from-2013-AR-OSA-with-appendices.pdf for revised contract.

compensation pool. This metric relates to specific customer satisfaction surveys.

- SAIDI: If PSEG "fails to achieve a result at the 37.5 percentile or better, as calculated by using electric reliability benchmarking data from the US Energy Information Administration for companies with >500,000 customers, and utilizing the IEEE standard for SAIDI without major event days", the incentive compensation pool is reduced by 50%.
- Emergency Preparation and Response: If PSEG's response to a major storm does not score high enough on an Emergency Preparation and Response Scorecard published by the New York Public Service Commission, the incentive compensation pool will be reduced by 25% or 50%.

Default Performance Metrics listed in the revised contract are:

- Customer Satisfaction: "commencing in 2024, the Service Provider failure's to achieve a third quartile result on either component - Residential or Business - for any two consecutive Contract Years provides LIPA with the right, but not the obligation, to terminate this Agreement"
- Emergency Preparation and Response: similarly measured with respect to the scorecard published by the New York Public Service Commission.
- Failure to comply with various Cybersecurity requirements.

I recommend the adoption of metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" in the performance-based mechanism to be applied to LUMA.

V. T&D system performance has deteriorated in several key areas since LUMA assumed control

Q: What will you discuss in this section?

A: In this section, I review several key areas in which performance has deteriorated under LUMA, highlighting the need to establish penalties as part of the performance metrics.

First, there have been widespread public complaints of voltage fluctuations and power quality issues under LUMA that were not experienced under PREPA's operation. There is no public data on this issue, reflecting the need to establish power quality performance metrics. LUMA's refusal to provide to the public data on the number of complaints it has received for voltage fluctuations damaging equipment is one indication that LUMA is not transparent and that it may be admitting to hide the fact that this problem has worsened under LUMA.[55]

Second, related to customer service, LUMA's CEO admitted during an

[55] Juan Marrero, *LUMA no revela querellas por enseres eléctricos dañados en apagones*, METRO, (September 16, 2021). https://www.metro.pr/pr/noticias/2021/09/16/luma-no-revela-querellas-enseres-electricos-danados-apagones.html.

October 6th Congressional hearing that the volume of calls has increased since LUMA took over the system.[56]

Third, the reliability of the transmission and distribution system has deteriorated, according to SAIDI and CAIDI data filed with the Bureau in Case No. NEPR-MI-2019-0007. The time it takes to restore electric service after an interruption (CAIDI) has increased significantly 25 out of 26 regions under LUMA. The average system-wide time to restore electric service after an interruption (CAIDI) increased from 2 hours and 43 minutes during June, July and August 2020 to 4 hours and 38 minutes during June, July and August 2021 under LUMA. This increase in outage duration was also acknowledged by LUMA's CEO during the October 6 Congressional hearing.

While LUMA's overall SAIFI figure is slightly better than PREPA's figure, the significantly worse SAIDI and CAIDI figures are more important one in determining overall reliability. And PREB must note that LUMA's SAIFI improvement is not widespread – SAIFI has gotten worse in 8 of 26 regions.

[56] House Committee on Natural Resources Office of Insular Affairs Full Committee Hearing on PREPA Post Implementation of the LUMA Transmission and Distribution Contract, at 2 hours 29 minutes (October 6, 2021).

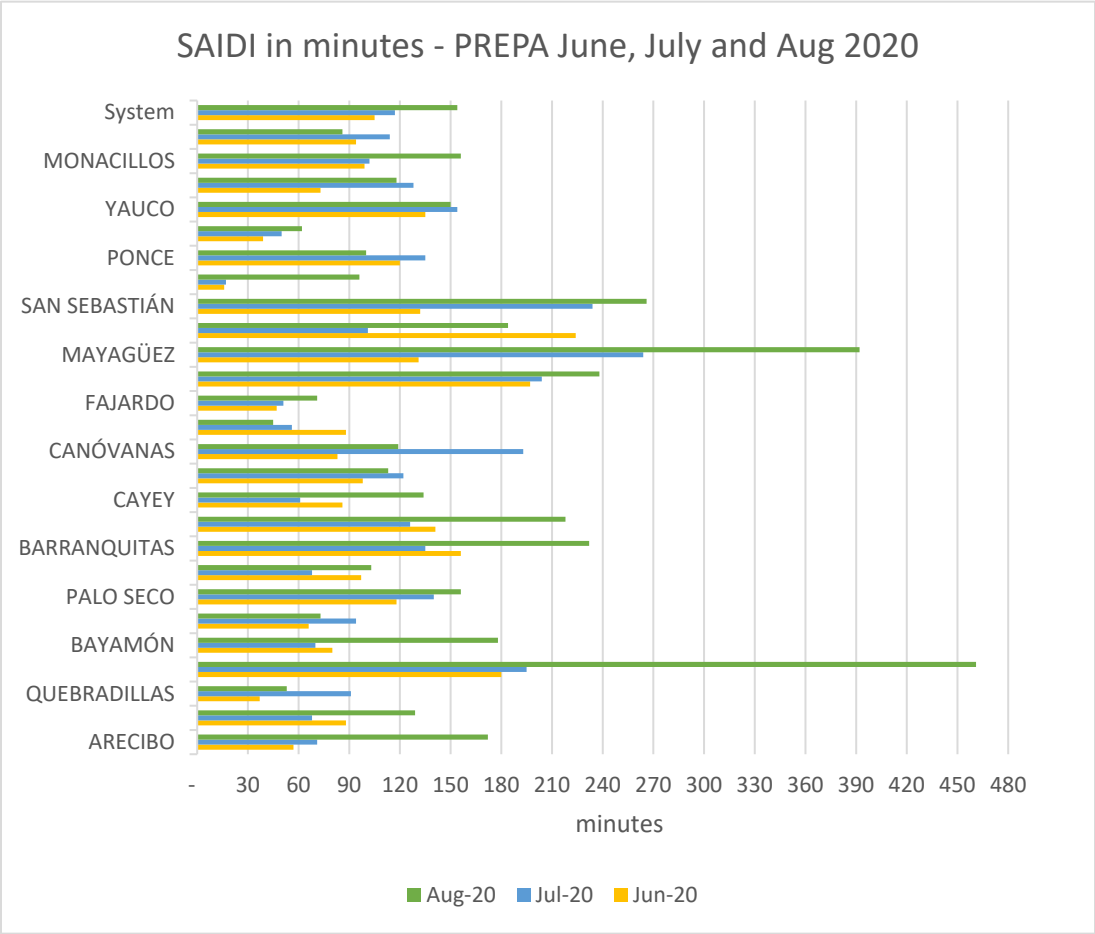

Figure 2. SAIDI, in minutes, per region, under PREPA June, July and August 2020 (restated values as per Nov 4 2021, reported by LUMA to PREB)

Figure 2 shows SAIDI for June, July and August 2020 per region, in minutes, under PREPA administration of the power system as reported by LUMA to the PREB (restated values as per Nov 4 2021). During June thru August 2020 7 out of 26 regions have SAIDI under 120 minutes. Three regions have SAIDI above 240 minutes in at least one month. The average monthly system wide interruption duration is 125 minutes during these three months.

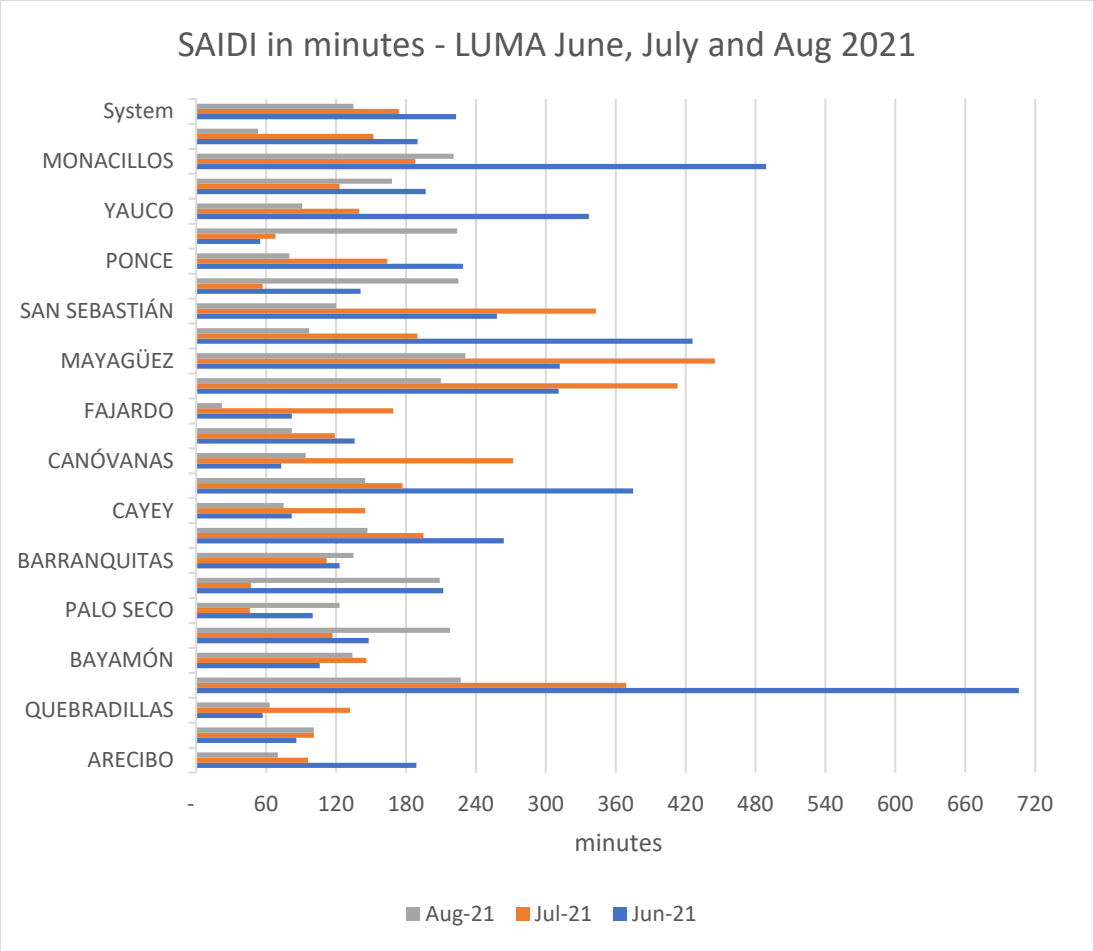

Figure 3. SAIDI, in minutes, per region, under LUMA June, July and August 2021 (restated values as per Nov 4 2021, reported by LUMA to PREB)

Figure 3 shows SAIDI for June, July and August 2021 per region, in minutes, under LUMA administration of the power system as reported by LUMA to the PREB (restated values as per Nov 4 2021). During June thru August 2021 only 1 out of 26 regions have SAIDI under 120 minutes. Ten regions have SAIDI above 240 minutes. The average monthly system wide interruption duration is 177 minutes during these three months.

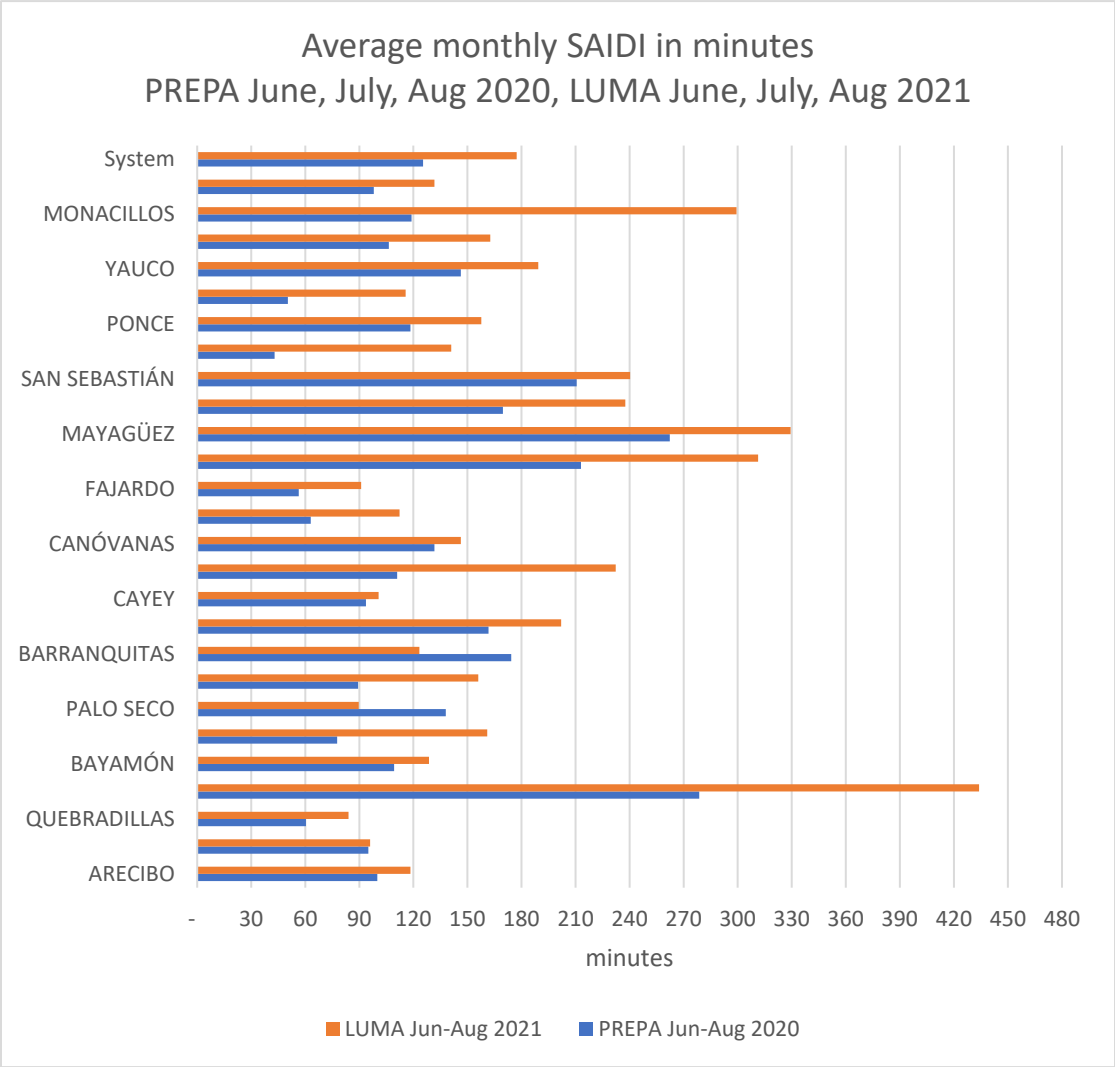

Figure 4. Average monthly SAIDI, in minutes, per region, under PREPA June, July and August 2020 and under LUMA June, July and August 2021 (restated values as per Nov 4, 2021, reported by LUMA to PREB)

Figure 4 shows average monthly SAIDI per region for PREPA (June thru August 2020) vs LUMA (June thru August 2021). In 24 out of 26 regions LUMA's performance is worse than PREPA's. The average monthly system wide interruption duration is 125 minutes for PREPA

during June thru August 2020 and 177 minutes for LUMA during June thru August 2021.

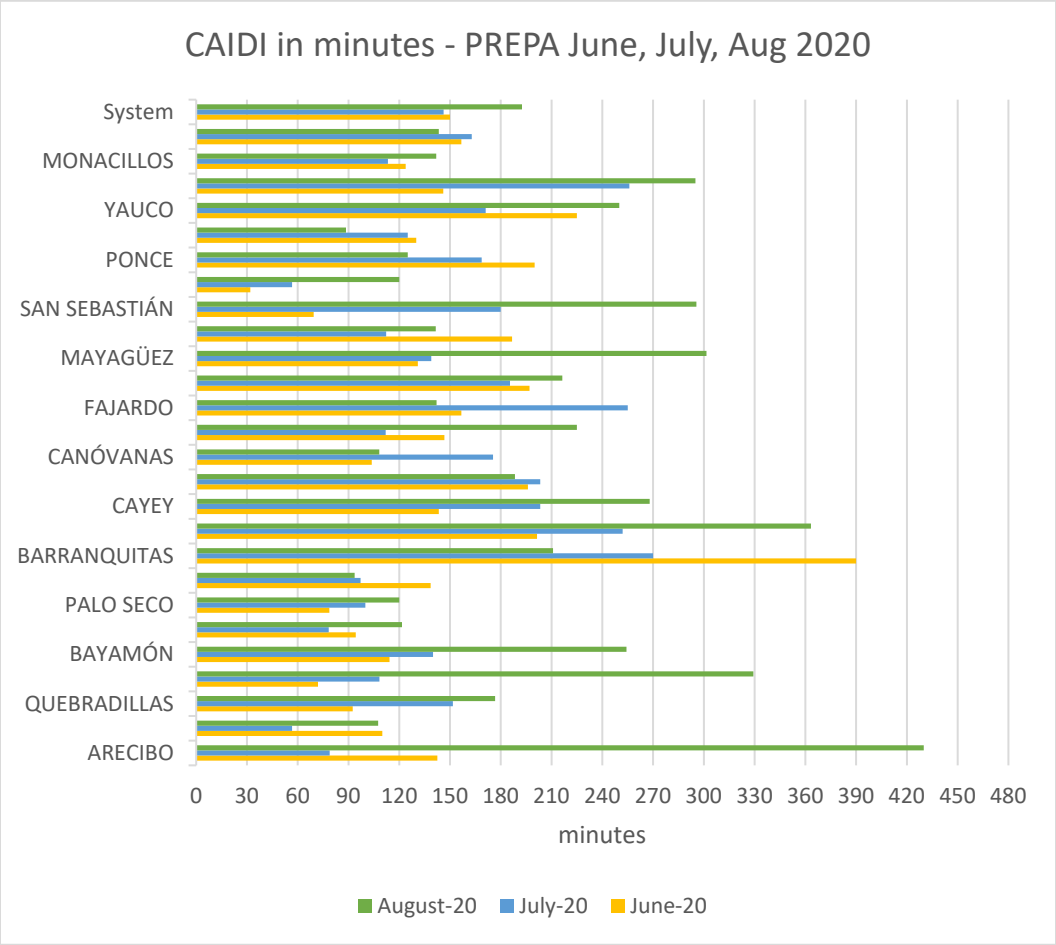

Figure 5. CAIDI, in minutes, per region, under PREPA June, July and August 2020 (calculated from restated values reported by LUMA to PREB, Nov 4 2021)

Figure 5 shows CAIDI, in minutes, per region as reported by PREPA from June thru August 2020. Eleven (11) out of 26 regions have CAIDI in excess of 240 minutes for at least one month.

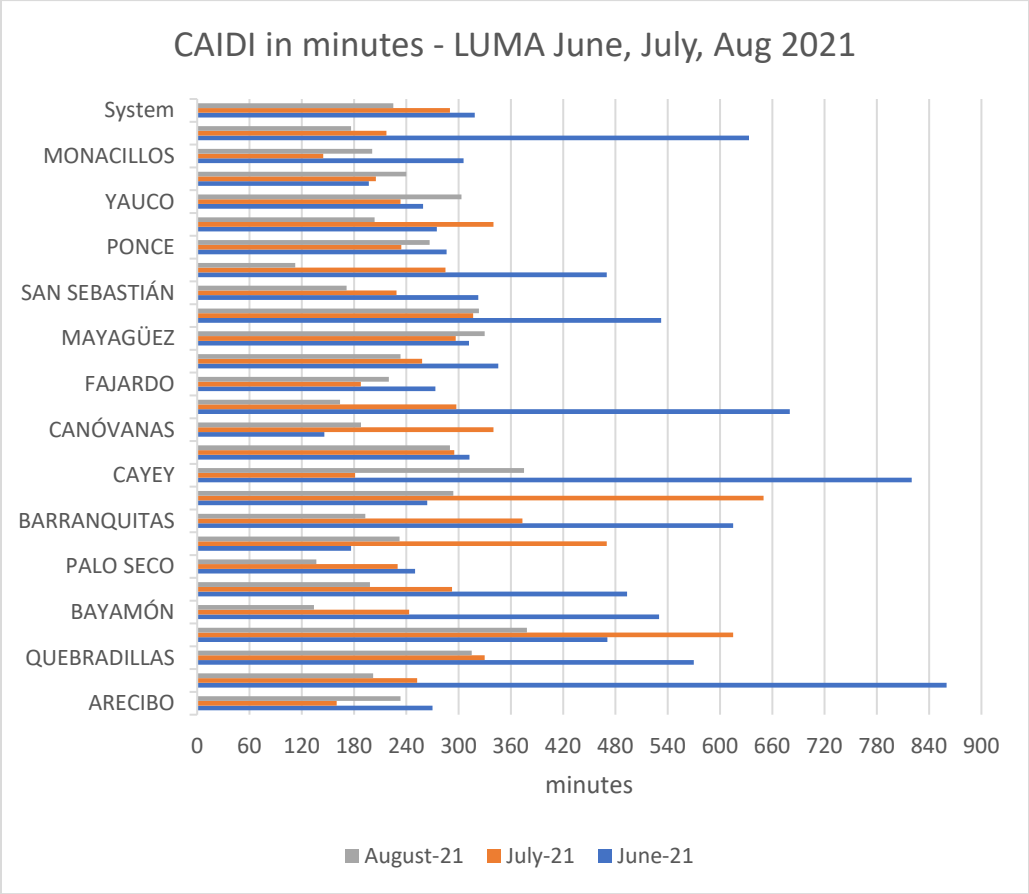

Figure 6. CAIDI, in minutes, as reported by LUMA from June thru August 2021.

Figure 6 shows CAIDI, in minutes, per region as reported by LUMA from June thru August 2021. All regions have a CAIDI above **240 minutes for at least one month**. Eleven (11) out of 26 regions have CAIDI in excess of 480 minutes. CAIDI exceeds 600 minutes in 7 regions and exceeds 780 minutes in 2 regions. The Manatí region exceeds 840 minutes (14 hours) in June 2021!

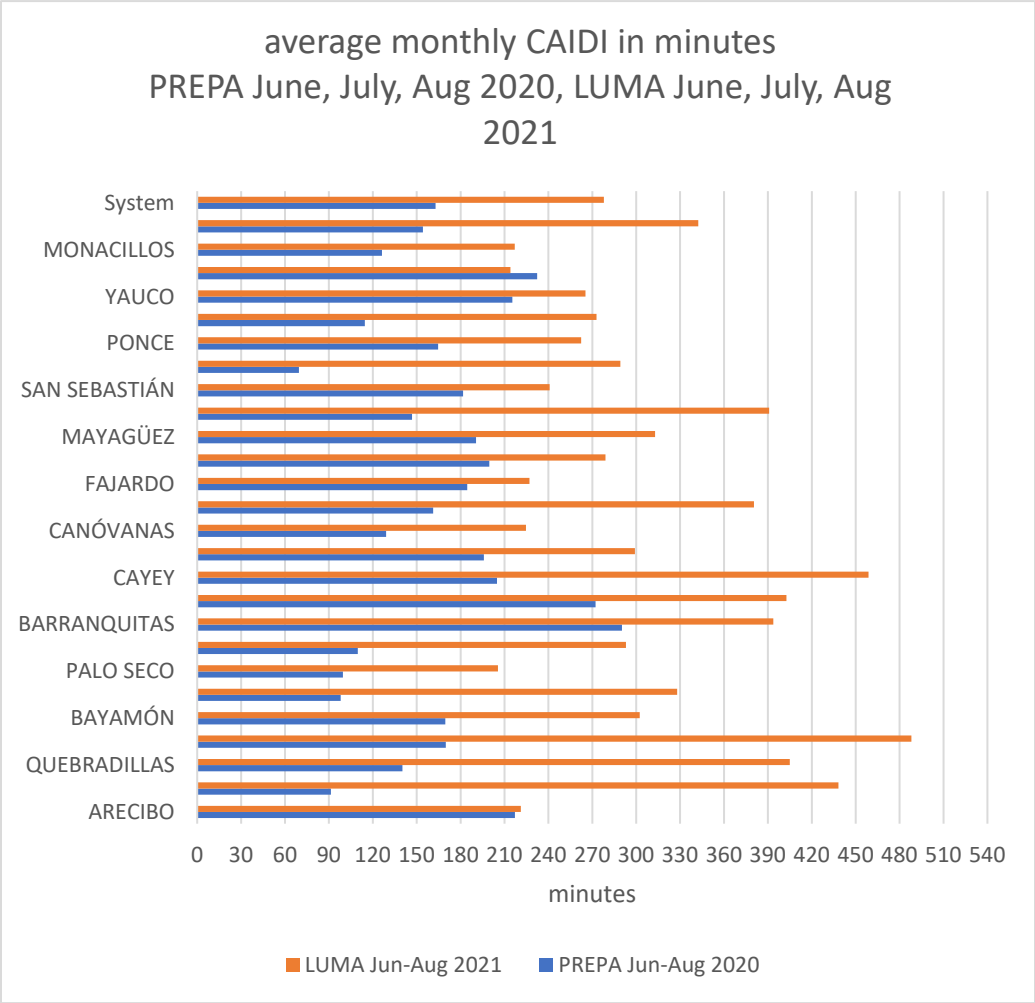

Figure 7. CAIDI as reported by PREPA (June thru August 2020) vs LUMA (June thru August 2021)

Figure 7 shows CAIDI as reported by (June thru August 2020) vs LUMA (June thru August 2021. In 25 out of 26 regions CAIDI, the time it takes LUMA to restore service after an interruption has increased. The system wide restoration time has increased from 163 minutes under PREPA to 278 minutes under LUMA.

VI. Summary of conclusions and recommendations

Q: What are your conclusions and recommendations?

A: My conclusions and recommendations are:

Conclusion 1 – LUMA's performance metrics, if achieved, would result in reasonable 20th century utility service for Puerto Rico. Additional metrics are necessary to incentivize the transformation envisioned by Law 120 and to achieve a 21st Century electric grid.

Conclusion 2 – LUMA's metrics, in contrast to performance metrics in other jurisdictions, include no penalties for underperformance, which is particularly problematic given that service deterioration is already evident in certain areas. With respect to some metrics, LUMA proposes to be rewarded for meeting basic expectations.

Recommendation 1 – The Bureau should consider additional metrics to incentivize the transformation to a "modern, sustainable, reliable, efficient, cost-effective, and resilient system." I recommend the adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

Recommendation 2 - I also recommend that the Bureau open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives.

Recommendation 3 – In developing metrics, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. At a minimum, the Bureau should require public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

Recommendation 4 – Penalties should be included in performance metrics that would be triggered if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.

Recommendation 5 - I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. Instead, a failure to stay within budget should reduce LUMA's ability to achieve incentives in other categories.

Recommendation 6 - I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

Recommendation 7 – The PREB should adopt metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" in the performance-based mechanism to be applied to LUMA.

Recommendation 8 - If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.**

Recommendation 9 - Finally, I recommend that performance metrics adopted by the PREB should be true performance based, where rewards and penalties are clearly defined. This should be adopted regardless of the "fix fee + additional fee" structure of the existing Contract between LUMA and PREPA. A "fixed fee" compensation structure is contradictory to the purpose of a rewards and penalties system, since a fixed fee structure promotes underachievement.

Q: Does this conclude your testimony?

A: Yes, it does. However, I retain the right to modify or clarify my views based on new information made available to me.

Q. Are exhibits attached to your testimony?

A: Yes. Expert Witness CV (Exhibit 1); LUMA Performance Targets Report (Exhibit 2); and Synapse Energy Economics Report (Exhibit 3);

LUMA's Responses and Objections to PREB's First Request of Information (Exhibit 4); LUMA's Responses and Objections to LECO's First Request of Information (Exhibit 5); LUMA's Responses and Objections to LECO's Fourth Request of Information (Exhibit 6); LUMA's November 10th submission of additional responses in LECO's Fourth Request of Information (Exhibit 7).

CERTIFICATION

I Agustín Alexi Irizarry-Rivera, of legal age, married, engineer and resident of San Germán, Puerto Rico, CERTIFY that the contents of my testimony are known to me and are the truth according to the best of my abilities and reasonable knowledge. The technical and operational aspects included in the testimony are based on information that has been gathered in good faith; but I cannot guarantee the truthfulness of information gathered from third parties.

Agustín Alexi Irizarry-Rivera, Ph.D., P.E.

Before me, the undersigned Notary Public, personally appeared Agustin Alexi Irizarry Rivera, who acknowledges that the above is true this day of November 16, 2021 in San Germán, Puerto Rico.

[+] Personally known OR [ ] Identification Document provided

—

Affidavit# 447

Notary Public Name, Signature, Seal

ANA J. NAVARRO RODRIGUEZ NOTARIO PUERTO RICO

RECIBO

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Sello de Asistencia Legal
80016-2021-0316-20513033

Lcda. Ana J. Navarro Rodriguez
Abogada-Notaria: RUA 17,132
PO Box 743 Hormigueros, PR 00660

Exhibit 1

Expert Witness CV

Dr. Agustín A. Irizarry Rivera

Dr. Agustín A. Irizarry Rivera
Professional Engineer License 12342

P.O. Box 1016 Phone (787) 448-2553
Hormigueros, Puerto Rico 00660

EDUCATION

- Ph.D., Iowa State University, Ames, IA, 1996
  Dissertation Title: "Risk-based operating limits for dynamic security constrained electric power systems." Advisor: Dr. James D. McCalley, committee members: Dr. V. Vittal, Dr. V. Ajjarapu, Dr. G. Sheblé, Dr. H. T. David.

- MSEE, University of Michigan, Ann Arbor, MI, 1990

- BSEE, Magna Cum Laude, University of Puerto Rico, Mayagüez, PR, 1988

POST DOCTORAL TRAINING

(9/08 - 6/09) Researcher at Plataforma Solar de Almería (PSA), Tabernas, Spain. The PSA is the premiere European research and development laboratory for solar thermal concentration systems.

Integration of standard power system models, for the electric network, generator-turbine and controls, with thermo hydraulic models of a solar thermal power plant with no energy storage to provide a comprehensive, albeit simplified, dynamic model set to simulate and study the solar power plant/electric network interaction.

ACADEMIC WORK EXPERIENCE

- (7/05 – present) Professor, (6/00 – 6/05) Associate Professor and (1/97 – 6/00) Assistant Professor of Electrical Engineering at the University of Puerto Rico, Mayagüez (UPRM).
  During this time Dr. Irizarry Rivera has taught:

  1. INEL 3105 Electric Systems Analysis I
  2. INEL 4075 Electrical Engineering Fundamentals
  3. INEL 4103 Electric Systems Analysis III (Introduction to Electric Power Systems)
  4. INEL 4405 Electric Machines
  5. INEL 4407 Electrical Systems Design I
  6. INEL 4415 Electric Power Systems Analysis
  7. INEL 4048 Engineering Practice
  8. INEL 4998 Undergraduate Research
  9. INEL 5406 Transmission and Distribution Systems Design
  10. INEL 5495 Design Projects in Electric Power Systems: Design of the Distribution System for an Eolic Generation Park.
  11. INEL 5496 Design Projects in Power Electronics: Design, Simulation, Fabrication and Test of Brushless Commutation for Permanent Magnets DC Motors.
  12. INEL 5995 Special Problems - Environmental and Infrastructure Impact of Eolic Generation
  13. INEL 6025 Advanced Energy Conversion
  14. INEL 6027 Electric Power Systems Dynamics and Control
  15. INEL 6028 Optimization and Operation of Electric Power Systems
  16. INEL 6077 Over Voltage Phenomena in Electric Power Systems
  17. INEL 6995 Special Topics in Electrical Engineering: Reactive Power
  18. INEL 6995 Special Topics in Electrical Engineering: Power System Distribution

- President (8/16 – present and 1/11 – 8/12) and (08/10 – 12/10) Member, School of Engineering Personnel Committee

- President (8/16 – present and 8/06 – 06/07) and (08/09 – 08/12) Member, Electrical and Computer Engineering Department Personnel Committee

- (8/06 – 5/07) President, ADHOC Committee to Evaluate Proposals for a New UPRM Class Schedule

- (8/05 – 8/06) Elected Academic Senator UPRM.

  Duties included: Coordinator of the ADHOC Committee to Design Instruments to Evaluate the Chancellors' Performance, Coordinator of the ADHOC Committee to Evaluate Proposed Academic Work Schedules for the Mayagüez Campus, Member of the Courses Committee.

- (2/00 – 8/00) Assistant Dean of Academic Affairs UPRM.

  Duties included: supervisor of the Registrar Office and the Admissions Office, coordinator of the registration process for the whole Campus, author of the Academic Calendar proposal, coordinator of the Students Academic Progress Committee, supervisor of the Courses Central Archive keeper and coordinator of the Campus Early Admission Program.

- (10/00 – 01/02) and (8/99 – 2/00) Associate Director for Academic Affairs – Electrical and Computer Engineering Department, UPRM.

  Duties included: Graduate Programs Director, updating the faculty recruitment plan, coordinator of the curriculum revision and accreditation processes, evaluate the creation of new academic programs, coordinator and supervisor of the Department registration process, co-author of proposals to bring external funding to the Department, in charge of promoting and facilitating scientific research in the Electrical and Computer Engineering Department.

ACADEMIC INTERESTS AT GRADUATE LEVEL:

Renewable/alternate energy sources such as; photovoltaic, eolic, waves and solar thermal and their integration to the grid
- ✓ Electric power system dynamics and operation
- ✓ Power systems risk assessment

EXAMPLES OF FUNDED RESEARCH and EDUCATION PROJECTS

Development and Validation of Models to Assess Dynamic Response of Converter-Dominated Power Systems across Multiple Spatiotemporal Scales – (2019-2023) A $1,039,255 project (UPRM budget out of $3.5 million total) to identify, study, and develop models that allow the study of electric networks where electric generation is dominated by converter-based generators. A project in collaboration with University of Alaska Fairbanks and South Dakota State University.

Puerto Rico Solar Business Accelerator – (2020-2022) (Investigator) A $500,000 project, funded by EDA US Department of Commerce, to design and build two (2) microgrids to provide resiliency for community serving businesses in Puerto Rico.

Development of Representative Microgrids Test Cases and Study of Selected Operational Scenarios in the Island of Puerto Rico – (2019-2021) (CO Principal Investigator) A $100,000 project, sponsored by Sandía National Laboratory, to adapt existing models, or developed new models, for

components of microgrids as defined in the Puerto Rico Energy Bureau (PREB) Microgrid Rule and use these models to simulate the behavior of several microgrids to evaluate the PREB Microgrid Rule's requirements.

GEARED (Grid Engineering for Accelerated Renewable Energy Deployment) – (2013-2018) A $929,000 project (UPRM budget out of $6.9 million for the Consortium) to develop and run a Distributed Technology Training Consortium in the Eastern United States, led by the Electric Power Research Institute (EPRI) in collaboration with four U.S. universities (University of Puerto Rico Mayaguez, Georgia Institute of Technology, Clarkson University, University of North Carolina at Charlotte) and seventeen utilities and system operators. The Consortium will leverage utility industry R&D results with power engineering educational expertise to prepare power engineers in management and integration of renewable energy and distributed resources into the grid.

Streamlined and Standardized Permitting and Interconnection Processes for Rooftop Photovoltaic (PV) in Puerto Rico (2012-2013) (Investigator) A $301,911 project sponsored by the US Energy Department that seeks to improve the PV energy market of rooftop systems up to 300 kW in Puerto Rico. The project strives to create not only a standardized framework for PV deployment, but also streamlined: organized, lean permitting and interconnection processes where most residential and small commercial PV systems can be installed safely and quickly.

Design of a Renewable Energy Track within the Electrical Engineering Program at UNAPEC, Dominican Republic (2011-2012) A $29,000 award to design a Renewable Energy Track within the existing Electrical Engineering Program of UNAPEC.

IGERT: Wind Energy Science, Engineering and Policy (WESEP) (2011-2015) A $171,600 sub-award from Iowa State University, the lead Institution, to fund master students doing research in wind technology, science, and policy as they relate to accomplishing three objectives: (a) increase the rate of wind energy growth; (b) decrease the cost of wind energy; and (c) extend penetration limits.

Center for Resources in General Education (CIVIS) – (2008-2016) A 2,500,000 (total for UPRM), approximately $500,000 for Engineering, education project to strengthen and further develop general education objectives at UPRM. Dr. Irizarry is the coordinator for the CIVIS supported UPRM Energy Systems Instrumentation Lab.

Achievable Renewable Energy Targets For Puerto Rico's Renewable Energy Portfolio Standard (2007-2009) A $327,197 project sponsored by the Puerto Rico Energy Affairs Administration (Administración de Asuntos de Energía), to produce an estimate, based in realistic boundaries and limitations, of renewable energy available in Puerto Rico for electricity production. The renewable energy resources studied were: biomass - including waste-to-energy, micro hydro, ocean - waves, tides, currents and ocean thermal, solar - photovoltaic and solar thermal, wind – utility as well as small wind, and fuel cells. The purpose of producing these estimates was to establish adequate targets, as a function of time, for Puerto Rico's Renewable Portfolio Standard.

Colegio San Ignacio - Ejemplo de Sostenibilidad (2007-2008) A $73,332 project to match the energy needs of Colegio San Ignacio with its available renewable energy sources. Demonstration projects with a strong educational component will be proposed to the School to be designed, installed and operated on the Scholl Campus with the participation of the School Faculty and students. The philosophy behind the program will be one of sustainable development.

Programa Panamericano de Capacitación en Ingeniería de Potencia Eléctrica (2006-2008) A $97,370 educational project to deliver a Web-broadcast master program in electric power engineering to engineers at UNAPEC University in the Dominican Republic. Courses in this program responded to the reality and necessities of the Dominican Republic electric power industry and aims for sustainable development.

Caguas Sustainable Energy Showcase, Phase I (2006-2007) A $90,055 project sponsored by the Municipality of Caguas, Puerto Rico to assess the current electric energy consumption profile, by sector; residential, commercial, industrial and governmental, of Caguas and to propose achievable goals (percentages of demand), by sector, to be satisfied using renewable energy sources.

Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Machines (2003-2004) A $99,444 project sponsored by the National Science Foundation (NSF) to estimate parameters and failure probabilities for synchronous generators. The main outcomes of this work were the application of useful alternate robust estimation techniques and the identification of failure modes for risk-based maintenance of generators.

Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks (2002-2005) A $499,849 project sponsored by the National Science Foundation (NSF) and the Office for Naval Research (ONR) to develop a model for the next generation power network using a distributed concept based on scalable coordination by an Intelligent Power Router (IPR). Our goal was to show that by distributing network intelligence and control functions using the IPR, we will be capable of achieving improved survivability, security, reliability, and re-configurability. Our approach builds on our knowledge from power engineering, systems, control, distributed computing, and computer networks.

Puerto Rico Wind Resource Assessment - Phase I: Partnership formation and prospective site identification (2002-2003) A $32,465 project sponsored by the Puerto Rico Energy Affairs Administration to increase the knowledge of wind resources in Puerto Rico. We assessed wind velocity probabilities at sites that may be used to install wind farms. The criteria to select the prospective sites was not convenience of data gathering, such as existing towers or existing wind recording stations, but land availability for establishment of a wind farm, road access, available electric grid connections, zoning regulations and indicators of potential wind resource such as existing wind data, topography, wind-deformed vegetation or eolian landforms.

Puerto Rico SMES Project Phase I - Evaluation Study (1997-1999) A $579,188 project sponsored by FOMENTO's Science and Technology Board to determine the energy requirements (size) of an energy storage unit to provide Puerto Rico's electrical system with rapid response spinning reserve in order to prevent blackouts under generation deficiency conditions.

EXAMPLES OF FUNDED TECHNOLOGY TRANSFER PROJECTS

Wind Resource Assessment in Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below).

Inspección de Instalación de Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below).

Sustainable Energy Projects for Bayamón's Sustainability Master Plan (2009) A technology transfer project. Duties included: assist Bayamón´s staff to define the scope of renewable energy projects. Pre-design a Photovoltaic Parking Roof for the Sports Complex Onofre Carballeira Umpierre, write the RFP sent to companies, evaluate the design submitted by companies that responded to the RFP, design performance criteria for the construction, test, and delivery phases of the project and evaluate the performance of the company/companies during the construction, test, and delivery phases of the project.

Ahorro Energético vía Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2007) A $37,800 technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below), to produce an estimated 25%

energy savings in 100 residences at Villa Turabo, Caguas via solar thermal water heaters and supplemental photovoltaic electricity generation.

INTERNATIONAL CONFERENCES AND WORKSHOPS COORDINATION

1. (06/06 – 06/10) Member of the Probabilistic Methods Applied to Power Systems International Society (PMAPS IS) The PMAPS IS, incorporated in Canada, is the governing body of the PMAPS Conferences. From 06/06 thru 05/08 Dr. Irizarry Rivera was the General Chair of the coming PMAPS 2008 Conference and his primary responsibility was to organize the PMAPS 2008 Conference. From 05/08 thru 06/10 Dr. Irizarry Rivera is the General Chair of the previous PMAPS Conference and his primary responsibility is to manage the selection of a venue for PMAPS 2012.
2. (06/06 – 05/08) General Chair of the 10th International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) Rincón, Puerto Rico, May 25-29, 2008. The PMAPS Conferences fill a needed role in the power engineering community by providing a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.
3. (01/06 – 05/06) Chair of the Sustainable Energy Workshop "**De Acuerdo con la Energía Sostenible y Ahora ¿Cómo llegar allí?**" at the University of Puerto Rico Mayagüez, May 22 and 23, 2007.

OTHER RECENT PROFESSIONAL EXPERIENCE

ELECTRIC POWER INDUSTRY

(09/14 – date) Member of the Board of Directors – PREPANet, LLC. A network infrastructure provider that uses an optical network platform in Puerto Rico to provide wholesale telecommunication services. Member Representing the Interest of Consumers.

(06/12 – 09/14) Member of the Board of Directors - Puerto Rico Electric Power Authority (PREPA). Elected Member Representing the Interest of Consumers.

- Vice-President of the Board
- President, Board Committee for Audits
- Member, Board Committee on Electric Power System State and Improvements
- Member, Board Committee on Labor and Legal Affairs
- Member, Board Committee on Customer Services

EXPERT WITNESS IN CIVIL COURT and PUERTO RICO ENERGY BUREAU

1. (10/21 – date) Expert witness – Case No. NEPR-AP-2020-0025 (LUMA's performance metrics) before the Puerto Rico Energy Bureau. Expert witness for Earthjustice on behalf of Local Environmental Organizations.

2. (08/19 – 05/20) Expert witness – Case No. CEPR-AP-2018-0001 (PREPA's IRP) before the Puerto Rico Energy Bureau. Expert witness for Earthjustice on behalf of Local Environmental Organizations.

3. (02/10 – 06/12) Expert witness - A DP 2007-0085 Héctor Soto Villanueva et al. vs. Puerto Rico Electric Power Authority et al. - Aguadilla Court House, Aguadillla, Puerto Rico.

4. (07/09 – 06/12) Expert witness – Civil case number 09-cv-01340 (SEC) Leticia Figueroa Villegas et al. vs. Autoridad de Energía Eléctrica et al. United States District Court for the District of Puerto Rico, San Juan, Puerto Rico.

5. (07/09 – 06/12) Expert witness – Civil case number EDP 2009-0097 (402) Luz Eneida Marcano Díaz et

al. vs. Autoridad de Energía Eléctrica et al. Caguas Court House, Caguas, Puerto Rico.

6. (07/09 – 06/12) Expert witness – Civil case number EDP 2009-0022 Eduardo Nieves et al. vs. Autoridad de Energía Eléctrica et al. Caguas Court House, Caguas, Puerto Rico.

7. (05/07 – 06/12) Expert witness – Civil case number ADP 2003-0130 José A. Rosario Cordero vs. Municipio de Aguadilla, et al. Aguadilla Court House, Aguadillla, Puerto Rico.

8. (08/05 – 06/12) Expert witness – Civil case number A BCI2006-0085 Fabián Crespo Muñiz et al. vs. Autoridad de Energía Eléctrica et al. Aguada Court House, Aguadillla, Puerto Rico.

9. (07/09 – 04/11) Expert witness - Civil case number 09-cv-1844 (CCC) Francisco Antonio Frías Pujols et al. vs. Puerto Rico Electric Power Authority - United States District Court for the District of Puerto Rico San Juan, Puerto Rico

10. (06/07 – 06/08) Expert witness – Civil case number ISCI 2006-00937 (206) Emilio Malavé Ortiz y Enid Rivera Román vs. Autoridad de Energía Eléctrica Mayagüez Court House, Mayagüez, Puerto Rico.

11. (09/05 – 05/08) Expert witness – Civil case number I DP2002-0257 Marilyn Meléndez Vélez et al. vs. Autoridad de Energía Eléctrica et al. Mayagüez Court House, Mayagüez, Puerto Rico.

12. (10/04 – 06/12) Expert witness – Civil case number DKPD-2002-0610 (1008) Naomi Malavé Conde, et al. vs. Distribuidora de Provisiones y Comestibles, Inc., Bayamón Court House, Bayamón, Puerto Rico.

13. (12/02 – 06/12) Expert witness – Civil case number DKDP2002-0460 (1008) Dalia E. Rivera Ortiz, et al. vs. Autoridad de Energía Eléctrica. Bayamón Court House, San Juan, Puerto Rico.

14. (06/01 – 06/12) Expert witness – Civil case number K DP2002- 0108 (503) Maribel Lozada Rodríguez vs. Autoridad de Energía Eléctrica. San Juan Court House, San Juan, Puerto Rico.

15. (11/03 – 11/07) Expert witness – Civil case number DKDP2003-578 (1001) Francisco Colón Calcador vs. Autoridad de Energía Eléctrica. Bayamón Court House, San Juan, Puerto Rico.

16. (06/02 – 01/04) Expert witness – Civil case number K DP2002-1088 María Jiménez Carrión vs. Municipio de San Juan. San Juan Court House, San Juan, Puerto Rico.

17. (2/01 – 02/03) Expert witness – Civil case number E DP1997-0275 (402) Gerardo Pérez Viera vs. Autoridad de Energía Eléctrica y otros. Caguas Court House, Caguas, Puerto Rico.

18. (7/00 – 1/02) Expert witness – Civil case number F DP1999-0011, Pablo Sánchez Rosa y otros vs. Cooperativa de Seguros Múltiples y otros. Carolina Court House, Carolina, Puerto Rico.

19. (5/98 – 10/98) Expert witness - Civil Case number K DP1995-0084, María Elena Ravelo Egaña vs. Autoridad de Energía Eléctrica. San Juan Court House, San Juan, Puerto Rico.

ELECTRIC POWER GRID MANAGEMENT EVALUATION

- (05/07 – 06/09) Consultant – Engineering evaluation of power system transmission and distribution limitations for Cunningham Lindsey International, Inc. provided technical advice associated to a claim of increased operational costs due to restrictions on a power system operation.

RENEWABLE ENERGY

1. (03/20 – 05/21) Consultant – Engineering services. Define and study scenarios prioritizing energy efficiency and distributed sustainable energy sources, to be considered as alternatives to the plan of action proposed by PREPA in the Integrated Resource Plan (IRP). Guide and support other consultants in the execution of this study for CAMBIO PR Inc.

2. (05/15 – 10/15) Consultant – Engineering services (assist in the definition of the project, pre- design, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in a 199 kW photovoltaic project for Rico Banana Inc., Guayanilla, Puerto Rico.

3. (04/16 – 05/16) Consultant – Engineering services (assist in the definition of the project, project inspector) in a 300 kVA, three-phase, pole-mounted substation for Rico Banana Inc., Guayanilla, Puerto Rico.

4. (07/15 – 12/16) Consultant - Engineering services (assist in the definition of projects, pre-design, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in energy efficiency and photovoltaic systems, Municipio Autónomo de Bayamón.

5. (01/11 – 05/12) Consultant - Wind Energy Resource Assessment for New Era Eolic LLC, Puerto Rico.

6. (07/10 – 08/11) Consultant – Engineering supervision of residential photovoltaic installations in Urbanización Villa Turabo, Municipio Autónomo de Caguas.

7. (07/09 – 08/10) Consultant - Engineering services (assist in the definition of the project, pre-design, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in a 250 kW photovoltaic project on the Onofre Carballeira Sports Complex, Municipio Autónomo de Bayamón.

8. (08/07 – 08/08) Consultant – Engineering design of residential photovoltaic generation for one hundred (100) dwellings in Urbanización Villa Turabo, Municipio Autónomo de Caguas.

9. (10/06 – 12/06) Consultant – Provided technical advice in sitting and interconnection issues for potential wind energy projects for UPC Wind.

10. (06/04 – 06/05) Consultant to, and Partner of, ecoEnergy - Provided engineering services and technical advice in wind data analysis, sitting, preliminary wind turbines selection, interconnection issues and preliminary power purchase agreement negotiations for potential wind energy projects in Puerto Rico.

11. (4/01 – 07/02) Consultant – Provided engineering services and technical advice in wind data analysis, sitting, preliminary wind turbines selection, interconnection issues with a proposed desalination plant and drafting of "Request for Information" and "Request for Proposals" documents for the Puerto Rico Energy Affairs Administration.

PEER REVIEWED PUBLICATIONS:

1. Chen, S.E., Tang, W.W., Irizarry, A.A., Baez-Rivera, Y., Pando, M.A., Majerekar, M., Young, D.T. and Ng, Y. (2020) "Post-Hurricane Investigations A Critical Component towards Improved Grid Resiliency-Hurricane Maria in the Puerto Rico," ASCE Journal of Performance of Constructed Facilities, DOI: 10.1061/(ASCE)CF.1943-5509.0001447.

2. E. O'Neill-Carrillo, I. Jordan, A.A. Irizarry-Rivera, and R. Cintrón, "The Long Road to Community

Microgrids," IEEE Electrification Magazine. Vol. 6, No. 4, pp. 6-17, December 2018.

3. Ng, Y. Chen, S.E., Pando, M.A., Irizarry, A.A., Baez-Rivera, Y., Tang, W.W., Majerekar, M. and Martinez, R. "Storm Effect Binomial Analysis and Puerto Rico Grid Hardening after Maria" Submitted to ASCE Journal of Performance of Constructed Facilities.

4. Chen, S.E., Pando, M.A., Irizarry, A.A., Baez-Rivera, Y., Tang, W.W. and Ng, Y. "Resiliency of Power Grid Infrastructure under Extreme Hazards – Observations and Lessons Learned from Hurricane Maria in Puerto Rico," Submitted to Sustainable City Infrastructures.

5. A. Irizarry-Rivera, K.V. Montano-Martinez, S. Alzate-Drada, F. Andrade, "A Case Study of Residential Electric Service Resiliency thru Renewable Energy Following Hurricane María", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.

6. S. Alzate-Drada, K.V. Montano-Martinez, A. Irizarry-Rivera, F. Andrade, "Advanced Metering Applications in Microgrids: A hardware in the Loop (HIL) Electric Power Setup", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.

7. K.V. Montano-Martinez, S. Alzate-Drada, A. Irizarry-Rivera, F. Andrade, "Characteristics of Residential Battery Storage System for Better Integration with Electric Distribution System", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.

8. Carlos Vélez-Rivera, Emmanuel Arzuarga-Cruz, Agustín A. Irizarry-Rivera and Fabio Andrade, "Global Data Prefetching using BitTorrent for Distributed Smart Grid Control", Proceedings of the Forty-eight Annual North American Power Symposium, Denver, Colorado, September 18-20, 2016.
9. José R. Matagira-Sánchez and Agustín A. Irizarry-Rivera, "Feasibility Study of Micro Pumped Hydro for Integration of Solar Photovoltaic Energy into Puerto Rico's Electric Grid", Proceedings of the Forty-seventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.

10. Laura M. Adarme-Mejía and Agustín A. Irizarry-Rivera, "Feasibility Study of a Linear Fresnel Concentrating Solar Power Plant located in Ponce Puerto Rico", Proceedings of the Forty-seventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.

11. Mónica I. Mercado-Oliveras and Agustín A. Irizarry-Rivera, "Residential Grid-tied Photovoltaic Energy System Design in Puerto Rico", Proceedings of the Forty-seventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.

12. Armando L. Figueroa-Acevedo and Agustín A. Irizarry-Rivera, "Variability Assessment of Solar and Wind Resources in Puerto Rico", Proceedings of the Thirteenth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Durham, UK, July 7-10, 2014.

13. Agustín A. Irizarry-Rivera, Efraín O'Neill-Carrillo and E. Jiménez-Toribio, "Puerto Rico Small Hydro Report", Status of the Caribbean Chapter on World Small Hydropower Report, International Network for Small Hydropower, Lara Jin Qiu-ting Esser (Editor), 2014.

14. Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Chapter 3 Intelligent Power Routers: Distributed Coordination for Electric Energy Processing Networks", In J. Momoh, L. Mili (Editors) Operation and Control of Electric Energy Processing Networks, John Wiley and Sons/IEEE Press,

2010.

15. José A. Colucci Ríos, Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera. "Renewable Energy in the Caribbean: A Case Study from Puerto Rico", In E. Laboy, F. Schaffner, A. Abdelhadi (Editors) Environmental Management, Sustainable Development and Human Health, Taylor and Francis Press, 2009, pp 291.

16. Efraín O'Neill-Carrillo, Marla Pérez-Lugo, Cecilio Ortiz-García, Agustín A. Irizarry-Rivera and José A. Colucci-Ríos, "Sustainable Energy: Balancing the Economic, Environmental and Social Dimensions of Energy," Proceedings of the IEEE Energy 2030 Conference, November 2008, Atlanta, Georgia.

17. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, José A. Colucci-Rios, William Frey, Cecilio Ortiz- García and Marla Pérez-Lugo, "Advancing a Sustainable Energy Ethic Through Stakeholder Engagement," Proceedings of the IEEE Energy 2030 Conference, November 2008, Atlanta, Georgia.

18. Efraín O'Neill-Carrillo, Marla Pérez-Lugo, Cecilio Ortiz-García, Agustín A. Irizarry-Rivera and José A. Colucci-Ríos, "Sustainability, Energy Policy and Ethics in Puerto Rico", Proceedings of Energy and Responsibility: A Conference on Ethics and the Environment, April 10-12, 2008, Knoxville, Tennessee.

19. José A. Colucci Ríos, Agustín A. Irizarry-Rivera and Efraín O'Neill-Carrillo, "Sustainable Energy for Puerto Rico", Proceedings of the 2007 Energy Sustainability Conference, June 27-30, 2007, Hilton Long Beach, California, USA.

20. Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Intelligent Power Routers: A Distributed Coordination Approach for Electric Energy Processing Networks", International Journal of Critical Infrastructures, Vol. 3 No 1/2 pp. 20-57, 2007.

21. Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera, "Socially-Relevant Capstone Design Projects in Power Engineering," Proceedings of the IEEE/PES Power Systems Conference and Exposition, October 2006, Atlanta, GA.

22. Luis O. Jimenez, Efrain O'Neill, William Frey, Rafael Rodríguez-Solis, Agustín A. Irizarry-Rivera, and Shawn Hunt, "A Learning Module of Social and Ethical Implications for Electrical and Computer Engineering Capstone Design Courses", Proceedings of the Thirty-sixth Annual Frontiers in Education Conference, San Diego, California, October 28-31, 2006.

23. Efraín O'Neill-Carrillo, Eddie Marrero, Agustín A. Irizarry-Rivera, "Integrated Laboratory Experiences in Power Engineering Courses," Proceedings of the International Conference on Engineering Education, July 2006, San Juan, Puerto Rico.

24. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, Jorge A. Cruz-Emeric, "Curricular Revisions in Electrical Engineering at UPRM," Proceedings of the Thirty-fifth Annual Frontiers in Education Conference, Indianapolis, Indiana, October 2005.

25. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Economical Effects of the Weibull Parameter Estimation on Wind Energy Projects", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

26. Linda Monge-Guerrero and Agustín A. Irizarry-Rivera, "A Degradation Model of Synchronous Generator Stator Insulation to Compute Failure Probabilities", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

27. Jennifer Jiménez-González and Agustín A. Irizarry-Rivera, "Generation Displacement, Power Losses and

Emissions Reduction due to Solar Thermal Water Heaters", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

28. Héctor R. Zamot, Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera, "Analysis of Wind Projects Considering Public Perception and Environmental Impact," Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.

29. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Development of Eolic Generation Under Economic Uncertainty", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.

30. Carlos M. Torres-Ortolaza and Agustín A. Irizarry-Rivera, "Failure Modes and Failure Probability of Intelligent Power Routers", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.

31. Agustín A. Irizarry-Rivera, Manuel Rodríguez, Miguel Vélez-Reyes, José R. Cedeño, Bienvenido Vélez Efraín O'Neill-Carrillo and Alberto Ramírez, "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks", Proceedings of the 2003 EPNES Workshop, Orlando, Florida, October 23-24, 2003.

32. Tania Martínez-Navedo and Agustín A. Irizarry-Rivera, "Voltage Stability Assessment of an Island's Power System as a Function of Load Model", Proceedings of the Thirty-fifth Annual North American Power Symposium, University of Missouri-Rolla, Rolla, Missouri, October 20-21, 2003.

33. Agustín A. Irizarry-Rivera. "Benefits of Storing Electric Energy from Wind in Puerto Rico", Proceedings of the Caribbean Colloquium on Power Quality (CCPQ), Dorado, Puerto Rico, June 24-27, 2003.

34. Efraín O'Neill Carrillo, Miguel Vélez Reyes, Agustín A. Irizarry-Rivera and Eduardo Marrero. "The Power of Undergraduate Research", IEEE Power and Energy Magazine, Volume 1, Number 4, July/August 2003.

35. Agustín A. Irizarry-Rivera and J.D. McCalley. "Risk of Insecurity", Proceedings of the Euro Conference on Risk Management in Power System Planning and Operation in a Market Environment (RIMAPS 2001), Porto, Portugal, September 8-11, 2001.

36. Efraín O'Neill Carrillo, Agustín A. Irizarry-Rivera and Miguel Vélez Reyes. "Curriculum Improvements in Power Engineering", Proceedings of the Thirty-first ASEE/IEEE Frontiers in Education Conference, Reno, Nevada, October 10-13, 2001.

37. A.A. Irizarry-Rivera, Wenceslao Torres and Efran Paredes. "Evaluation and Technology Review of Energy Storage for the PREPA System", Proceedings of the Electric Energy Storage Applications and Technologies Conference, Orlando, Florida, September 18-20, 2000.

38. A.A Irizarry-Rivera. "Teaching Electric Power System Analysis Using Visually Attractive Tools," Proceedings of the Twenty-ninth ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico November 10-13, 1999.

39. A.A Irizarry-Rivera, Manuel A. Pérez Quiñonez and Rudolph P. Darken. "Using Virtual Worlds to Explore Electric Power Grids and Plants," Proceedings of the Twenty-ninth ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico November 10-13, 1999.

40. L.C. González-Carrasquillo and A.A. Irizarry-Rivera. "Calculation of Capacity Value of a Wind Farm in Puerto Rico's Electric Power System," Proceedings of the Sustainable Applications for Tropical Island States (SATIS '99) Conference, San Juan, Puerto Rico, August 25-27, 1999.

41. A.A. Irizarry-Rivera and Ivette Malpica Crespo. "Monolineal Animado y Equivalente del Sistema Eléctrico Existente en Puerto Rico: Una Herramienta de Enseñanza," Memorias del IX Simposio de Ingeniería Eléctrica, Universidad Central de las Villas, Santa Clara, Cuba, February 24-27, 1999.

42. E. Paredes-Maisonet and A.A Irizarry-Rivera. "Energy Storage Systems to Mitigate Frequency Decline under Generation Deficiency Conditions," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.

43. M. Rodríguez-Fernández and A.A Irizarry-Rivera. "Overview of the Dynamic Performance of a Small Electric Power System in the Presence of Eolic Generation," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.

44. Jiménez-Dávila and A.A Irizarry-Rivera. "Establishment of a Lightning Location System in Puerto Rico," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.

45. L.C. González-Carrasquillo and A.A Irizarry-Rivera. "A Procedure to Determine Wind Power Capacity Value and its Future Application to Puerto Rico's Electric Power System," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.

46. J.D. McCalley, A.A. Fouad, V. Vittal, A.A. Irizarry-Rivera, B.J. Agrawal and R.G. Farmer. ``A Risk- Based Security Index for Determining Operating Limits in Stability Limited Electric Power Systems," IEEE Transactions on Power Systems, Volume 12 , Issue 3 , Aug. 1997, pp. 1210-1219.
47. A.A. Irizarry-Rivera, J.D. McCalley and Vijay Vittal. ``Computing Probability of Instability for Stability Constrained Electric Power Systems," Electric Power Systems Research Journal, Volume 42, Issue 2, August 1997, pp. 135-143.

48. A.A. Irizarry-Rivera, J.D. McCalley and V. Vittal. ``Limiting Operating Point Functions and their Influence on Probability of Instability," Proceedings of the Fifth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Vancouver, British Columbia, Canada, September, 1997.

49. Z. Zhu, S. Zhao, J.D. McCalley, V. Vittal and A.A. Irizarry-Rivera. ``Risk-Based Security Assessment Influenced by Generator Rejection," Proceedings of the Fifth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Vancouver, British Columbia, Canada, September, 1997.

50. Nguyen, A.A. Irizarry-Rivera, J.D. McCalley and V. Vittal. ``Survey Development for Assessing Impact of Power System Disturbances," Proceedings of the Fifth Annual Midwest Electro-Technology Conference, Iowa State University, Ames, Iowa, 1996.

51. A.A. Irizarry-Rivera and J.D. McCalley. ``A Cartesian Product Approach to Determine the Probability of Instability for Stability Limited Electric Power Systems," Proceedings of the Twenty-seventh Annual North American Power Symposium, Montana State University, Bozeman, Montana, 1995.

52. A.A. Irizarry-Rivera, J.D. McCalley, V. Vittal, and A.A. Fouad. ``A Risk-Based Electric Power System Security Index: Moving from Frequency to Probability of Instability," Proceedings of the Fourth Annual Midwest Electro-Technology Conference, Iowa State University, Ames, Iowa, 1995.

53. A.A. Irizarry-Rivera and J.D. McCalley. ``A Security Assessment Approach for Stability-limited Electric Power Systems Using a Risk-based Index," Proceedings of the Thirty-second Annual Power Affiliate Meeting, Iowa State University, Ames, Iowa, 1995.

54. J.D. McCalley, A.A. Fouad, V. Vittal, A.A. Irizarry-Rivera, B.J. Agrawal and R.G. Farmer. ``A Probabilistic Problem in Electric Power System Operation: The Economy-Security Tradeoff for Stability Limited Power

Systems," an invited paper, Proceedings of the Third International Workshop on Rough Sets and Soft Computing, San Jose State University, San Jose, California, 1994.

SELECTED PRESENTATIONS:

1. A. Huamán, A.A. Irizarry-Rivera "Distribution System Hosting Capacity Analysis of Distributed Solar Photovoltaic Systems with Energy Storage in Puerto Rico", University of Alaska, Fairbanks, August 2021

2. D. López, A.A. Irizarry-Rivera "Development of Distribution System Modelling, using OpenDSS, and its Application to a Virtual Power Plant Operation in the Island of Culebra Puerto Rico", University of Alaska, Fairbanks, August 2021.

3. D. Osorio, A.A. Irizarry-Rivera "Distributed Small Solar Farms Impact on Small Islands: Development of a TestBed Platform using DigSILENT", University of Alaska, Fairbanks, August 2021.

4. A.A. Irizarry-Rivera, Ingrid Vila, Cathy Kunkel "Renewable Distributed Solar Resource Integration Study", Puerto Rico Energy Bureau, Public Hearings, February 2021.

5. A.A. Irizarry-Rivera. "Renewables and the Power Sector: Renewable Integration into the Existing Grid, Workforce Development", New England Power Seminar, Avon Old Farms Hotel, Avon, Connecticut, September 21-25, 2015.

6. A.A. Irizarry-Rivera. "Update on Renewables: Context, Solar PV on Islands, Renewable Integration into the Existing Grid, Workforce Development", New York Power Conference, New York Sciences Academy, 7 World Trade Center, Manhattan, New York City, New York, May 14, 2015.

7. Armando Figueroa, A.A. Irizarry-Rivera. "Requisitos de Reserva Operacional de un Sistema de Potencia Eléctrica con Significativa Generación Renovable", Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Viernes 360-Centro de Convenciones, San Juan, Puerto Rico, May 16, 2013.

8. A.A. Irizarry-Rivera, E. O'Neill-Carillo. "Streamlined and Standardized Permitting and Interconnection Processes for Rooftop Photovoltaic Systems in Puerto Rico", Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Casa Capitular Calle Obispado, Mayagüez, Puerto Rico, May 14, 2013.
9. A.A. Irizarry-Rivera. "¿Cuál Crisis Energética? El uso racional de la energía y renovables", Convención de la Sociedad de Planificadores de Puerto Rico, Sede del Colegio de Arquitectos y Arquitectos Paisajistas, Calle del Parque 255, San Juan, Puerto Rico, November 14, 2012.

10. A.A. Irizarry-Rivera. "Generación Eólica: El Debate de Comida vs. Energía", Escuela de Leyes, Pontificia Universidad Católica de Ponce, March 20, 2012.

11. A.A. Irizarry-Rivera. "Concentrated Solar Thermal Electricity Production: Principles, Resource and Technology", Brickell Avenue Business Interruption and Energy Conference (BABIEC), JW Marriot, Miami, October 27-28, 2011.

12. A.A. Irizarry-Rivera. "Wave to Wire: An Overview of Electricity Generation from Waves; Resource, Technology, System Integration and Economics", New York Power Conference, Downtown Conference Center at Pace University, Manhattan, New York City, New York, May 19, 2011.

13. A.A. Irizarry-Rivera. "The estate vs. the citizens: Crisis (mis)management in education and energy", Lucidity and Engagement: The UPR Strikes (2010-2011) and Academic Activism in Puerto Rico (Part 2), A panel session in the American Ethnological Society (AES) and the Society for Urban, National and Transnational Anthropology (SUNTA) Meeting, Caribe Hilton Hotel, San Juan, Puerto Rico, April 15, 2011.

14. A.A. Irizarry-Rivera. "Recurso Solar en Puerto Rico y la Tecnología Solar Térmica para la Producción de Electricidad", Universidad Interamericana Recinto de Guayama, April 8, 2011.

15. A.A. Irizarry-Rivera. "A usar el español en la investigación tecnológica: reflexión de un ingeniero a su regreso de Andalucía", Universidad de Puerto Rico, Mayagüez, Octuber 12, 2010.

16. A.A. Irizarry-Rivera. "Achievable Renewable Energy Targets for Puerto Rico", Universidad Interamericana Recinto de Guayama, April 15, 2010.

17. A.A. Irizarry-Rivera. "Renewable Portfolio Standards", Convención Anual Colegio de Químicos de Puerto Rico 2007, Puerto Rico Conventions Center, August 10, 2007.

18. A.A. Irizarry-Rivera. "Alternativas Energéticas Sostenibles. Energía Solar: Termal y Fotovoltaica", Convención Anual Colegio de Ingenieros y Agrimensores de Puerto Rico 2007, Cambio Climático: Ingeniería, Agrimensura y Sostenibilidad, Hotel El Conquistador, Fajardo, Puerto Rico, August 3, 2007.

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20. A.A. Irizarry-Rivera. "Energía Eólica", Mega Viernes Civil, Seminario de Diseño y Construcción Verde del Instituto de Ingenieros Civiles, Colegio de Ingenieros y Agrimensores de Puerto Rico, Centro de Convenciones de Puerto Rico, May 18, 2007.

21. A.A. Irizarry-Rivera. "Generación Eólica y Solar: Fotovoltaica, Termal", Tercera Reflexión Ambiental, Foro de Desarrollo de Energía Sustentable, Teatro de la Universidad de Puerto Rico, Río Piedras, April 18, 2007.

22. A.A. Irizarry-Rivera & Gerson Beauchamp "Generación Fotovoltaica para Puerto Rico", Workshop sponsored by the Alianza Ciudadana para Educación en Energía Renovable (ACEER), Centro Cultural de Mayagüez, April 21, 2007.

23. A.A. Irizarry-Rivera. "Costo de la generación eólica y ahorro por desplazamiento de generación", Conference sponsored by the Puerto Rico Chamber of Comerce, Hotel Condado Plaza, San Juan Puerto Rico, February 21, 2007.

24. A.A. Irizarry-Rivera. "Energía eléctrica en Puerto Rico: generación, transmisión y conservación", Workshop sponsored by the Alianza Ciudadana para la Educación en Energía Renovable (ACEER), Centro Cultural de Mayagüez, February 3, 2007.

25. A.A. Irizarry-Rivera and E. Juan-García "Electrical Shock and Trauma: Causes, Mechanisms of Injury and Case Studies", Workshop sponsored by the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Mayagüez, November 8, 2005.

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27. A.A. Irizarry-Rivera. "Environmental Impact of Eolic Power", Sustainable Energy Workshop sponsored by the Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Headquarters, May 19, 2004.

28. A.A. Irizarry-Rivera. "Electricity Hazards", Energy Systems Seminal Series (ES^3) Electrical and Computer Engineering Department, University of Puerto Rico, Mayagüez, March 30, 2004.

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30. A.A. Irizarry-Rivera. "Future Power Systems", Industry University Symposium on Electrical Engineering, sponsored by the Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Headquarters, November 14, 2003.

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32. A.A. Irizarry-Rivera. "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks: First Year Progress Report", Electric Power Networks Efficiency and Security (EPNES) Workshop, sponsored by the National Science Foundation (NSF), Orlando, Florida, October 23-24, 2003.

33. A.A. Irizarry-Rivera. "Eolic Generation", Energy Forum sponsored by the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Hotel Wyndham El Conquistador, August 1st, 2003.

34. A.A. Irizarry-Rivera. "EPNES: Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks", Modernizing the National Grid Workshop, sponsored by the National Science Foundation (NSF), New Orleans, Louisiana, November 18-19, 2002.

35. A.A. Irizarry-Rivera. "Puerto Rico SMES Project", Puerto Rico Chamber of Commerce and Guests, Puerto Rico Chamber of Commerce Headquarters, Old San Juan, Puerto Rico, January 28, 1998.

GRADUATE THESES and PROJECTS SUPERVISED:

1. Anny Huamán. "Electric Distribution System Hosting Capacity Analysis of Distributed Solar Photovoltaic Systems with Energy Storage in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

2. Daniel López. "Virtual Power Plant Operation of Distributed Photovoltaic Systems with Batteries in the Island of Culebra Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

3. David Osorio. "Small Solar Farms Impact on the Stability of Electric Power Systems of Small Islands", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

4. Carlos García. "Ocean Wave Energy into Electricity Using Point Absorbers in the North Coast of Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.

5. Karen Montaño. "Characteristics of Electric Batteries for Residential Use and Better Integration with the Electric Distribution System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2018.

6. Laura Adarme. "Feasibility of Linear Fresnel Solar Thermal Generation in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2018.

7. José Matagira. "Feasibility of Micro Pumped Hydro Storage for Photovoltaic Energy", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2016.

8. Luis de Jesús. "Design and Characterization of Fresnel Solar Concentrator for Solar Thermal Drying of Coffee in Puerto Rico", ME Report, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2014.

9. Armando Figueroa. "Requisitos de Reserva Operacional de un Sistema de Potencia Eléctrica con Significativa Generación Renovable", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2013.

10. Felipe Hernández. "Feasibility of Dish/Stirling Solar Thermal Generation in Puerto Rico and in the Dominican Republic", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2012.

11. Franchesca Aponte. **"**Ocean Wave Energy into Electricity Using Offshore Wave Energy Devices in the North Coast of Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.

12. Magaby Quintero. **"**Ocean Wave Energy into Electricity Using Shoreline Devices in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.

13. Miguel Rios**.** "Small Wind / Photovoltaic Hybrid Renewable Energy System Optimization", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2008.

14. Linda Monge. "Effect of Distributed Energy Storage Systems in Voltage Stability of an Island Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2006.

15. Jennifer Jiménez. "Benefits of Electric Generation Displacement Using Solar Thermal Water Heating", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

16. Carlos Ramos. "Determination of Favorable Conditions for the Development of a Wind Power Farm in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

17. Carlos Torres. "Failure Probability of Intelligent Power Routers", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

18. Orlando Leal Flores. "Analysis and Simulation of EM Fields of a Permanent Magnets DC Linear Motor used to Propel a Magnetically Levitated Train", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2004.

19. Tania Martínez Navedo. "Voltage Stability Assessment of an Island Power System as a Function of Load Model", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2002.

20. Jorge Valenzuela Valenzuela. "Development of Small Signal Analysis Tools to Study Power System Dynamics Using Simulink", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2001.

21. Ismael A. Jiménez Dávila. "Calibration of Magnetic Finder System for Lightning Location Using AM Carrier Signals", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.

22. Francisco Quiles Torres. "Identifying Electrical Needs and Implementing Improvements on the Main Power Substation of a Manufacturing Plant", ME Project, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.

23. Luis C. González Carrasquillo. "A Procedure to Determine Wind Power Capacity Value and its Future

Application to Puerto Rico's Electric Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.

24. Efran Paredes Maisonet. "Determination of Required Rapid Response Spinning Reserve to Avoid Under frequency Load Shedding under Generation Deficiency Conditions in Puerto Rico's Electric Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 1999.

25. Mireya Rodríguez Fernández. "Power System Dynamic Analysis for the Integration of Wind Farms to Puerto Rico's Electric Grid", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 1999.

HONORS AND OTHER PROFESSIONAL ACTIVITIES:

- Recipient "Ingeniero Electricista Distinguido 2013" (Distinguished Electrical Engineer 2013) from the Mayagüez Chapter of the Puerto Rico Professional Engineers Society (Capítulo de Mayagüez del Colegio de Ingenieros y Agrimensores de Puerto Rico) - In recognition of services rendered to the profession, achievements in engineering education and his performance as Vice-President of the Puerto Rico Electric Power Authority Board of Directors.

- Recipient "2010 Distinguished UPRM Alumni" from the University of Puerto Rico Mayagüez Alumni Association.

- Recipient "Ingeniero Electricista Distinguido 2005" (Distinguished Electrical Engineer 2005) from the Electrical Engineering Institute of the Puerto Rico Professional Engineers Society (Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico) - In recognition of services rendered to the profession and outstanding professional achievements in the field of electrical engineering.

- Recipient "2004 Professional Progress in Engineering Award" (PPEA) from Iowa State University

  PROFESSIONAL PROGRESS IN ENGINEERING AWARD - Established in 1988

  In recognition of outstanding professional progress and personal development in a field of engineering specialization as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership position. There shall also be evidence of recognition through citations and acceptance of achievements by colleagues, and of the promise of continued progress and development.
- Recipient "2003-2004 Electrical and Computer Engineering Outstanding Faculty Award" from the School of Engineering, Mayagüez, Puerto Rico

- Recipient ``Iowa State University Research Excellence Award'' for Ph.D. dissertation

- Registered Professional Electrical Engineer in Puerto Rico (6/91) and Member of the "Colegio de Ingenieros y Agrimensores de Puerto Rico"

- Magna Cum Laude – BSEE, University of Puerto Rico, 1988

- Member Institute of Electrical and Electronic Engineers (IEEE) - Power Engineering Society and Faculty Advisor of the Power Engineering Society Student Chapter at the University of Puerto Rico Mayagüez

- Advocate – American Wind Energy Association

- Engineering Futures Facilitator and Member of Tau Beta Pi the National Engineering Honor Society. (06/98 – 06/08) Principal Faculty Advisor of Puerto Rico's Tau Beta Pi Alpha Chapter, (06/08 - present) Faculty Advisor of Puerto Rico's Tau Beta Pi Alpha Chapter

SERVICES RENDERED TO THE PROFESSION

- Member of the Energy Committee of the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico").

- Member of the AD HOC Committee for Renewable Energy and Climate of the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico").

- Instructor of Continuous Education Courses at the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico")

- Member of the AD HOC Committee to Evaluate the Technical Administration of the Puerto Rico Electric System by the Puerto Rico Electric Power Authority during the Tropical Storm (TS) Jeanne of September 15, 2004 - The official state inquiry by the CIAPR into what caused a general electric blackout in the Island of Puerto Rico during Tropical Storm Jeanne. It is part of the CIAPR public responsibility to conduct such inquiries when technical matters are in dispute. Responsibilities included: analysis of technical evidence, as submitted by PREPA, of the power system state and behavior as TS Jeanne crossed over Puerto Rico, the formulation of a hypothesis to explain such behavior, and to judge the decisions made on the administration of the power system during the storm.

EXAMPLES OF UNDER GRADUATE RESEARCH and DESIGN PROJECTS:

1. **Design of the Distribution System for an Eolic Generation Park**. The complete design of the Distribution System for an Eolic Generation Park. This included the decision to install an aerial or underground system and specification of: transformers, conductors, protection system, grounding system, conduits, junction boxes, lighting protection and design of the substation to connect the eolic park with the local electric utility. Other requirements included: estimate of materials and construction costs, a construction and project management schedule and analysis to determine the required reactive compensation. Students: Franchesca Aponte Santiago, Dumeng Roman Johana, Melissa Hernandez Bernier, Erika Padilla Ocasio, Magaby Quintero Lopez, Marilyn Ramirez Alvarado, Sharlene Rivera Gonzalez, Rodolfo Morales Medina and Giancarlo Santos Santiago.

2. **Environmental and infrastructure impact of eolic generation in Puerto Rico**. The study of key aspects of eolic generation and their environmental impact with emphasis in: noise, electromagnetic interference, avian issues and aesthetic considerations. Student studied the infrastructure impact of eolic generation projects specifically on roads, sea ports and sea bottom. Students were aware of socio-economic and political considerations and implications on eolic generation projects. Students: Camille T. Ocasio, Verónica Narváez and David Marrero.

3. **Design Projects in Power Electronics: Design, Simulation, Fabrication and Test of Brushless Commutator for Permanent Magnets DC Motors**. Project involved the preliminary design of a brushless commutator including computer simulations of the proposed circuit, identification of components to be used including component costs and manufacturer data, necessary tools and materials needed to construct and test the commutator, and detailed work schedule of the steps needed to complete the design and prototype construction tasks. A working prototype and documented results of tests performed to the prototype to ensure its compliance with design specifications was required.

Proposed modifications to solve any problems found during testing, computer simulations of the proposed modifications to the commutator circuit were also required. Students: Noel G. Figueroa Urdaz, Camille Guzmán Torres, Lourdes Orona Jiménez, José J. Rodríguez Alvarez, Reyes M. Ruiz Donate, José L. Valenzuela Rivera and Miguel D. Vázquez Peña.

4. **Development of an Animated One-line Equivalent of Puerto Rico's Existing Electric Power System**. Project involved the use of the commercially available **PowerWorld Simulator**, a user-friendly, highly interactive package for engineering analysis, to develop a one-line equivalent of Puerto Rico's existing electric power system. The animated and graphical one-line equivalent of Puerto Rico's electric system is geographically accurate as well as electrically equivalent to the generation and transmission (115 kV and above) of the Puerto Rico Electric Power Authority (PREPA). This equivalent has being used by engineering students to study the behavior of Puerto Rico's electric power grid under a variety of system conditions. It will also provides an excellent teaching tool to demonstrate the principles of electric power flow, voltage profiles and their relation to reactive power, economic dispatch and steady-state system security. Students: Ivette Malpica

5. **Using Virtual Worlds to Explore Electric Power Grids and Plants.** Virtual worlds provide the capability of visiting spaces difficult to explore because of: time constraints, natural hazards, and cost of accessibility or access restrictions. Electric power system courses are constrained to show primary components of a power system using drawings and photos. Development of virtual worlds tailored to suit the topic being discussed is an attractive solution. Student may browse around the system learning as they go along. They provide motivation and the electric utility may use these tools to familiarize new personnel with their system and inform and educate non-technically trained decision- makers using accurate and visually attractive presentations. Two undergraduate students participated in the project developing virtual worlds of a power plant. Students: Iomar Vargas and Emmanuel Arzuaga.

OTHER PROFESSIONAL EXPERIENCE

- (2006) Implementation Specialist – Alliance for the Strengthening of Mathematics and Science Teaching (AFAMaC): An Alliance among the Puerto Rico Department of Education and University of Puerto Rico Mayagüez (UPRM) to professionally advance Mathematics and Science school teachers of 7th, 8th and 9th grade in three Educational Districts; Mayagüez, Moca and San Sebastian. The primary goal of the project is to improve knowledge and practice of Mathematics and Science teachers thru summer and weekend long internships at the UPRM taking courses that will focus on content (Math, Physics, Chemistry, Geology, Basic Engineering, and Information Technology) rather than teaching methods.

- (01/03) Consultant – Engineering evaluation of electrical installation at a private residence in Mayagüez, Puerto Rico. Identified electrical design deficiencies and failures to comply with the National Electric Code.

- (05/98 – 08/98) Consultant – Electric Energy Audit and Consumption Estimates for a small Hotel in Aguadilla, Puerto Rico. Analyzed electric bills and estimated energy consumption of the Hotel including internal generation to settle a billing dispute between the Hotel Management and the Puerto Rico Electric Power Authority.

- (02/98 – 04/98) Consultant – Redesign the electric distribution system of a Trailer Camp Facility in La Parguera, Puerto Rico.

- (1/94 - 5/96) Computer Network System Administrator at Iowa State University, Ames, Iowa
  Performed software and hardware system administration for UNIX workstation network serving 50 users.

- (7/93 - 10/96) Research Assistant at Iowa State University, Ames, Iowa

- Developed a risk-based method to assess security and determine operating limits for electric power systems, a project sponsored by Electric Power Research Institute (EPRI).
- Utilized state of the art industry-grade power systems software applications (power flow, stability, etc).
- Performed large scale system studies of WSCC network
- Supervised two undergraduate students in their undergraduate research projects

- (8/90 - 6/93) Assistant Researcher at the University of Puerto Rico, Mayagüez, Puerto Rico

  Administered the optics and laser facilities of the Physics Department and supervised authorized personnel in the operation of the equipment

- (9/89 - 2/90) Research Assistant at the University of Michigan, Ann Arbor, Michigan

  Developed a novel and simple technique to create an optical source capable of providing high peak power at a desired frequency or a short pulse with a tunable, spectrally pure frequency

- Summer Intern at Aluminum Company of America, ALCOA Center, Pennsylvania

  - (5/90 - 7/90) Characterized electromagnetic field properties of electromagnetic acoustic transducers and eddy current sensors
  - (5/89 - 8/89) Implemented the Digital Holographic Interferometry Technique for surface displacement measurements
  - (6/88 - 8/88) Implemented the Synthetic Aperture Focusing Technique for ultrasonic testing using an HP1000 computer
  - (6/87 - 8/87) Designed, fabricated and analyzed electromagnetic acoustic transducers

ADDITIONAL EDUCATIONAL INFORMATION:

Graduate Coursework:

23 hours in Power Systems, 23 hours in optics, 12 hours in electromagnetics, 9 hours in Control Systems, 12 hours in Math and 9 hours in probability and statistics.

Salient Ph.D. Research Contributions:

- Developed a method that allows risk-based security assessment in an operating environment considering any type of security violation.
- Developed, using probability theory, expressions to calculate the conditional probability of insecurity given a fault occurs for thermal overloads and transient instability.
- Developed a method to generate risk-based operating limits in terms of parameters available to system operators, illustrated using nomograms based on risk rather than deterministic limits. The change from deterministic to risk-based operating limits is transparent to system operators since they just see new nomograms or tables.
- Investigated the effect of conventional protection systems on risk of an operating point.

Participated in investigation of the effect of special protection schemes on risk of transient instability.

Exhibit 2

LUMA Performance Targets Report

Expert Report of Agustín Irizarry-Rivera Pursuant LUMA's Performance Targets

Submitted to the
Puerto Rico Energy Bureau

November 16, 2021

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I. Introduction

The following organizations: Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc.-Enlace de Acción Climática, Comité Yabucoeño Pro-Calidad de Vida, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Sierra Club Puerto Rico, Inc., Mayagüezanos por la Salud y el Ambiente, Inc., Coalición de Organizaciones Anti Incineración, Inc., Amigos del Río Guaynabo, Inc., and other parties-in-interest in this case, have asked that I prepare a report and recommendations for performance-based metrics, penalties, and incentives to apply to LUMA, designed to improve the performance of Puerto Rico's electricity grid.

I have been asked to assess the actual "performance metric" structure proposed by LUMA and how it compares with performance-based incentives in the electric utility business. I have also been asked to assess if the proposed Performance Targets will "transform the Puerto Rico energy system into a modern, sustainable, reliable, efficient, cost-effective, and resilient system" which are the goals of Law 120. Law 120 is the law that gives rise to the LUMA contract.

The goals presented in this report, and the metrics put forward, fit well within the transformation required by Law 120 and Law 17-2019

I encourage the Puerto Rico Energy Bureau to follow the same path other regulators have followed and open a truly participative process to determine specific, measurable, objectives and propose metrics to measure progress toward these objectives. These metrics should incorporate both rewards for exceeding expectations and penalties for not achieving the expected.

Based on the comparison of what LUMA proposes and actual best practices I present a series of examples of performance-based incentives that are currently in used in other jurisdictions. Finally, I study and evaluate the performance metrics proposed by LUMA, with emphasis on reliability indices.

A. Conclusions and Recommendations

My main conclusions are:

Conclusion 1 – LUMA's performance metrics, if achieved, would only result in reasonable 20th century utility service for Puerto Rico. Additional metrics are necessary to incentivize the transformation required by Law 17, Law 120, and the Transmission and Distribution Operations & Maintenance Agreement, to achieve a 21st Century electric grid.

Conclusion 2 – LUMA's metrics, in contrast to performance metrics in other jurisdictions, include no penalties for underperformance, which is particularly problematic given that service deterioration is already evident in certain areas. With respect to some metrics, LUMA proposes to be rewarded for meeting basic expectations.

My recommendations are:

Recommendation 1 – The Bureau should consider additional metrics to incentivize the transformation to a "modern, sustainable, reliable, efficient, cost-effective, and resilient system." I recommend the adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

Recommendation 2 - I also recommend that the Bureau open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives.

Recommendation 3 – In developing metrics, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. LUMA itself has acknowledged the possibilities of errors and biases affecting the calculation of reliability indices. At a minimum, the Bureau should require public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

Recommendation 4 – Penalties should be included in performance metrics that would be triggered if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.

Recommendation 5 - I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. Instead, a failure to stay within budget should reduce or eliminate LUMA's ability to achieve incentives in other categories.

Recommendation 6 - I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

Recommendation 7 – The PREB should adopt metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" from the Long Island Power Authority's contract with PSEG in the performance-based mechanism to be applied to LUMA.

Recommendation 8 - If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.**

Recommendation 9 - Finally, I recommend that performance metrics adopted by the PREB should be true performance based, where rewards and penalties are clearly defined. This should be adopted regardless of the "fix fee + additional fee" structure of the existing Contract between

LUMA and PREPA. A “fixed fee” compensation structure is contradictory to the purpose of a rewards and penalties system, since a fixed fee structure promotes underachievement.

A description of my qualifications is available in Section VII of this Report.

II. The concept of performance-based metrics

a. Why performance metrics?

The people of Puerto Rico have goals that we want to achieve sooner rather than later.

Goals are general guidelines while objectives define strategies or implementation steps to attain the identified goals. Objectives are specific, measurable, and have a defined completion date.

A well-structured "Performance Incentive Mechanism" may help to define objectives, and execute actions, to achieve our goals sooner rather than later.

Performance-based regulation is a regulatory framework that recognizes that the traditional utility business model incentivizes capital investment and increased sales, which is not necessarily aligned with public policy objectives, the interests of consumers or environmental protection. [1]

How is performance-based regulation new? It is new because it departs from the way utilities were compensated in the 20th Century. The 20th Century electric utility industry was limited to one technological solution that was economic: centralized generation and long transmission lines to deliver energy to the distribution system where citizens were using electricity. This required large capital investment that could only be financed thru public investment (public power or municipal entities) or cooperative arrangements (coop power, ultimately publicly financed by federal loans[2] in the United States) or private investment. But private investment, and public power when investment was done via issuing bonds, was only available if investment was a "pass thru" via pre-approved rates that would cover the debt with investors (or bond holders) and offer a private utility an opportunity to earn a rate of return for shareholders (a structure very close to "cost plus").

This private financing structure requires strict government regulation to ensure achievement of several key goals: adequacy of energy supply[3], reliability, affordability of electric service and

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[1] "Performance-based Regulation: Aligning Utility Incentives with Policy Objectives and Customer Benefits" B. Stafford and L. Frantzis, https://blog.aee.net/performance-based-regulation-aligning-utility-incentives-with-policy-objectives-and-customer-benefits Oct 11, 2017.

[2] Rural electric cooperative power plants financed almost exclusively by loans from the Rural Utilities Service (USDA).

[3] The North American Reliability Corporation (NERC) traditional definition of "reliability" was ubiquitous throughout the electric utility industry, and consists of two fundamental concepts: adequacy and operating reliability:
Adequacy is the ability of the electric system to supply the aggregate electric power and energy requirements of the electricity consumers at all times, considering scheduled and reasonably expected unscheduled outages of system components.
Operating reliability is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system components. "Operating reliability" is a new term, as in the past this was called "security". NERC had used the term "security" until September 2001 when security became synonymous with US homeland protection in general and critical infrastructure protection in

protection of the consumers from the monopoly power of the, usually one, energy provider. The utility revenues are collected thru pre-approved recovered costs. Since rates are set on a per unit of energy sold utilities are incentivized to drive up energy consumption to increase revenue and profit.

In the 21st Century utility the traditional goals of adequacy, reliability, affordability of electric service and protection of the consumers from the monopoly power of the energy provider continue but we add specific outcomes defined by stakeholders and policymakers. Some of these outcomes are at odds with the traditional utility goals of maximizing utility-owned capital investment and increasing sales. The financial structure used to compensate the utility needs to change, and incentives must be designed to achieve objectives, thus the performance-based regulation and performance-based metrics.[4] Incentives may be structured as positive (bonus) or negative (penalty).

Figure 1. Performance-based metrics zones.

Performance-based mechanisms encompass three basic "zones": penalties for underperformance ("does not meet expectations"), a deadband[5] around adequate performance ("meets expectation" or doing your job), and incentives for excellence ("exceed expectations").

As discussed in the second half of my testimony, LUMA suggests receiving a bonus by achieving the expected and not being penalized if it fails to meet expectations – as it has failed to do in numerous metrics to date.

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particular. Source: North American Electric Reliability Corporation (NERC), Definition of "Adequate Level of Reliability", Operating Committee and Planning Committee, December 2007.

[4] Performance-based Regulations: Aligning Utility Incentives with Policy Objectives and Customer Benefits, B. Stafford and L. Frantzis, Advanced Energy Perspectives, https://blog.aee.net/performance-based-regulation-aligning-utility-incentives-with-policy-objectives-and-customer-benefits.

[5] PREB describes this concept as follows: "Deadbands create a neutral zone ... in which the utility does not receive a reward or penalty." PREB May 21, 2021 Resolution and Order, PREB Docket NEPR-MI-2019-0007, pp. 5-6.

Experience from other jurisdictions may serve as a guideline for designing performance-based incentives in Puerto Rico.[6] In particular, Hawaii is implementing performance-based regulation[7], and performance-based incentives are also included in the operation & maintenance agreement of the Long Island Power Authority, often held up as a model for the PREPA T&D privatization.[8]

I encourage the Puerto Rico Energy Bureau to follow the same path other regulators have followed and open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives. These metrics should incorporate both rewards for exceeding expectations and penalties for not achieving the expected.

III. Law 120 goals and performance metrics

Puerto Rico Law 120 was enacted with the objective to "transform the Puerto Rico energy system into a **modern, sustainable, reliable, efficient, cost-effective, and resilient system**". The contract between LUMA and PREPA on its Recitals quotes the purpose of Law 120 that gives rise to the contract:

WHEREAS, in accordance with Act 120, Owner[9] desires to transform Puerto Rico's energy system into a modern, sustainable, reliable, efficient, cost-effective and resilient system;

The Puerto Rico Legislature recognized that performance-based mechanisms could help achieve this transformation, and in law 17-2019 set forth the following criteria to evaluate performance-based mechanisms:

1) the volatility and affordability of the electric power service rates;
2) the economic incentives and investment payback;
3) the reliability of the electric power service; customer service and commitment, including options to manage electric power costs available to customers;
4) customers' access to the electric power companies' information systems including, but not limited to, public access to information about the aggregated customer energy and individual consumers' access to the information about their electric power consumption;
5) compliance with the Renewable portfolio standard and rapid integration of renewable energy sources, including the quality of the interconnection of resources located in consumers' properties;
6) compliance with metrics to achieve the energy efficiency standards established in this Act;
7) infrastructure maintenance.

[6] David Littell et al, Next-Generation Performance-Based Regulation: Volume 3 (Innovative Examples from Around the World), May 30, 2018, https://www.raponline.org/knowledge-center/next-generation-performance-based-regulation-volume-3-innovative-examples-from-around-the-world/.
[7] Public Utilities Commission Docket 2018-0088 Decision and Order 37787 "Instituting a Proceeding To Investigate Performance-Based Regulation".
[8] Appendices to Amended and Restated OSA, https://www.lipower.org/wp-content/uploads/2016/10/Appendices2-14.pdf.
[9] In the contract PREPA is identified the "Owner". Transmission and Distribution System Operation and Maintenance Agreement, June 22, 2020, at p. 1.

In this section, I examine the goals of law 120 and possible performance metrics to measure progress towards those objectives, considering also the additional criteria outlined by Law 17-2019.

A. A modern electric system

In a traditional, 20th Century, electric power system the architecture was based on large-scale generation; centralized, a one-way control strategy of the system; and passive loads. The traditional system was not designed to meet many emerging trends, such as greater adoption of relatively low inertia generation sources, increasing penetration of distributed generation resources, and the need for greater resilience due to climate change.

A modern electric power system must be flexible, robust, agile. It must have the ability to dynamically optimize grid operations and resources, rapidly detect and mitigate disturbances, integrate diverse generation sources, on both the supply and demand sides, integrate demand response and energy-efficiency resources, enable consumers to manage their electricity use, and provide strong protection against physical and cyber risks.[10]

A modern electric power system must include more distributed control, two-way flows of electricity and information, more energy storage, more energy justice, more sustainable sources of energy, and consumers as energy producers thru assertive deployment of resilient and distributed renewable energy resources and as participants of demand management and efficient use of electricity programs.[11]

Utilities must work to increase ***the value of the services they provide to citizens***. Effective grid modernization will increase the perceived value of the electricity service for customers, reducing the likelihood they want to take their demand elsewhere by going off-grid. This value comes from enabling the platform functionalities that increase efficiency, allowing storage and renewables to enter the market, and facilitating customer bill control.

Regardless of personal preferences the "power system of the future" has been driven by a complex set of trends. Among these are: renewable energy cost reductions, including for distributed generation and battery storage; energy security, reliability, and resilience goals; evolving customer engagement; the trend of decreasing energy needs for many utilities (decreasing demand forecast); local and global environmental concerns; energy justice

[10] Quadrennial technology review: An assessment of Energy Technologies and research opportunities, Chapter 3: Enabling Modernization of the Electric Power System, September 2015.
[11] International Energy Agency. "Technology Roadmap: Smart Grid." OECD/IEA. Paris, France, 2011. https://iea.blob.core.windows.net/assets/fe14d871-ebcb-47d3-8582-b3a6be3662ba/smartgrids_roadmap.pdf.

imperatives; innovations in data, intelligence, and system optimization; revenue and investment challenges.[12]

a. Examples of performance areas

Synapse Energy Economics prepared a Handbook on Utility Performance Incentive Mechanisms, which offers the following table of metrics that track traditional performance areas:

Table 1. Traditional performance areas[13]

performance dimension	Purpose
Reliability	service is reliable and interruptions are remedied quickly
Employee Safety	employees are not subjected to excessive risks
Public Safety*	the public is not subjected to excessive risks
Customer Satisfaction	the utility is providing adequate levels of customer service
Costs	Indicates the cost of supply side resources

* Notably absent from the performance metrics proposed by LUMA

Most of LUMA's proposed metrics fall into this "traditional" categories rather than modern performance areas. Notably, though, LUMA does not propose any metrics to track the risks imposed on the public.

Modern performance areas[14], shown in Table 2, also include:

Table 2. Modern performance areas[15]

performance dimension	Purpose
System Efficiency	the utility system as a whole is being operated more efficiently
Customer Empowerment	customers are participating in demand- side programs or installing demand-side resources
Network Support Services	customers and third-party service providers have access to networks and utility information
Environmental Goals	the utility and its customers are reducing environmental impacts, particularly related to climate change
Resiliency	Modern technological options, such as distributed renewable energy plus storage, are used, and even encouraged, by the utility to provide continuity of basic electric services under stressed grid conditions

[12] "Power Systems of the Future", National Renewable Energy laboratory (NREL) Technical Report NREL/TP-6A20-62611 February 2015.
[13] See Utility Performance Incentive Mechanisms: A Handbook for Regulators, Synapse Energy Economics, Table 3, Traditional Performance Areas. https://www.synapse-energy.com/sites/default/files/Utility%20Performance%20Incentive%20Mechanisms%2014-098_0.pdf ("Synapse Handbook"). Attached as Exhibit 3 to Expert Testimony.
[14] These are in addition to traditional performance areas which still apply.
[15] See Synapse Handbook Table 4, Emerging Performance Areas, *supra*.

Within these modern performance areas, other jurisdictions are proposing new metrics to measure how well utilities meet evolving customer needs. Examples of existing or proposed performance metrics in other jurisdictions are shown in Table 3 below.

Table 3. Existing or proposed performance metrics in other jurisdictions

Metric	adopted, or considered, by
Peak load reductions	Illinois
Stakeholder engagement	Illinois, Hawaii
Customers accessing energy usage portals	Illinois
Effective resource planning	Hawaii
System load factor	Illinois
Line loss reductions	UK, Illinois
Distributed generation interconnections	UK, Illinois, Hawaii
Cost of renewable energy	California
Carbon intensity	Hawaii
Renewable energy curtailments	Hawaii

Metrics from Hawaii are especially relevant here, as PREB has determined that Hawaii Electric Light Company and Hawaiian Electric Company share several elements with PREPA and should be considered a useful peer utility.[16]

B. A sustainable electric system

The most often quoted definition of sustainability comes from the UN World Commission on Environment and Development: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[17]

The US Environmental Protection Agency (EPA) states "To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations."

Therefore, the use of energy is considered sustainable if it meets the needs of the present without compromising the needs of future generations.

Sustainability objectives may include:

- Compliance with robust energy efficiency and demand response targets. Simple yet significant changes such as high-efficiency appliances and lighting, like LED light bulbs, which use between a fifth or a sixth of the energy of a comparable incandescent bulb, have been embraced by consumers. PREB has recognized this objective and set metrics to

[16] PREB May 2021 Resolution and Order on Final Performance Baseline data and Benchmarks, Docket NEPR-MI-2019-0007, p. 8.
[17] "Our Common Future" (Brutland Report) United Nations World Commission on Environment and Development, October 1987.

achieve it – for example, the amount and percentage of customers with advanced meters, and savings from energy efficiency programs.[18] Metrics could also include steps to raise customer awareness of energy efficiency and demand response programs, perhaps by including information in the bills that customers receive each month from LUMA.

- Rapid integration of renewable energy, particularly rooftop photovoltaic (PV) solar panels which require much less distribution infrastructure than centrally located power stations. Law 17-2019 requires PREB to consider renewables integration when setting performance-based penalties and incentives for LUMA – and specifically highlights "the quality of the interconnection of resources located in consumers' properties."[19] To meet this requirement, PREB's May Order set a baseline of 3% generation from renewable power purchase agreements, and a benchmark of 40% by 2025 – including distributed renewables.[20] Beyond 2025 - grid modeling has demonstrated the feasibility of integration of 75% distributed renewable energy in Puerto Rico with only modest improvements to the distribution system.[21] Rapid integration of distributed solar resources is currently being stymied by LUMA's failure to both rapidly process new interconnection applications and to deal with the backlog of rooftop solar plus storage systems awaiting interconnection. PREB has recognized interconnection as a problem that could be solved through performance-based penalties and incentives – PREB has sent LUMA several requests of information in this proceeding related to LUMA's work to reduce the backlog.[22] LUMA's efforts should be measured through a performance metric – and penalized if both the backlog is not resolved in a timely fashion and a new, expedite, process to manage new applications is not quickly implemented by LUMA.

- Deployment of electric vehicle charging infrastructure. Along with increased energy sales, utilities may sell charging *as a service*, whether through owning the EV charging infrastructure, buying and selling the energy that powers the vehicles, or as a platform for optimizing EV charging. Again, LUMA could aid these efforts by making customers aware of these services through information in monthly bills.

Another essential dimension of sustainability is public safety. As detailed further below, public safety measures are absent in LUMA's proposal of performance metrics.

Since the standard business model for private utilities revolves in part around building new capital-intensive infrastructure, sustainability measures that reduce the need for such infrastructure

[18] PREB May 21, 2021 Resolution and Order, Attachments B and C.
[19] Law 17-2019 Section 5.21(e)
[20] PREB May 21, 2021 Resolution and Order Attachment A.
[21] "Estudio de Integración de Recursos Eléctricos Distribuidos", Informe Final. Disponible en https://cambiopr.org/solmastechos/#downloads.
[22] LUMA's responses and Objections to PREB's First Request for Information are attached as Exhibit 4 to the Expert Testimony.

means lower revenues and less profit for investors. For this reason, a private entity may not fully embrace sustainable solutions. A significant number of electric utilities are not moving toward a sustainable future since they are not adapting to disruptive technologies that may significantly reduce customers' dependence on electric utilities.[23] LUMA's contract does not prohibit subcontracting federal funds to its affiliate companies, which are mainly transmission and distribution system construction companies, not renewable energy companies; thus LUMA too has an incentive not to pursue sustainable solutions. In fact, LUMA's parent company plans to seek contracts in Puerto Rico for its affiliates.[24]

Performance-based incentives are needed to realign utility business practices in favor of sustainable technologies.

a. Examples of metrics to achieve the goal of a sustainable electric system

Integration of renewable energy, energy efficiency, demand response, public safety and environmental metrics are essential to achieve a sustainable electric system. Table 4, below, shows examples of metrics to achieve a sustainable energy system.

Table 4. Examples of metrics to achieve a sustainable energy system[25]

metric	purpose	metric formula
Energy efficiency	Indication of participation, energy and demand savings, and cost effectiveness of EE programs	Percent of customers per year Annual and lifecycle energy savings[26] Annual and lifecycle peak demand savings (MW) Program costs per MWh energy saved
Demand response	Indication of participation and actual deployment of DR resources	Percent of customers per year Number of customers enrolled MWh of DR provided over past year Potential and actual peak demand savings (MW)
Distributed generation	Indication of the technologies, capacity, and rate of DG installations, and whether net metering policies are supporting DG growth	Number of interconnections per year Net metering installed capacity (MW) Net metering MWh sold back to utility Net metering number of customers MW installed by type (PV, CHP, small wind, etc.)

[23] "Sustainability in the Electric Utility Industry; How Electric Companies Can Become Sustainable", November 2018. https://www.fleetcarma.com/sustainability-electric-utility-industry-electric-companies-can-become-sustainable/.

[24] "Quanta believes there is opportunity for it to compete for work associated with Puerto Rico's electric T&D system modernization efforts that are separate from its ownership interest in LUMA." https://investors.quantaservices.com/news-events/press-releases/detail/277/quanta-services-and-atco-led-consortium-selected-by-the.

[25] See Table 12, Synapse Handbook, *supra.*

[26] PREB has set a metric for annual savings from government energy efficiency programs. PREB May 21, 2021 Order Attachment V.

Energy storage	Indication of the technologies, capacity, and rate of customer sited storage installations and their availability to support the grid	Number of interconnections per year MW installed by type (thermal, chemical, etc.) Percent of customers with storage technologies enrolled in demand response programs
Electric vehicles	Indication of customer adoption of EVs and their availability to support the grid	Number of additions per year Percent customers with EVs enrolled in DR programs
Information availability	Indicator of customers' ability to access their usage information and monitor their own consumption[27]	Number of customers able to access daily usage data via a web portal Percent of customers with access to hourly or sub-hourly usage data via web
Time-varying rates	Indication of saturation of time varying rates	Number of customers on time-varying rates

PREB's May 2021 Order set includes Generation from RPS-eligible PPOAs as a metric, with a baseline of 3% and benchmark of 40% by 2025 (including distributed resources). LUMA's obligation to complete distributed generation interconnections, and to clear the massive backlog of systems waiting to be interconnected, is directly related to this metric. I recommend that PREB impose interconnection of distributed generation resources as a metric, with a penalty if LUMA fails to clear the backlog in a timely manner.

Table 5 shows examples of metrics to achieve public safety.

Table 5. Examples of metrics to achieve public safety[28]

metric	Purpose	metric formula
Incidents, injuries, and fatalities	Indicator of incidents, injuries, and fatalities associated contact with the electric system by members of the public	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by type of activity
Emergency response time	Indicator of speed of response to emergency situations involving the electric system	Percent of electric emergency responses within 60 minutes each year*
Enhancing vegetation management	reduce voltage fluctuations, improve public safety, eliminate damage to lines during storms	electric lines miles annually subjected to tree trimming/total electric line miles

*This is not CAIDI. CAIDI is the average time it takes the utility to restore service after an outage. Emergency response time is the time it takes the utility to respond to an emergency not to restore service.

While reducing environmental impacts is a key part of sustainability, many of the metrics related to environmental performance (e.g. emissions of SO2, NOx and CO2) are generation-related issues

[27] Law 17-2019 Section 5.21(d) requires PREB to consider metrics that give the public access to information about the aggregated customer energy and give individual consumers access to the information about their electric power consumption.

[28] See Table 7, Synapse Handbook, *supra.*

outside of the control of LUMA. For a transmission and distribution system operator, minimizing the use of polluting sources of generation – through the rapid integration of distributed renewables, improvements in energy efficiency and demand response, see Table 4, and reduction in line losses – is key to achieving environmental goals. More examples of metrics to achieve better environmental performance are shown in

Table 6.

Table 6. Examples of T&D metrics to achieve better environmental performance[29]

metric	Purpose	metric formula
System losses	Indication of reductions in losses over time	Total electricity losses / MWh generation, excluding station use Technical losses as % of net generation, and Technical loss reduction as % of net generation[30] Reduction in network line losses

LUMA proposed reduction in network line losses in Annex IX in its June 2020 T&D OMA, but removed it from the proposed Annex IX. LUMA witness Don Cortez explains that although the metric does provide a measure of LUMA's success in reducing line losses overall, LUMA chose not to include it. Direct Testimony of Don Cortez lines 196-202. I recommend that PREB impose this metric, and require LUMA to provide regular reports of System Losses and LUMA's plan to reduce system losses.

C. A reliable electric system

The North American Electric Reliability Corporation (NERC) defines the reliability of the interconnected bulk power system (BES) in terms of three basic and functional aspects as follows[31]:

Adequacy: The ability of the electric system to supply the aggregate electric power and energy requirements of electricity consumers at all times while considering scheduled and reasonably expected unscheduled outages of system components

Operating Reliability: The ability of the electric system to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system components

[29] See Table 11, Synapse Handbook, *supra.*
[30] PREB set these as metrics in its May 21, 2021 Order Attachment D.
[31] 2021 State of Reliability: An Assessment of 2020 Bulk Power System Performance, August 2021, NERC.

Regarding adequacy, **system operators such as LUMA**, can and should take controlled actions or introduce procedures to maintain a continual balance between supply and demand within a balancing area (formerly known as a control area). **Emergency actions** in a capacity deficit condition **include public appeals** and the following: interruptible demand that the end-use customer makes available to its load-serving entity via contract or agreement for curtailment, voltage reductions (often referred to as "brownouts" because incandescent lights will dim as voltage is lowered, sometimes as much as 5%), rotating interruptions/outages where a preplanned set of distribution feeders is interrupted for a limited time and put back in service and another set is interrupted, thus, "rotating" the outages. While LUMA has employed rotating interruptions in recent months, it has made no efforts at public appeals for conservation or implementing demand response with large customers.

NERC offers a set of Reliability Standards to deliver an adequate level of reliability. Adequate Level of Reliability is defined as the state that the design, planning, and operation of the BES will achieve when the following reliability performance objectives are met with the following considerations:

- The BES does not experience instability, uncontrolled separation, cascading, and/or voltage collapse under normal operating conditions when subject to predefined disturbances.
- The BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined disturbances.
- The BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined disturbances.

Severe voltage fluctuations, a phenomenon normally not seen while PREPA managed the electric grid, has been reported under LUMA operation in all regions in Puerto Rico. LUMA has not explained the frequency nor the severity of this conditions that often results in permanent damage to customers' appliances and deterioration of electric equipment. Many Puerto Ricans have been forced to replace food or medicine that spoiled when refrigerators were unpowered. I recommend that PREB require LUMA to implement a system where customers can obtain restitution from LUMA for financial losses caused by problems with the T&D system that LUMA operates.

- Adverse reliability impacts on the BES following low-probability disturbances (e.g., multiple contingencies, unplanned and uncontrolled equipment outages, cyber security events, or malicious acts) are managed.
- Restoration of the BES after major system disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

a. Reliability indicators for the transmission system

NERC specifies definitions, calculations, rating levels, and purpose for the reliability indicators for the BES. Reliability indicators tie the performance of the BES to a set of reliability performance objectives defined by NERC. Reliability performance objectives are established and defined using NERC's definition of Adequate Level of Reliability. Each reliability indicator is mapped to a specific performance objective and is then evaluated to determine whether the actual performance of the system meets expectations.

Appendix A "Reliability Indicator Ratings and Descriptions" of the **2021 State of Reliability: An Assessment of 2020 Bulk Power System Performance**, August 2021 report by NERC could be adapted as shown in the following table (considering that LUMA only operates transmission and not generation) to provide adequate reliability metrics to measure LUMA's performance on keeping the reliability of the bulk electric power system.

Examples of transmission system reliability performance metrics are shown in Table 7 below.

Table 7. Examples of transmission system reliability performance metrics

metric	Purpose	metric formula
Transmission-related events resulting in loss of load	Identify transmission system events that result in load shedding	Number of non-weather-related events that result in a certain level of load shedding
Transmission Outage Severity	Identify the extend (amount of affected customers) and duration (minutes of interruption) of a transmission related outage	Amount of affected customers/total number of customers Interruption time times the number of affected customers
Automatic AC Transmission Outages	Identify prevalence of high-risk transmission failure modes	Number of transmission element outages caused by failed protection system, human error, failed AC substation equipment, or failed AC circuit equipment
Automatic AC Transformer Outages	Identify prevalence of high-risk transformer failure modes	Number of outages (per transformer) due to failed protection system, human error, or failed AC substation equipment
Transmission element unavailability	Identify overall level of transmission element and transformer availability	Percentage of transmission system elements unavailable for service due to automatic and non-automatic outages
Load shed due to transmission outage	Minimize/mitigate load shed due to transmission outages	number of transmission related load-shed events amount of distributed generation available under contract in the event of an emergency

b. Additional reliability indicators

LUMA proposes to use SAIDI and SAIFI to measure reliability of service. LUMA proposes to eliminate CAIDI claiming "it is limited as a performance metric". I strongly disagree with this claim. CAIDI is the average restoration time, or the time it takes to the electric utility to restore service once an interruption occurs. It is probably the most understandable and thus meaningful metric to the general public of all reliability indices. I strongly recommend that PREB maintain CAIDI as a metric.

SAIDI is the "System Average Interruption Duration Index". SAIDI is the average, non-momentary[32], outage duration for each customer served over a defined period of time (usually 1 year) and is usually measured in minutes or hours. The average SAIDI during 2019 for US electric utilities was 92 minutes. This SAIDI does not consider major interruption events caused by hurricanes, earthquakes, etc. Through the NEPR-MI-2019-0007 proceeding to set baselines and benchmarks, PREB set a SAIDI benchmark of 102 minutes – significantly higher than the average for mainland utilities. LUMA, however, proposes benchmarks that would allow for significantly longer interruptions: 1,119; 932, and 749 minutes for Years 1, 2, and 3, respectively. Those SAIDI statistics would not provide reliability anywhere close to the U.S. average – I recommend that PREB reject the proposed benchmarks and stay with its SAIDI benchmark of 102 minutes.

SAIFI is the "System Average Interruption Frequency Index". SAIFI is the average number of interruptions that a customer would experience over a defined period of time (usually 1 year) and is usually measured in interruptions per customer. In the US the average SAIFI is 1.1 interruptions per year without including major events.

CAIDI is the "Customer Average Interruption Duration Index". CAIDI gives the average outage duration that any given customer would experience over a period of time, usually 1 year. CAIDI can also be viewed as the average restoration time, the time it takes to the electric utility to restore service once an interruption occurs. In the US the average CAIDI is about 82 minutes.

MAIFI is the "Momentary Average Interruption Frequency Index". MAIFI gives the average number of momentary interruptions that a customer would experience over a period of time, usually 1 year. We consider a momentary interruption to be an outage of less than 5 minutes in duration. Hawaii reports an average MAIFI between 0.55 and 0.88 interruptions.[33]

IEEE Standard 1366 defines the calculation of these indices. Given previous controversy over PREPA's methodology in calculating these indices, as well as overall lack of public trust in LUMA's and PREPA's operations, I urge the Bureau to require LUMA to make public their raw outage data, in addition to the indices. This would go towards Law 17-2019's requirement that PREB's review in this proceeding consider "public access to information about … aggregated customer energy…".

[32] A momentary service interruption last for less than 5 minutes.

[33] From https://www.hawaiianelectric.com/about-us/key-performance-metrics/service-reliability
Oahu reports 0.7 to 1.1 interruptions, Maui county reports 0.3 to 0.7 interruptions, and Hawaii island reports 0.65 to 0.85 interruptions from Q3-2019 thru Q2-2021.

Electric power quality is the degree to which the voltage, frequency, and waveform of a power supply system conform to established specifications.[34] Good power quality is a steady supply voltage that stays within the prescribed range, steady A.C. frequency very close to the rated value, and smooth voltage curve waveform that closely resembles a sine wave.

Since June 1 2021, we have seen an increase in voltage fluctuations, thus a decrease in power quality, under LUMA's operation of the electric power system. Voltage fluctuations are described by IEEE as systematic variations of the voltage waveform envelope, or a series of random voltage changes, the magnitude of which falls outside the voltage limits set by ANSI C84.1.[35] ANSI C84.1 establishes nominal voltage ratings and operating tolerances for 60 Hz electric power systems above 100 V.

At the residential service voltages, the allowed voltage range for 120 V nominal is 126 V (maximum) to 114 V (minimum) and the allowed voltage range for 240 V nominal is 252 V (maximum) to 228 V (minimum). The Standard indicates that occurrence of service voltages outside these limits should be infrequent and that such conditions should be limited in extent, duration and frequency. Corrective measures shall be undertaken within a reasonable time to bring back voltages within allowed limits.

c. Examples of transmission & distribution performance reliability metrics

Reliability performance metrics are shown in Table 8.

Table 8. Examples of additional reliability performance metrics[36]

metric	purpose	metric formula
System Average Interruption Duration Index (SAIDI)	Indicator of sustained interruptions experienced by customers	Total customer minutes of sustained interruptions / total number of customers
System Average Interruption Frequency Index (SAIFI)	Indication of how many interruptions are experienced by customers	Total number of customer interruptions / total number of customers
Customer Average Interruption Duration Index (CAIDI)	Indicator of the length of interruptions experienced by customers	Total minutes of sustained customer interruptions / total number of interruptions
Momentary Average Interruption Frequency Index (MAIFI)	Indicator of momentary interruptions experienced by customers	Total number of momentary customer interruptions per year / total number of customers

[34] Dugan, Roger C.; Mark McGranaghan; Surya Santoso; H. Wayne Beaty (2003). Electrical Power Systems Quality. McGraw-Hill Companies, Inc.
[35] American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hz) ANSI C84.1-2020.
[36] See Table 5, Synapse Handbook

Power quality	Indicator of voltage changes, which can cause damage to end use equipment and frequency deviations	Numerous metrics indicating changes in voltage including transient change, sag, surge, undervoltage, harmonic distortion, noise, stability, flicker and others.
Enhancing vegetation management*	reduce voltage fluctuations, improve public safety, eliminate damage to lines during storms	electric lines miles annually subjected to tree trimming/total electric line miles

*Enhancing vegetation management is also in the public safety category.

PREB recognized the value of enhanced vegetation management, and PREB's 6th Request of Information asked several discovery questions related to this issue: specifically, for planned trim miles, trim acreage, and widening miles for FY 2022, 2023, and 2024, and for LUMA's steady-state preventative vegetation maintenance plan. LUMA has thus far refused to provide those figures. I recommend that PREB require that information to be provided and set penalties for failure to fulfill the planned tasks.

D. An efficient and cost-effective electric system

Although the term "efficiency" is typically associated with how energy is consumed at the point of end use the concept of efficiency can also be applied to how energy is produced and distributed. Also, a simple cost-benefit analysis to justify efficiency is fairly straightforward: using less energy means paying less for energy, but this simplistic approach overlooks important additional benefits that efficiency brings, such as:

- environmental – the easiest ton of CO2 to remove from the atmosphere is the one that is not emitted in the first place. Greater energy efficiency in the T&D system means lower emissions in generation to deliver the same amount of consumed energy.

- energy autonomy - fuel conservation reduces Puerto Rico's dependence on foreign fuel supplies—oil, natural gas and coal—which can be replaced by endogenous resources.

- reduced grid costs – reduced energy demand reduces the need for T&D investments.

The U.S. Energy Information Administration (EIA) estimates that electricity transmission and distribution (T&D) losses equaled about 5% of the electricity transmitted and distributed in the United States in 2015 through 2019.[37] T&D losses are significantly higher in Puerto Rico[38]. The responsibility for reduction of T&D losses must fall on LUMA, as the operator of the T&D system.

[37] Source: https://www.eia.gov.

[38] T&D losses are estimated to be 15% to 17% of total generation in Jennifer Jiménez's electrical engineering master thesis: Jennifer Jiménez, "Benefits of Electric Generation Displacement Using Solar Thermal Water Heating", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.

The US Energy Information Administration (EIA) also informs that utility distribution spending has risen 54% since 1997, from $31 billion to $51 billion annually, costs which are included in our utility rates. Cost effective alternatives to traditional infrastructure – including energy efficiency and distributed renewable energy resources plus storage - must be used to achieve system savings. Moreover, effective resource planning, is essential to achieve cost effective solutions. In effective resource planning stakeholder input is incorporated early, the process is designed to consider all relevant resources as well as the use of appropriate assumptions and modeling tools.

a. performance metrics for efficient and cost-effective power system

In addition to the energy efficiency and demand response metrics presented in Table 4, possible performance metrics include those shown in

Table *9*.

Table 9. Examples of performance metrics for efficient and cost-effective system[39]

metric	Purpose	metric formula
Total energy delivery costs	costs of delivering energy to consumers	All T&D expenses (including administrative expenses) per net kWh sold
Effective resource planning	Indicator of efficacy, breadth, and reasonableness of resource planning process	Numerous metrics regarding incorporation of stakeholder input, consideration of all relevant resources, use of appropriate assumptions and modeling tools, etc.
Load factor	Indication of improvement in system and customer load factors over time	Sector average load / sector peak load Monthly system average load / monthly system peak load
Usage per customer	Indication of customers' energy consumption changes over time	Sector sales / sector number of customers
System losses	Indication of reductions in losses over time	Total electricity losses / MWh generation, excluding station use

E. A resilient electric system

In the context of a power system, resiliency includes the ability to ensure electric service continuity—and quickly recover from—high-impact, low-frequency events. Recent extreme weather events—including Hurricanes María, Katrina and Sandy, the February 2021 blackouts in Texas, and the Tohoku earthquake and tsunami in Japan—have demonstrated the need for

[39] See Tables 10 and 11, Synapse Handbook, *supra*.

resiliency.[40] Enhanced resiliency of the power system is based on three elements—damage prevention, system recovery, and survivability, elements that align closely with sustainability: the environmental, social, and economic performance of electric power companies and impacts on their stakeholders.

Why is resiliency needed now? The North American Electric Reliability Corporation (NERC) reported that the number of so-called major disturbances increased dramatically from 1992 to 2009.

Enhanced power system resiliency is based on three elements:

- Damage prevention: the application of engineering designs and advanced technologies that harden the power system to limit damage. Hardening of the electric system should be well aligned to sustainability goals such as hardening that ensures more distributed renewable energy.
- System recovery: advanced tools and techniques to restore service as soon as practicable
- Survivability: the use of distributed resources – in the case of Puerto Rico, rooftop solar and storage - to aid consumers, communities, and institutions in continuing some level of normal function without complete access to their normal power sources

a. Examples of performance metrics toward a resilient electric system

In addition to metrics described in previous sections, metrics to incentivize a move towards a more resilient power system are shown in Table 10.

Table 10. Examples of other resiliency performance metrics

metric	purpose	metric formula
Distributed generation	provide basic electric service continuity during system outages	interconnections per year
Distributed storage	provide basic electric service continuity during system outages	interconnections per year
Hardening existing power plants and substations against storm damage	reduce exposure to damage due to storms	
Targeted distribution system investment	Strengthening the distribution system to allow more distributed renewable generation	Incremental miles of distribution circuits operating at 13.2 kV Millions of dollars invested in strengthening distribution system to achieve more distributed renewable generation

[40] See "Electric Power System Resiliency: Challenges and Opportunities", Electric Power Research Institute (EPRI), (February 8, 2016) https://www.epri.com/research/products/000000003002007376.

IV. Performance metrics and performance-based mechanisms examples from Hawaii

This section summarizes examples of performance-based mechanisms used in Hawaii. All of these were established following a stakeholder engagement process ordered by the Hawaii Public Utility Commission.

These examples show two key characteristics of performance-based mechanisms: they include both rewards and penalties **and provide rewards only for hard to reach objectives**.

a. Interconnection Approval PIM

The Interconnection Approval Performance Incentive Mechanism (Interconnection Approval PIM) aims to promote the reduction of total interconnection time for distributed energy resources (DER) under 100 kW in capacity. The Public Utility Commission of Hawaii issued Decision and Order (D&0) 37787 defining the metric as:

Metric: The metric will be the mean (average) number of business days it takes the Companies to complete all steps within the Companies' control to interconnect DER systems <100kW in size, in a calendar year. The PIM will be applied to each of the Companies' performances, respectively. The time within the Companies' control for each installation used to determine the average will be capped at two standard deviations above the mean (the "updated adjusted average").

Decision and Order 37878 follows D&O 37507 which established "three tiers of targets to earn financial rewards and three tiers of targets that will incur financial penalties." Upside targets were set at or above the annual thresholds included in the table 7[41] of the below, with corresponding financial rewards

D&O 375071 Table 7: Interconnection Approval PIM Reward Targets

**Targets shown in average number of business days with outliers excluded*

Thresholds and Potential Reward Level	2021	2022	2023	2024	2025
TIER 1: +$1,050,000 HECO +$225,000 HELCO/MECO	21	18	15	12	9
TIER 2: +$700,000 HECO +$150,000 HELCO/MECO	24	21	18	15	12
TIER 3: +$350,000 HECO +$75,000 HELCO/MECO	27	24	21	18	15

The targets were "designed to incent incremental improvement on existing interconnection approval times working backwards from a desired end-state that reflects national exemplary performance." The downside targets "should be at or below the annual thresholds included in Table 8".

[41] Tables in this section, numbered Table 7 and Table 8, follow the original numbering of the Decision and Order from Hawaii.

D&O 375071 Table 8: Interconnection Approval PIM Penalty Thresholds

**Targets shown in average number of business days with outliers excluded*

Thresholds and Potential Penalty Level	2021	2022	2023	2024	2025
TIER 1: -$315,000 HECO -$67,500 HELCO/MECO	42	39	36	33	30
TIER 2: -$210,000 HECO -$45,000 HELCO/MECO	39	36	33	30	27
TIER 3: -$105,000 HECO -$22,500 HELCO/MECO	36	33	30	27	24

The tables from the Decision and Order from Hawaii are examples. I recommend opening a public participation process to define the targets, penalties and incentives that PREB should impose to LUMA. PREB's initial orders measured performance using total days waiting for interconnection, rather than averages.

b. Low to Moderate Income (LIM) Energy Efficiency PIM

The low to moderate (LIM) income energy efficiency performance-based mechanism was set by the Hawaii PUC to promote the utilities collaboration with Hawaii Energy[42] to deliver savings for LMI customers. D&O 37787 establish three (3) metrics:

Metric 1 ("Energy Savings"): Residential Hard-to-Reach ("RHTR") Energy (kWh) Savings Beyond Hawaii Energy's Target

The metric is based on "**verified kWh energy savings**, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

The threshold to qualify for an incentive is **"100% of Hawaii Energy's kWh target energy savings as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

Metric 2 ("Peak Demand Reduction"): Residential Hard to Reach Peak Demand (kW) Reduction Beyond Hawaii Energy's Target

The metric is based on "**verified peak demand reduction**, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

And again, the threshold to qualify for an incentive is **"100% of Hawaii Energy's kW target peak demand reduction as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

[42] Hawaii Energy program mission is "... to empower island families and businesses to make smarter energy choices to reduce energy consumption, save money, and pursue a 100% clean energy future." https://hawaiienergy.com/about.

Metric 3 ("Program Participation"): A&A Customers[43] Served Beyond Hawaii Energy's Target

The metric is based on "The sum of program participants each year ("customers served") in Hawaii Energy Residential A&A, and any Commission-approved and verified energy savings for LMI customers resulting from advanced rate design and any future co-deployed Hawaii Energy and Hawaiian Electric energy efficiency programs."

And again, the threshold to qualify for an incentive is **"100% of Hawaii Energy's kW target peak demand reduction as set forth in its Commission-approved annual plan for RHTR programs."** thus the "hard to reach" label on the metric name.

The total reward for the PIM is capped at $2 million, annually, across all three metrics combined and is set to be "comprehensibly revisited" after three years.

V. LUMA's proposed performance metrics

A. LUMA's performance metrics: a 20th Century vision

Table 11 summarizes LUMA's proposed performance metrics:

Table 11. Performance metrics proposed by LUMA

Category	LUMA's proposed metrics
Customer service	J.D. Power Customer Satisfaction Survey (residential)
	J.D. Power Customer Satisfaction Survey (business)
	Average Speed of Answer
	Customer Complaint Rate
	Abandonment Rate
Technical, Safety & Regulatory	OSHA Recordable Incident Rate
	OSHA Fatalities
	OSHA Severity Rate
	OSHA DART Rate
	SAIFI
	SAIDI
	Distribution Line Inspections & Targeted Corrections
	Transmission Line Inspections & Targeted Corrections
	T&D Substation Inspections & Targeted Corrections
Financial Performance	Operating Budget
	Capital Budget: Federally Funded
	Capital Budget: Non-Federally Funded
	Overtime
	Days Sales Outstanding - General Customers
	Days Sales Outstanding - Government Customers

[43] Residential A&A Programs are: Single & Multifamily Direct Install, Water Heating Direct Install, Bulk Appliance programs. Source: https://hawaiienergy.com/for-homes

PREB rejected the J.D. Power Customer Satisfaction Survey metrics in the NEPR-MI-2019-0007 proceeding, stating that LUMA would have to provide "a more thorough analysis" before these metrics could be included.[44] This analysis is not currently possible because, as LUMA witness Jessica Laird acknowledges "[t]here is no previous data from [PREPA] to compare."[45] Instead, it appears that LUMA used an email survey of about 4,000 customers and 163 companies.[46] An email survey omits a massive percentage of Puerto Rican customers – and the responses omit the concerns of less tech-savvy customers. I recommend that PREB strike any incentive tied to these metrics, until a more thorough set of data is available, using survey-taking means more inclusive than an email survey.

Act 57-2014 Sections 6.26 and 6.27 give customers the right to file complaints regarding electric company billing or service, and requires electric companies to create a procedure to address all complaints. PREB's NEPR-MI-2019-0007 proceeding to set baselines and benchmarks set a Customer Complaint Rate metric, which properly counted all initial complaints filed by customers under Act 57-2014. PREB set a baseline of 841 complaints per 10,000 customers. LUMA did not challenge that conclusion, but now proposes a very different Customer Complaint metric, which omits the vast majority of customer complaints, and only counts the small percentage of these complaints that become formal complaints to be decided by PREB. I recommend that PREB include both metrics: both initial complaints and formal complaints: and impose a penalty on LUMA if the actual initial complaints in FY2020 exceed the baseline figure set by PREB of 841 per 10,000 customers.

LUMA also proposes several "Major Outage Event" metrics related to its preparations, operational response and communications before and during a major outage.

When compared to Table 1 it is clear that LUMA's proposed performance metrics are focused on traditional utility performance areas. The implicit goal is to achieve a reasonable 20th century utility service.

Despite the LUMA contract's reiteration of Law 120's goals, key elements of the transformational vision of Law 120 and Law 17 are entirely absent from LUMA's proposed performance metrics.

The purpose of employee safety (labor safety) is to ensure that employees are not subjected to excessive risks. It is a very bad idea to provide a financial incentive to a company for merely complying with basic moral, legal and ethical obligations such as employee safety. If there are a

[44] *In Re* The Performance of the Puerto Rico Electric Power Authority, Resolution and Order, NEPR-MI-2019-0007, at p. 15 (May 21, 2021)
[45] Direct Testimony of Mrs. Jessica Laird, *In Re* Performance Targets for LUMA Energy Servco, LLC, NEPR-AP-2020-00025, at lines 86-90 (August 18, 2021), https://energia.pr.gov/wp-content/uploads/sites/7/2021/08/Exhibit-1-Pre-Filed-Testimonies-on-LUMAs-Performance-Metrics-Targets.pdf.
[46] *Id.*, at lines 69-70.

metrics that truly calls for penalties, and only penalties, if minimum standards are not met, these are the labor safety metrics.

I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

For the Operating Budget metric: PREB's May 2021 Order set the Fiscal Year 2021 Baseline as 80.4% - meaning that PREB expects LUMA's FY2021 actual operating expenses to stay under 80.4% of the operating budget.[47] LUMA did not challenge that PREB conclusion, but now proposes to increase the baseline to either 100% or 102%, and seeks an incentive and an award of full base points just for staying within its budget.[48] I recommend that PREB reject LUMA's proposal and stay with the 80.4% baseline for the Operating Expenses metric.

PREB's May Order also includes a metric for "Capital expenses vs. Budget – Transmission & Distribution" and sets a baseline for a 9.9% ratio of T&D capital expenses to operating budget.[49] I recommend that PREB impose this metric on LUMA, with a penalty for failure to keep T&D capital expenses under 9.9% of the operating budget.

Additionally, I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. I recommend that all budget metrics: Operating Budget, Capital Budget: Federally Funded, Capital Budget: Non-Federally Funded, and Capital expenses vs. Budget – Transmission & Distribution be used only to impose penalties if minimum standards are not met. Instead, a failure to stay within budget should reduce or eliminate LUMA's ability to achieve incentives in other categories.

B. Recommendations of additional metrics

Based on the discussion in Section III, above, of potential metrics that could be used to incentivize the transformation towards a "modern, sustainable, reliable, efficient, cost-effective, and resilient system", as mandated by Law 120, as well as public safety, I recommend the adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

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[47] *In Re* The Performance of the Puerto Rico Electric Power Authority, *supra* note 46, Attachment A.

[48] *Supra*, note 10, Annex IX, Section D. See also LUMA's Responses and Objections to Fourth Discovery Request by LECO, In Re Performance Metrics Targets for LUMA Energy Servco, LLC, NEPR-AP-2020-00025, question 7 to LECO Information Request 4-7. LUMA's responses to LECO's Fourth Request of Information are attached as Exhibit 6 to the Expert Testimony. LUMA's November 10th submission of additional responses in LECO's Fourth Request of Information are attached as Exhibit 7 to the Expert Testimony.

[49] *In Re* The Performance of the Puerto Rico Electric Power Authority, Attachment A.

In addition, and following Law 17-2019's emphasis on the importance of public information disclosure, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. At a minimum, this should include public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

C. LUMA's metrics lack penalties and include incentive payments for achieving what should be expected

LUMA's proposal includes only incentives for achieving certain targets, but no penalties if a given level of performance is not maintained. The failure to include penalties is particularly concerning given that electric service has deteriorated in key areas since LUMA took control of the electrical system (see next section). For example, LUMA's performance in SAIDI and SAIFI has deteriorated relative to PREPA's performance, which was used to establish the performance metrics baseline.

Additionally, LUMA proposes that it should be awarded 25% of its incentive in the category of financial performance. Three of the metrics within this category simply represent LUMA's ability to stay within its budget. This is a basic expectation that should not result in incentive compensation. It is worth noting that in the Long Island Power Authority's transmission & distribution operation and maintenance agreement with PSEG, achievement of performance metrics in the "Cost Management Performance" category (staying within its operating and capital budgets) is a prerequisite to PSEG being able to achieve full incentive compensation. That is, PSEG does not earn any incentive for meeting the cost management metrics; instead, if it fails to one or both of the metrics, it is eligible for only 50% or 0% of the maximum possible incentive based on its performance in the other categories.[50] This is one of the revised LIPA contract's "Gating Performance Metrics" discussed in the next section.

Finally, if LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.

I recommend:

- Removing any incentive payment if LUMA stays within its capital and operating budgets. Instead, following the model of the LIPA contract, failure to stay within budget should reduce LUMA's ability to achieve incentives in other categories.

[50] Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a/ LIPA and PSEG Long Island LLC Dated as of December 31, 2013. Appendix 9.

- Including penalties if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.
- If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.**

D. Gating performance metrics and Default performance metrics

The Long Island Power Authority (LIPA) announced on November 9, 2021 a revised management services contract and settlement with PSEG Long Island. LIPA indicated that "the revised management agreement includes reforms designed to drive performance and accountability, while providing an unprecedented level of oversight of PSEG Long Island's operations"[51].

Appendix 4.3(C) of this revised contract include two interesting types of metrics that should be considered by PREB. These metrics are: "Gating Performance Metrics" – metrics that, if not achieved, reduce the overall ability to receive incentive compensation and "Default Performance Metrics" – failure to achieve these metrics gives LIPA the right to terminate the entire contract.

From the revised LIPA/PSEG Long Island contract "The Service Provider's failure to achieve a Gating Performance Metric in any Contract Year results in a percentage reduction to the Variable Compensation Pool for that Contract Year by the percentage specified in the Gating Performance Metric and, accordingly, reduces the amount that may be earned across all Scope Function-Specific Performance Metrics for that Contract Year"

Gating Performance metrics listed in the revised contract are:

- Cost Management: If PSEG is not within 102% of the capital budget and/or within 102% of the operating budget, the possible incentive compensation pool is reduced by 50% (for failure to achieve 1 metric) or 100% (for failure to achieve both). This is the same as the previous contract.
- Customer Satisfaction: Starting in 2024, failure to achieve a result in the 3rd quartile for either residential or business customers for two consecutive years will result in a 15% reduction in the incentive compensation pool. This metric relates to specific customer satisfaction surveys.

[51] Paul Ciampoli, *LIPA And PSEG Long Island Reach Agreement On New Reformed Contract*, American Public Power Association (November 10, 2021), https://www.publicpower.org/periodical/article/lipa-and-pseg-long-island-reach-agreement-new-reformed-contract.
See also: Second Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a LIPA and PSEG Long Island LLC, https://www.lipower.org/wp-content/uploads/2021/11/Changes-in-DRAFT-2021-AR-OSA-from-2013-AR-OSA-with-appendices.pdf for revised contract.

- SAIDI: If PSEG "fails to achieve a result at the 37.5 percentile or better, as calculated by using electric reliability benchmarking data from the US Energy Information Administration for companies with >500,000 customers, and utilizing the IEEE standard for SAIDI without major event days", the incentive compensation pool is reduced by 50%.
- Emergency Preparation and Response: If PSEG's response to a major storm does not score high enough on an Emergency Preparation and Response Scorecard published by the New York Public Service Commission, the incentive compensation pool will be reduced by 25% or 50%.

Default Performance Metrics listed in the revised contract are:

- Customer Satisfaction: "commencing in 2024, the Service Provider failure's to achieve a third quartile result on either component - Residential or Business - for any two consecutive Contract Years provides LIPA with the right, but not the obligation, to terminate this Agreement"
- Emergency Preparation and Response: similarly measured with respect to the scorecard published by the New York Public Service Commission.
- Failure to comply with various Cybersecurity requirements.

I recommend the adoption of metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" in the performance-based mechanism to be applied to LUMA.

VI. T&D system performance has deteriorated in several key areas since LUMA assumed control

In this section, I review several key areas in which performance has deteriorated under LUMA, highlighting the need to establish penalties as part of the performance metrics.

First, there have been widespread public complaints of voltage fluctuations and power quality issues under LUMA that were not experienced under PREPA's operation.

Second, related to customer service, LUMA's CEO admitted during an October 6th Congressional hearing that the volume of calls has increased since LUMA took over the system.[52]

Third, the reliability of the transmission and distribution system has deteriorated, according to SAIDI and CAIDI data filed with the Bureau in Case No. NEPR-MI-2019-0007. The time it takes to restore electric service after an interruption (CAIDI) has increased significantly 25 out of 26 regions under LUMA. The average system-wide time to restore electric service after an interruption (CAIDI) increased from 2 hours and 43 minutes during June, July and August 2020 to 4 hours and 38 minutes during June, July and August 2021 under LUMA. This increase in outage duration was also acknowledged by LUMA's CEO during the October 6 Congressional hearing.

[52] October 6, 2021 House Natural Resources Committee hearing at 2 hours 29 minutes.

While LUMA's overall SAIFI figure is slightly better than PREPA's figure, the significantly worse SAIDI and CAIDI figures are more important one in determining overall reliability. And PREB must note that LUMA's SAIFI improvement is not widespread – SAIFI has gotten worse in 8 of 26 regions.

Figure 2 shows SAIDI for June, July and August 2020 per region, in minutes, under PREPA administration of the power system as reported by LUMA to the PREB (restated values as per Nov 4 2021). During June thru August 2020 7 out of 26 regions have SAIDI under 120 minutes. Three regions have SAIDI above 240 minutes in at least one month. The average monthly system wide interruption duration is 125 minutes during these three months.

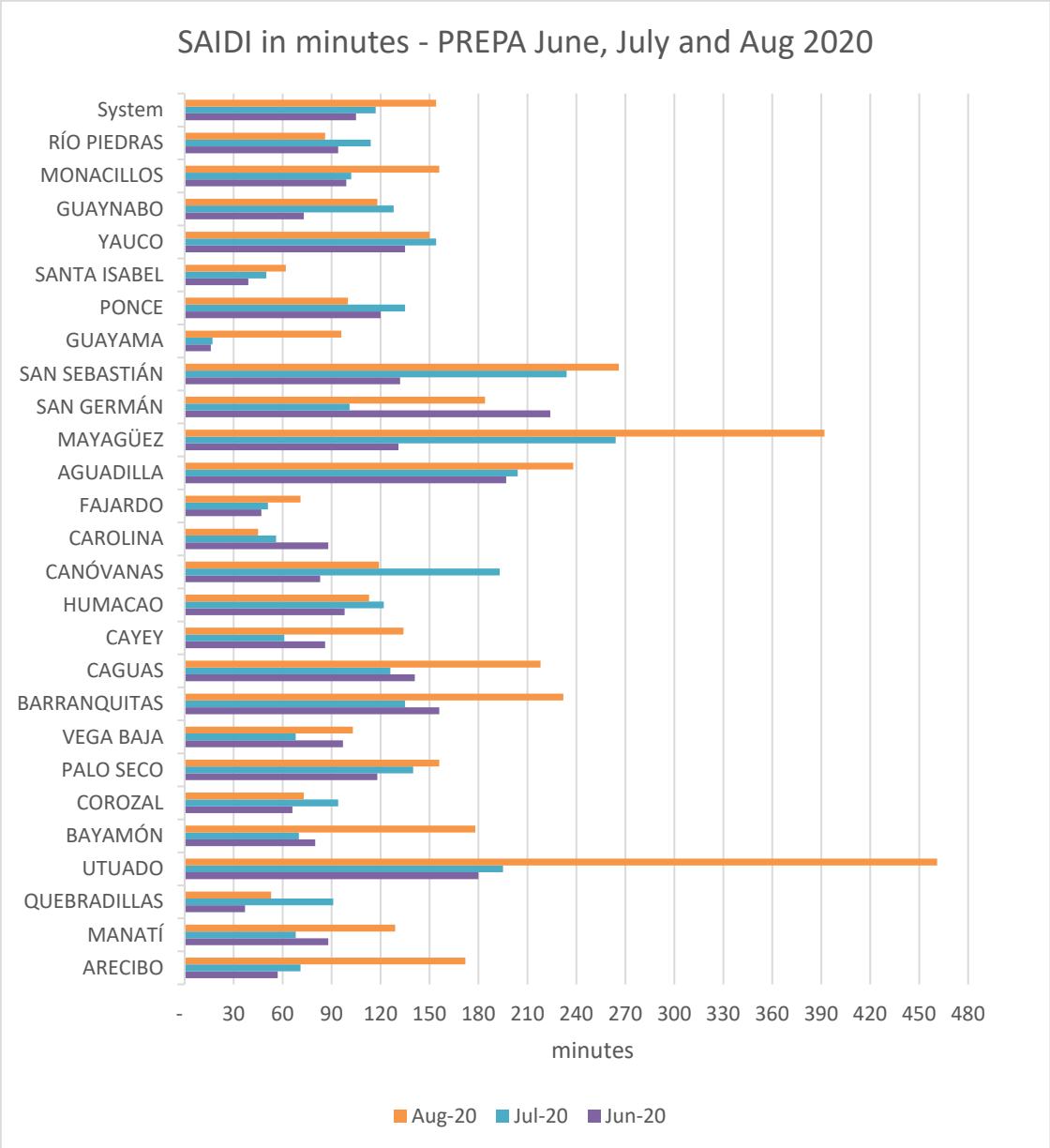


Figure 2. SAIDI, in minutes, per region, under PREPA June, July and August 2020 (restated values as per Nov 4 2021, reported by LUMA to PREB)

Figure 3 shows SAIDI for June, July and August 2021 per region, in minutes, under LUMA administration of the power system as reported by LUMA to the PREB (restated values as per Nov 4 2021). During June thru August 2021 only 1 out of 26 regions have SAIDI under 120 minutes. Ten regions have SAIDI above 240 minutes. The average monthly system wide interruption duration is 177 minutes during these three months.

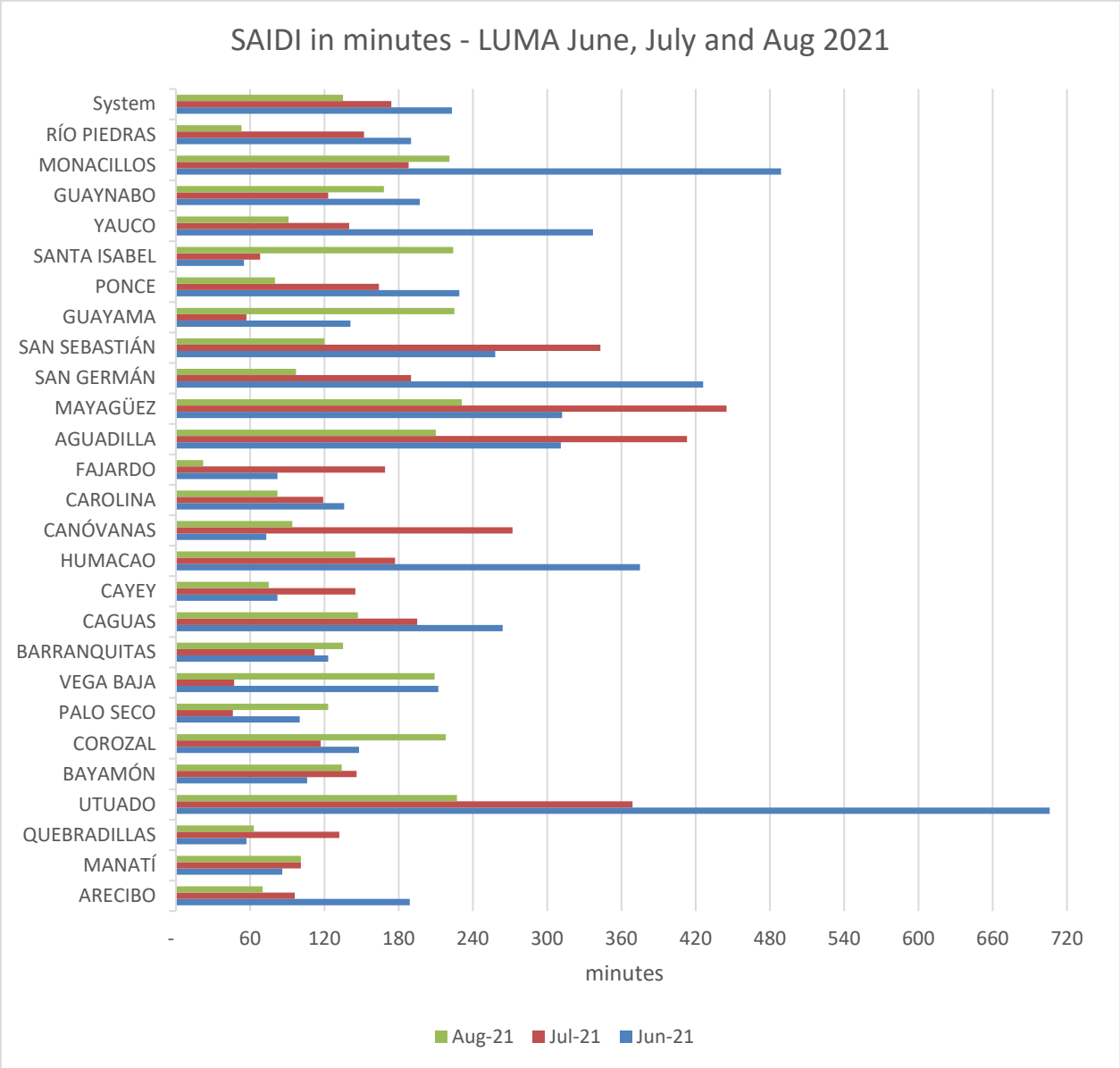


Figure 3. SAIDI, in minutes, per region, under LUMA June, July and August 2021 (restated values as per Nov 4 2021, reported by LUMA to PREB)

Figure 4 shows average monthly SAIDI per region for PREPA (June thru August 2020) vs LUMA (June thru August 2021). In 24 out of 26 regions LUMA's performance is worse than PREPA's. The average monthly system wide interruption duration is 125 minutes for PREPA during June thru August 2020 and 177 minutes for LUMA during June thru August 2021.

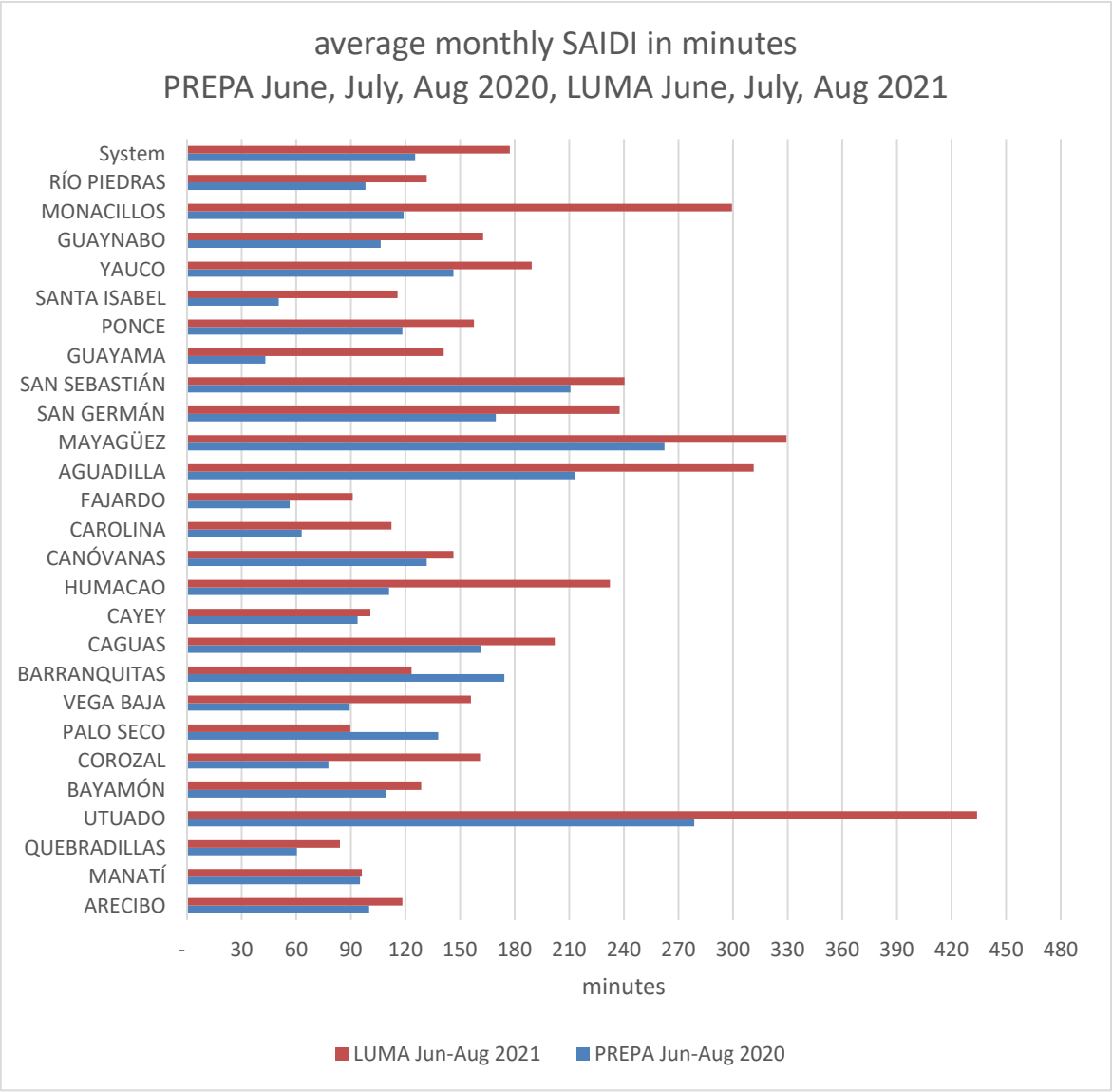


Figure 4. Average monthly SAIDI, in minutes, per region,
under PREPA June, July and August 2020 and under LUMA June, July and August 2021
(restated values as per Nov 4 2021, reported by LUMA to PREB)

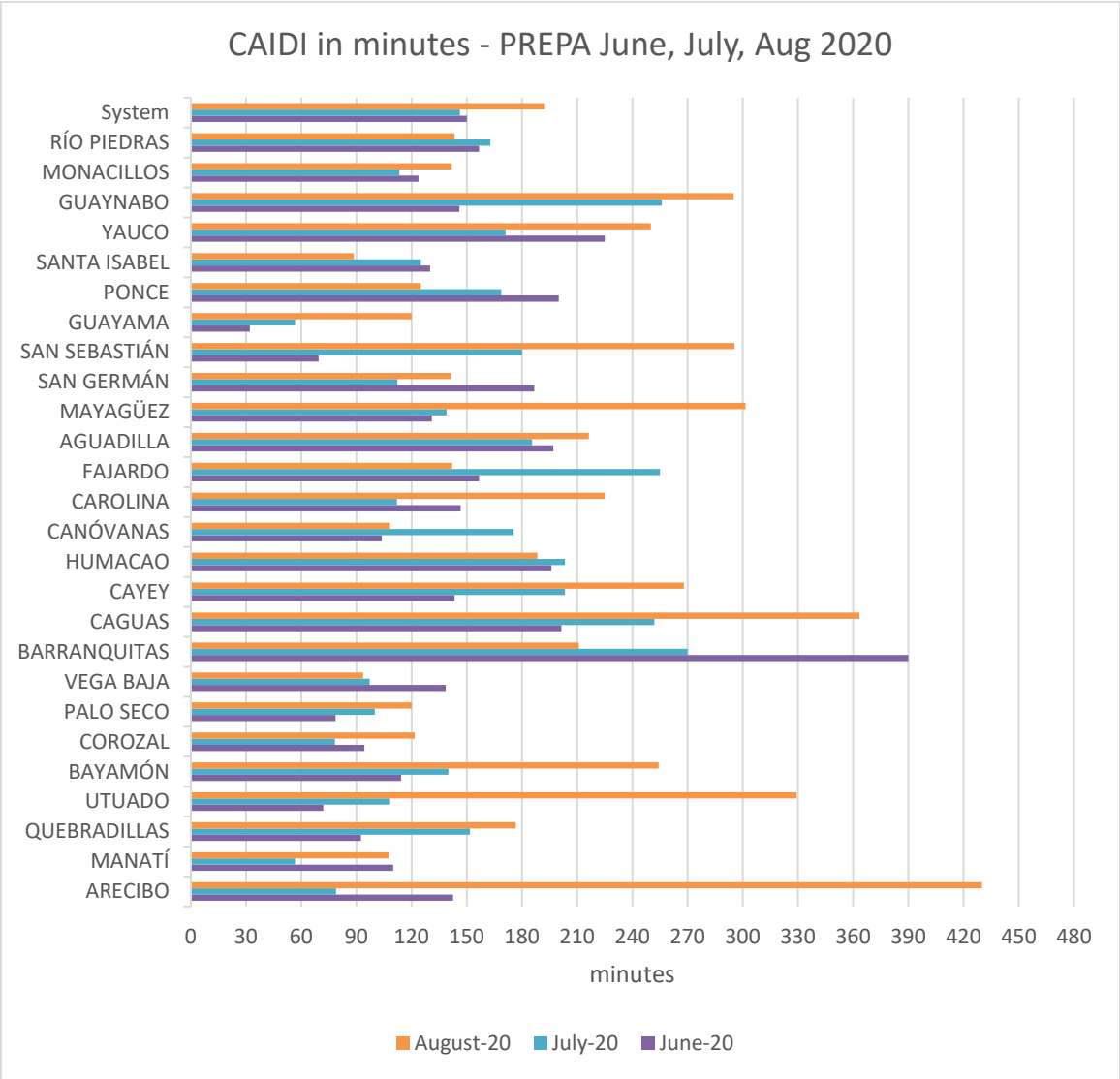


Figure 5. CAIDI, in minutes, per region, under PREPA June, July and August 2020 (calculated from restated values reported by LUMA to PREB, Nov 4 2021)

Figure 5 shows CAIDI, in minutes, per region as reported by PREPA from June thru August 2020. Eleven (11) out of 26 regions have CAIDI in excess of 240 minutes for at least one month.

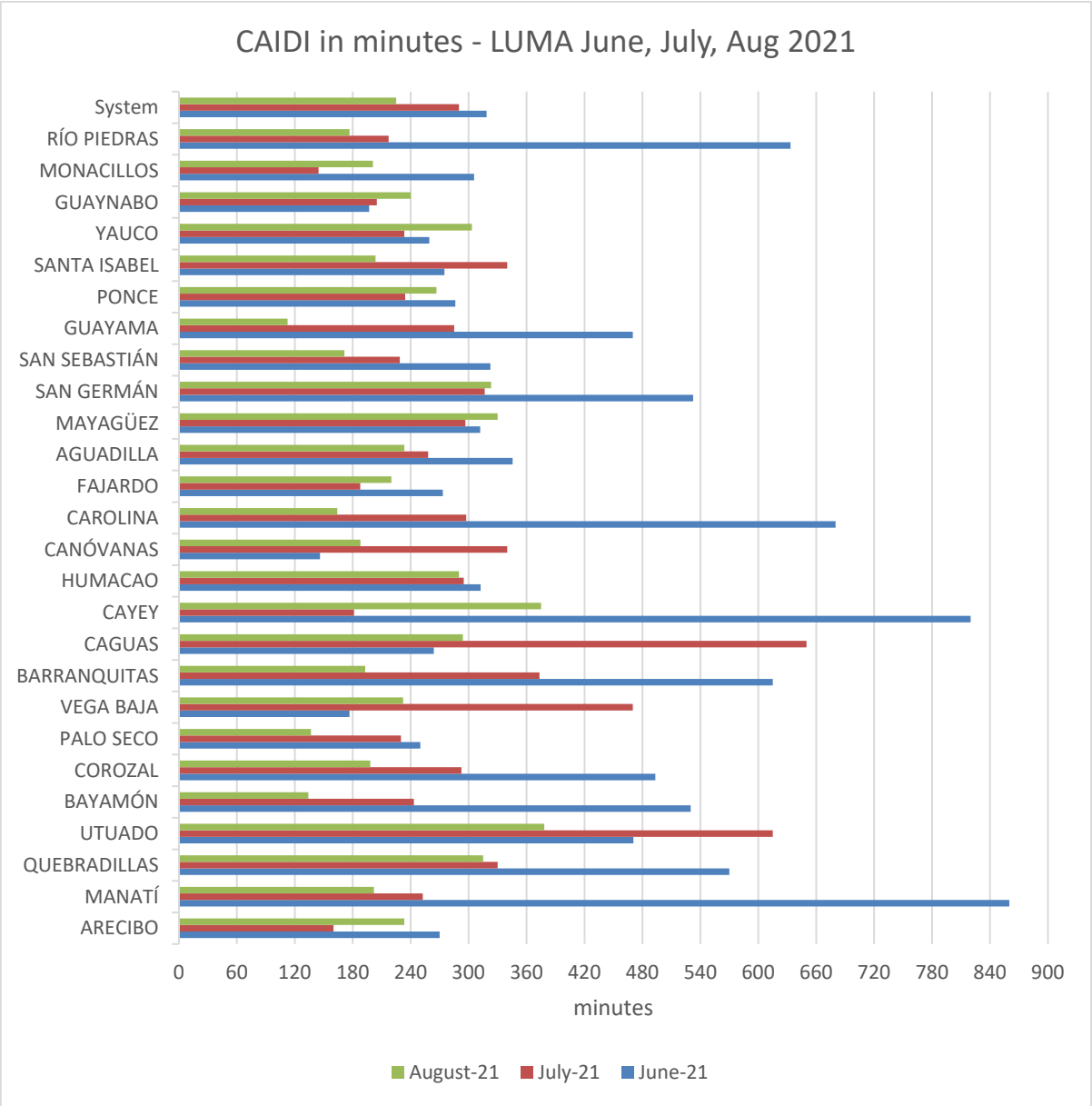


Figure 6. CAIDI, in minutes, as reported by LUMA from June thru August 2021.

Figure 6 shows CAIDI, in minutes, per region as reported by LUMA from June thru August 2021. All regions have a CAIDI above **240 minutes for at least one month**. Eleven (11) out of 26 regions have CAIDI in excess of 480 minutes. CAIDI exceeds 600 minutes in 7 regions and exceeds 780 minutes in 2 regions. The Manatí region exceeds 840 minutes (14 hours) in June 2021!

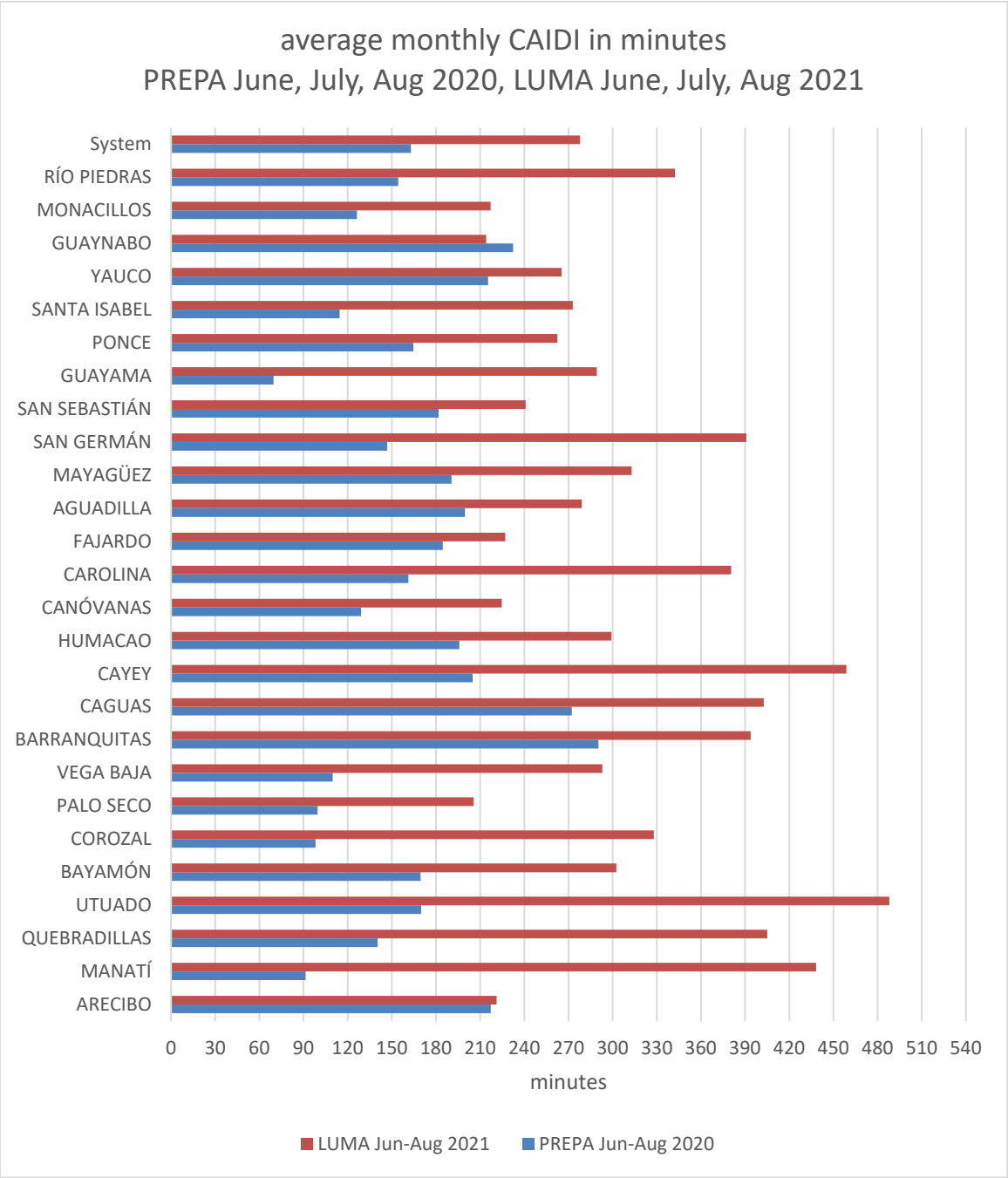


Figure 7. CAIDI as reported by PREPA (June thru August 2020) vs LUMA (June thru August 2021)

Figure 7 shows CAIDI as reported by (June thru August 2020) vs LUMA (June thru August 2021. In 25 out of 26 regions CAIDI, the time it takes LUMA to restore service after an interruption has increased. The system wide restoration time has increased from 163 minutes under PREPA to 278 minutes under LUMA.

VII. Summary of conclusions and recommendations

My conclusions and recommendations are:

Conclusion 1 – LUMA's performance metrics, if achieved, would result in reasonable 20th century utility service for Puerto Rico. Additional metrics are necessary to incentivize the transformation envisioned by Law 120 and to achieve a 21st Century electric grid.

Conclusion 2 – LUMA's metrics, in contrast to performance metrics in other jurisdictions, include no penalties for underperformance, which is particularly problematic given that service deterioration is already evident in certain areas. With respect to some metrics, LUMA proposes to be rewarded for meeting basic expectations.

Recommendation 1 – The Bureau should consider additional metrics to incentivize the transformation to a "modern, sustainable, reliable, efficient, cost-effective, and resilient system." I recommend the adoption of at a minimum, the metrics shown in Tables 4 thru Table 10 of this report.

Recommendation 2 - I also recommend that the Bureau open a truly participative process where stakeholders determine specific, measurable, objectives and propose metrics to measure progress toward these objectives.

Recommendation 3 – In developing metrics, it is important that there be opportunities for independent monitoring and verification of LUMA's performance. At a minimum, the Bureau should require public disclosure of raw outage data so that reliability indices can be independently verified and so that the Bureau and interested parties can better understand the causes, locations and trends of transmission and distribution outages on LUMA's system.

Recommendation 4 – Penalties should be included in performance metrics that would be triggered if LUMA's performance falls below a given level, such as the baseline performance of PREPA in the year leading up to June 1, 2021.

Recommendation 5 - I recommend that the Bureau remove any incentive payment to LUMA for staying within its budgets. Instead, a failure to stay within budget should reduce LUMA's ability to achieve incentives in other categories.

Recommendation 6 - I recommend that all labor safety metrics: OSHA Recordable Incident Rate, OSHA Fatalities, OSHA Severity Rate and OSHA DART Rate be used only to impose penalties if minimum standards are not met. Puerto Rico OSHA rules should be consulted and a comparison with similar jurisdictions should be conducted to establish the minimum standard.

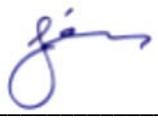
Recommendation 7 – The PREB should adopt metrics analogous to the "Gating Performance Metrics" and "Default Performance Metrics" in the performance-based mechanism to be applied to LUMA.

Recommendation 8 - If LUMA consistently under performs, during a number of evaluation periods, in key metrics such as: public and labor safety, sustainability, reliability, resiliency and customer service then the performance-based mechanism **should provide for a significant financial penalty in the fixed payment LUMA receives. If LUMA fails to correct these deficiencies its contract should be terminated.**

Recommendation 9 - Finally, I recommend that performance metrics adopted by the PREB should be true performance based, where rewards and penalties are clearly defined. This should be adopted regardless of the "fix fee + additional fee" structure of the existing Contract between LUMA and PREPA. A "fixed fee" compensation structure is contradictory to the purpose of a rewards and penalties system, since a fixed fee structure promotes underachievement.

Signature

I declare, under penalty of perjury, under the laws of the United States of America, that the foregoing is true and correct. Signed this 16th day of November 2021, in San Germán, Puerto Rico,



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Agustín Irizarry-Rivera, Ph.D., P.E.

Expert Witness Background

Agustín A. Irizarry-Rivera obtained his bachelor, Magna Cum Laude, at Universidad de Puerto Rico Mayagüez (UPRM) (1988), masters at University of Michigan, Ann Arbor (1990) and Ph.D. at Iowa State University, Ames (1996) all in electrical engineering. Since 1997 he has been Professor at the Electrical and Computer Engineering (ECE) Department UPRM where he teaches graduate and undergraduate courses such as: Electric Systems Analysis, Fundamentals of Electric Power Systems, Power System Analysis, Electric Machines, Electrical Systems Design, Advanced Energy Conversion, Power Systems Dynamics and Control and Transmission and Distribution Systems Design.

He has been elected member of the Electrical and Computer Engineering Department Personnel Committee and the School of Engineering Personnel Committee in three occasions and has served as President of both Committees twice. He has been elected Academic Senator to represent the School of Engineering in the Academic Senate. Dr. Irizarry-Rivera has served as Assistant Dean of Academic Affairs and Associate Director for Academic Affairs of the Electrical and Computer Engineering Department at UPR Mayagüez.

Dr. Irizarry-Rivera conducts research in the topic of renewable energy and how to adapt the existing power grid to add more of these resources in our energy portfolio. He had a research internship at Plataforma Solar de Almería, Tabernas, Spain from 2008 to 2009 to study concentrated solar thermal systems. He contributed to the development of dynamic models to simulate the interaction between these plants and the electric grid. He has served as Consultant on renewable energy and energy efficiency projects to Puerto Rico's Government agencies, municipalities, private developers and consulting firms in and outside Puerto Rico. He has also served as expert witness in civil court cases involving electric hazard, shock or electrocution.

Dr. Irizarry-Rivera conducts research in the topic of renewable energy and how to adapt the existing power grid to add more of these resources into our energy portfolio. He had a research internship at Plataforma Solar de Almería, Tabernas, Spain from 2008 to 2009 to study concentrated solar thermal systems. During this research internship he contributed to the development of dynamic models to simulate the interaction between these plants and the electric grid. A few examples of funded research and education projects are:

Development and Validation of Models to Assess Dynamic Response of Converter-Dominated Power Systems across Multiple Spatiotemporal Scales – (2019-2023) A $1,039,255 project (UPRM budget out of $3.5 million total) to identify, study, and develop models that allow the study of electric networks where electric generation is dominated by converter-based generators. A project in collaboration with University of Alaska Fairbanks and South Dakota State University.

Puerto Rico Solar Business Accelerator – (2020-2022) (Investigator) A $500,000 project, funded by EDA US Department of Commerce, to design and build two (2) microgrids to provide resiliency for community serving businesses in Puerto Rico.

Development of Representative Microgrids Test Cases and Study of Selected Operational Scenarios in the Island of Puerto Rico – (2019-2021) (CO Principal Investigator) A $100,000 project, sponsored by Sandía National Laboratory, to adapt existing models, or developed new models, for components of microgrids as defined in the Puerto Rico Energy Bureau (PREB) Microgrid Rule and use these models to simulate the behavior of several microgrids to evaluate the PREB Microgrid Rule's requirements.

GEARED (Grid Engineering for Accelerated Renewable Energy Deployment) – (2013-2018) (Principal Investigator) A $929,000 project (UPRM budget out of $6.9 million for the Consortium) to develop and run a Distributed Technology Training Consortium in the Eastern United States, led by the Electric Power Research Institute (EPRI) in collaboration with four U.S. universities (University of Puerto Rico Mayaguez, Georgia Institute of Technology, Clarkson University, University of North Carolina at Charlotte) and seventeen utilities and system operators. The Consortium will leverage utility industry R&D results with power engineering educational expertise to prepare power engineers in management and integration of renewable energy and distributed resources into the grid.

Streamlined and Standardized Permitting and Interconnection Processes for Rooftop Photovoltaic (PV) in Puerto Rico (2012-2013) (Investigator) A $301,911 project sponsored by the US Energy Department that seeks to improve the PV energy market of rooftop systems up to 300 kW in Puerto Rico. The project strives to create not only a standardized framework for PV deployment, but also streamlined: organized, lean permitting and interconnection processes where most residential and small commercial PV systems can be installed safely and quickly.

Design of a Renewable Energy Track within the Electrical Engineering Program at Universidad APEC, Dominican Republic (2011-2012) (CO Principal Investigator) A $29,000 award to design a Renewable Energy Track within the existing Electrical Engineering Program of UNAPEC.

IGERT: Wind Energy Science, Engineering and Policy (WESEP) (2011-2015) A $171,600 sub-award from Iowa State University, the lead Institution, to fund master students doing research in wind technology, science, and policy as they relate to accomplishing three objectives: (a) increase the rate of wind energy growth; (b) decrease the cost of wind energy; and (c) extend penetration limits.

Achievable Renewable Energy Targets For Puerto Rico's Renewable Energy Portfolio Standard (2007-2009) (Principal Investigator) A $327,197 project sponsored by the Puerto Rico Energy Affairs Administration (Administración de Asuntos de Energía), to produce an estimate, based in realistic boundaries and limitations, of renewable energy available in Puerto Rico for electricity production. The renewable energy resources studied were: biomass - including waste-to-energy, micro hydro,

ocean - waves, tides, currents and ocean thermal, solar - photovoltaic and solar thermal, wind – utility as well as small wind, and fuel cells. The purpose of producing these estimates was to establish adequate targets, as a function of time, for Puerto Rico's Renewable Portfolio Standard.

Colegio San Ignacio - Ejemplo de Sostenibilidad (2007-2008) A $73,332 project to match the energy needs of Colegio San Ignacio with its available renewable energy sources. Demonstration projects with a strong educational component were designed for the School with the participation of the School Faculty and students. The philosophy of the program was of sustainable development.

Programa Panamericano de Capacitación en Ingeniería de Potencia Eléctrica (2006-2008) A $97,370 educational project to deliver a Web-broadcast master program in electric power engineering to engineers at UNAPEC University in the Dominican Republic. Courses in this program responded to the reality and necessities of the Dominican Republic electric power industry and were aimed for sustainable development.

Caguas Sustainable Energy Showcase, Phase I (2006-2007) A $90,055 project sponsored by the Municipality of Caguas, Puerto Rico to assess the current electric energy consumption profile, by sector; residential, commercial, industrial and governmental, of Caguas and to propose achievable goals (percentages of demand), by sector, to be satisfied using renewable energy sources.

Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks (2002-2005) (Principal Investigator) A $499,849 project sponsored by the National Science Foundation (NSF) and the Office for Naval Research (ONR) to develop a model for the next generation power network using a distributed concept based on scalable coordination by an *Intelligent Power Router* (IPR). Our goal was to show that by distributing network intelligence and control functions using the IPR, we will be capable of achieving improved survivability, security, reliability, and re-configurability. Our approach builds on our knowledge from power engineering, systems, control, distributed computing, and computer networks.

He has served as Consultant on renewable energy, energy efficiency and electric grid performance and operation to Puerto Rico's Government agencies, municipalities, private developers and consulting firms in and outside Puerto Rico. He has also served as expert witness in civil court cases involving electric hazard, shock or electrocution.

He is author or coauthor of over 50 refereed publications including two book chapters (see complete list in the CV section). A licensed professional engineer in Puerto Rico since 1991 and member of IEEE he has organized local and international conferences such as the Tenth International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) in Rincón, Puerto Rico. PMAPS Conferences provide a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.

Dr. Irizarry-Rivera has received several awards and honors: **Distinguished Engineer 2013** from Puerto Rico's Professional Engineers Society (CIAPR) and **Distinguished Electrical Engineer 2005** from the Electrical Engineering Institute of CIAPR in recognition of services rendered to the profession and outstanding professional achievements in electrical engineering, the **2009 Distinguished Alumni Award** from UPRM Alumni Association, the **2004 Professional Progress in Engineering Award** from Iowa State University, in recognition of outstanding professional progress

and personal development in engineering as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership position and the 2003-2004 ECE **Outstanding Faculty Award** from UPRM's School of Engineering.

In May 2012 he was elected, by the consumers, to the Board of Directors of the Puerto Rico Electric Power Authority, in the first election of this kind in Puerto Rico, to represent the interests of consumers. He was President of the Board's Audit Committee and an active member of the Engineering and Infrastructure, Legal and Labor Affairs and Consumer's Affairs Committees. In 2013 Board Members elected him Vice President of the Board and he served in this capacity until September 2014 when his term expired.

He is Member of the Board of Directors, in the Interest of Consumers, of PREPA Holdings, LLC, a company registered in Delaware, whose sole owner is PREPA. PREPA Holdings owns PREPANET a communications network infrastructure provider that uses an optical network platform in Puerto Rico to provide wholesale telecommunication services.

Dr. Irizarry Rivera is being paid $150 per hour for his services in this case.

Expert Witness CV

Please refer to attached CV.

Exhibit 3

Synapse Energy Economics Report

Utility Performance Incentive Mechanisms

A Handbook for Regulators

Prepared for the Western Interstate Energy Board

March 9, 2015

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The views presented in this report are those of the authors and do not necessarily represent those of the project management team or reviewers. All errors are our own.

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EXECUTIVE SUMMARY

This report describes how regulators can guide utility performance through the use of performance incentive mechanisms. Regulators have used these mechanisms for many years to address traditional performance areas such as reliability, safety, and energy efficiency. In recent years, these mechanisms have also received increased attention due to regulatory concerns over resilience, utilities' ability to respond to technological change, and the expanding opportunities for distributed energy resources.

Whether performance incentive mechanisms are added onto traditional ratemaking practices, included as part of performance-based regulation (PBR) plans, or considered as a central element of new regulatory and utility business models, they can be used to help improve utility performance. As with all regulatory mechanisms, they should be designed thoughtfully and they should build off of lessons learned from past practices.

Advantages of Performance Incentives

Utility performance metrics and incentives can serve as a valuable tool for regulators for various reasons:

- They help to make regulatory goals and incentives explicit. All regulatory models provide financial incentives that influence utility performance, but many such incentives are not always explicit, recognized, or well understood.
- They allow regulators to offset or mitigate those current financial incentives that are not well aligned with the public interest.
- They allow regulators to improve utility performance in specific areas where historical performance has been unsatisfactory.
- Where utilities are subject to economic and regulatory cost-cutting pressures, they can encourage utilities to maintain, or even improve, customer service, customer satisfaction, and other relevant performance areas.
- They allow regulators to provide specific guidance on important state and regulatory policy goals. In the absence of performance metrics and incentives, utilities have little incentive or guidance for achieving policy goals.
- They allow regulators to give more attention to whether the desired outcomes are achieved, and spend less time evaluating the specific costs and means to obtain those outcomes.
- They can help provide greater regulatory guidance to address new and emerging issues, such as grid modernization, or to attain specific policy goals, such as promoting clean energy resources.
- They can help support new regulatory models that provide utilities with greater incentives to achieve desired outcomes and that tie utilities' profits more to performance than to capital investments.
- They can be applied incrementally, providing a flexible, relatively low-risk regulatory option.

Potential Pitfalls of Performance Incentive Mechanisms

As with all regulatory mechanisms, the success of performance incentive mechanisms is very much dependent upon their design and implementation. Experience to date has shown that there are many potential pitfalls that regulators should be aware of:

Disproportionate rewards (or penalties). Performance incentive mechanisms can sometimes provide rewards (or penalties) that are too high relative to customer benefits or to the utility costs to achieve the desired outcome. Rewards (or penalties) can also be unduly high if they are based on volatile or uncertain factors, especially factors that are primarily beyond a utility's control.

Unintended consequences. Providing financial incentives for selected utility performance areas may encourage utility management to shift attention away from other performance areas that do not have incentives. This creates a risk that performance in the areas without incentives will deteriorate.

Regulatory burden. Performance incentive mechanisms can be costly, time-consuming, or a distraction from more important activities for all parties involved. If this burden becomes too great, it can undermine the value of performance incentive mechanisms.

Uncertainty. Metrics, targets, and financial consequences that are not clearly defined create uncertainty, introduce contention, and are less likely to achieve policy goals. In addition, significant and frequent changes to performance incentive mechanisms create uncertainty for utilities, thereby inhibiting efficient utility planning and encouraging utilities to focus on short-term solutions.

Gaming and manipulation. Every performance incentive mechanism carries the risk that utilities will game the system or manipulate results.

In most cases, these pitfalls can be managed through sound design and implementation of performance metrics and incentives. They can also be mitigated by ongoing evaluation of and improvements to the incentive mechanisms. Chapter 6 presents a more detailed discussion of these pitfalls and recommendations for how to avoid them.

Performance Incentives Can Be Used in Any Regulatory Context

One of the advantages of performance metrics and incentives is that they can be used in any regulatory context. However, it is critical that performance metrics and incentives be specifically tailored to the existing (or anticipated) regulatory context in each state, to ensure that they adequately complement and balance the financial incentives provided by that regulatory context.

In a state with traditional cost-of-service regulation, performance metrics and incentives might be especially important to address areas with historically poor performance; to address areas

where regulators see opportunities for greater efficiencies or reduced costs; and to complement the existing regulatory incentives, such as incentives associated with capital investments, regulatory lag, increased sales, risk, and innovation.

In a state with performance-based regulation, performance metrics and incentives might be especially important to prevent the degradation of service as a result of pressures to reduce costs, and to complement the existing regulatory incentives, such as those provided by price (or revenue) caps, fixed periods between rate cases, and cost trackers.

In a state developing new regulatory and utility models, performance metrics and incentives might be especially important to re-direct utility management priorities toward desired performance outcomes, and shift the source of utility revenues away from capital investments and toward those desired outcomes.

In any state, performance metrics and incentives can be used to promote resources that are not supported or encouraged by the existing regulatory system, such as energy efficiency and renewable resources.

In any state, performance metrics and incentives can be used to provide guidance on how utilities can meet state regulatory policy goals, such as improving reliability and resiliency, empowering customers to reduce bills, or minimizing the cost of complying with the EPA Clean Power Plan.

In any state, performance metrics and incentives can be used to encourage utilities to investigate and adopt innovative technologies that are not otherwise supported by the existing regulatory system, such as distributed generation, grid modernization, storage technologies, or practices to support electric vehicles.

Key Principles and Recommendations

Based on our review of the literature and the lessons learned from various jurisdictions, we provide numerous recommendations and principles for designing effective performance metrics and incentive mechanisms. These are summarized in the table below.

Table 1. Key Principles and Recommendations

Regulatory Contexts **(Chapter 2)**	• Articulate policy goals • Recognize financial incentives in the existing regulatory system • Design incentives to modify, supplement or balance existing incentives • Address areas of utility performance that have not been satisfactory or are not adequately addressed by other incentives
Performance Metrics **(Chapter 3)**	• Tie metrics to policy goals • Clearly define metrics • Ensure metrics can be readily quantified using reasonably available data • Adopt metrics that are reasonably objective and largely independent of factors beyond utility control • Ensure metrics can be easily interpreted and independently verified
Performance Targets **(Chapter 4)**	• Tie targets to regulatory policy goals • Balance costs and benefits • Set realistic targets • Incorporate stakeholder input • Use deadbands to mitigate uncertainty and variability • Use time intervals that allow for long-term, sustainable solutions • Allow targets to evolve
Rewards and Penalties **(Chapter 5)**	• Consider the value of symmetrical versus asymmetrical incentives • Ensure that any incentive formula is consistent with desired outcomes • Ensure a reasonable magnitude for incentives • Tie incentive formula to actions within the control of utilities • Allow incentives to evolve

Questions for Regulators

Regulators may wish to ask several questions to help inform their decisions on whether and how to proceed with performance metrics and incentives:

- How well does the existing regulatory framework support utility performance?
- How well does the existing regulatory framework support state energy goals?
- What are the policy options available to improve utility performance?
- Are industry, technology, customer, or market conditions expected to change?
- Does the commission wish to articulate specific, desired performance outcomes? If so, in what performance areas?
- Does the commission prefer to oversee utility expenses and investments after the fact (e.g., through rate cases and prudence reviews), or to guide performance outcomes before investments are made?

Implementation Steps

Once a determination has been made to implement performance metrics or incentive mechanisms, the following steps can be implemented. These can be implemented incrementally to allow for each step to inform the subsequent step, or they can be implemented all at once.

1. Articulate goals**.** The first step is to identify and articulate regulatory policy goals. These goals should help inform choices of performance areas, targets, and penalties.

2. Assess current incentives**.** Next it is critical to understand the financial incentives created by the current or anticipated regulatory context.

3. Identify performance areas that warrant performance metrics**.** Performance metrics may be warranted for traditional performance areas or new and emerging areas.

4. Establish performance metric reporting requirements**.** Review performance reports to monitor those areas identified above, to identify any performance areas that may require targets.

5. Establish performance targets, as needed**.** Establish targets to provide utilities with clear messages regarding the level of performance expected by regulators. Review results to determine whether any performance areas warrant rewards or penalties.

6. Establish penalties and rewards, as needed. Establish rewards or penalties to provide direct financial incentives for maintaining or improving performance.

7. Evaluate, improve, repeat. The effectiveness of the mechanisms should be monitored and evaluated on a regular basis to determine whether there is a need for improvement.

1. INTRODUCTION

Purpose and Overview

This report describes how regulators can guide utility performance through the use of performance incentive mechanisms (sometimes abbreviated here as PIMs). Regulators have used these mechanisms for many years to address traditional performance areas such as reliability, safety, and energy efficiency. In recent years, these mechanisms have also received increased attention due to regulatory concerns over resilience, utilities' ability to respond to technological change, and the expanding opportunities for distributed energy resources. The ultimate objective of performance metrics and incentives is to better align utility regulatory and financial incentives with the public interest.

In the following chapters, we identify many of the metrics and performance incentives that regulators have used to monitor and evaluate utility performance, as well as emerging metrics and incentives that are being discussed in jurisdictions facing new issues and challenges, such as integration of renewable and distributed energy resources.[1] We provide a set of principles and recommendations for regulators, based on our review of the large amount of literature on these topics and the lessons learned from the case studies that we reviewed. Our research is primarily focused on electric utilities, but we have included some metrics specific to natural gas utilities as well.

This handbook builds off of a Western Interstate Energy Board report titled *New Regulatory Models* (Aggarwal and Burgess 2014).[2] That report provides a number of examples of how performance standards have been used by regulators.

Industry Changes and Pressures

Traditional cost-of-service regulation was originally designed in an era of significantly increasing sales and decreasing marginal costs, where the primary decisions required by utilities were related to how much and what type of generation and transmission to build to meet growing customer demand, and where the main goal was to ensure just and reasonable rates. The conditions currently facing the utility industry have changed considerably, for instance:

- Retail sales are increasing at much lower levels than in the past, and some utilities are experiencing declining sales. Sales may drop even further as customers adopt more demand-side measures, especially energy efficiency, distributed generation, and storage technologies.

[1] In fact, even where utility commissions have not implemented specific utility standards, utilities already comply with a variety of industry standards set by organizations such as the Institute of Electrical and Electronics Engineers (IEEE), the Occupational Safety and Health Administration (OSHA), the North American Electric Reliability Corporation (NERC), the Federal Energy Regulatory Commission (FERC), the Financial Accounting Standards Board, and the Environmental Protection Agency (EPA).

[2] The Phase I report is available here: http://westernenergyboard.org/wp-content/uploads/2014/03/SPSC-CREPC_NewRegulatoryModels.pdf

On the other hand, electric vehicles and other forms of electrification could lead to increased sales.

- Many utilities are facing the need to replace aging infrastructure, which may require significant capital investments that will not necessarily lead to reduced costs or increased sales.
- Utilities have many more options to choose from, in terms of generation, transmission, and distribution technologies, as well as more ways to address customer needs through resources on the customer side of the meter (including energy efficiency, demand response, distributed generation, automated metering technologies, and customer-facing smart grid options).
- Regulators have established a variety of public policy goals beyond simply maintaining just and reasonable rates. These include goals related to consumer protection, promoting competitive markets, encouraging and implementing demand-side resources, encouraging and implementing renewable resources, improving responses to major outages, and meeting carbon and other environmental constraints.

Some states are finding that traditional cost-of-service regulation may not provide utilities with the financial incentives to respond effectively to all of these developments. In some cases, traditional regulatory practices may provide financial incentives that hinder utilities from addressing these challenges. Consequently, performance metrics and incentives may provide an opportunity to better align utility incentives with evolving regulatory goals and the public interest in general.

Performance Metrics and Incentive Mechanisms

In this report we focus on both performance incentive mechanisms that use financial rewards and penalties to encourage utilities to meet specific targets, as well as performance metrics for simply monitoring and reporting utility performance. The relationship between the steps to implement these regulatory tools is shown in Figure 1 below.

Figure 1. Performance Incentive Mechanisms vs. Performance Metrics

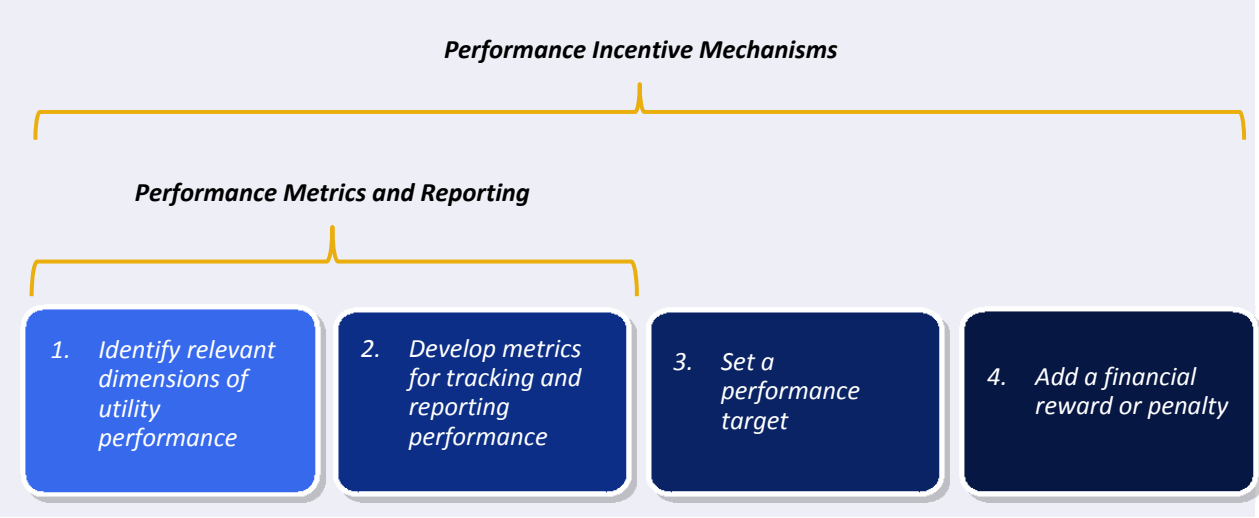

Figure 1 also highlights the various components involved in creating performance metrics and incentives.

These steps can be taken incrementally over time until the desired level of incentives is reached. First, performance metrics and reporting can be established to monitor utility performance. Second, specific performance targets can be set to provide a clear signal regarding the level of performance that is expected of a utility. Finally, financial rewards and penalties can be applied to increase the utility's motivation to achieve the performance targets. This incremental approach allows regulators and utilities to learn from each step before designing and implementing the next step. It also enables regulators to review utility performance without implementing financial rewards or penalties where such incentives are not necessary.

Alternatively, these four steps can be applied all at once, in the form of performance incentive mechanisms. This would be appropriate in those cases where regulators (a) have performance areas, metrics, and goals in mind, and (b) recognize the need for rewards and penalties.

Advantages of Performance Metrics and Incentive Mechanisms

Utility performance metrics and incentives can serve as a valuable tool for regulators for various reasons. For example:

- They help to make regulatory goals and incentives explicit. All regulatory models provide financial incentives that influence utility performance, but many such incentives are not always explicit, recognized, or well understood.
- They allow regulators to offset or mitigate those current financial incentives that are not well aligned with the public interest.
- They allow regulators to improve utility performance in specific areas where historical performance has been unsatisfactory.
- Where utilities are subject to economic and regulatory cost-cutting pressures, they can encourage utilities to maintain, or even improve, customer service, customer satisfaction, and other relevant performance areas.
- They allow regulators to provide specific guidance on important state and regulatory policy goals. In the absence of performance metrics and incentives, utilities have little incentive or guidance for achieving policy goals.
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- They can help provide greater regulatory guidance to address new and emerging issues, such as grid modernization, or to attain specific policy goals, such as promoting clean energy resources.
- They can help support new regulatory models that provide utilities with greater incentives to achieve desired outcomes and that tie utilities' profits more to performance than to capital investments.
- They can be applied incrementally, providing a flexible, relatively low-risk regulatory option.

2. REGULATORY CONTEXT

Evolving Regulatory Contexts

As Peter Bradford noted in the book *Regulatory Incentives for Demand-Side Management*: "All ratemaking is incentive ratemaking. It rewards some patterns of conduct and deters others" (Bradford 1992). In other words, every regulatory environment contains a variety of financial incentives that will affect utility performance. In designing performance metrics and incentive mechanisms, it is critical to first understand the incentives that existing under the existing regulatory environment.

There is currently a wide variety of regulatory systems across the United States, as each state has adopted different regulatory mechanisms over time to address its own needs. However, it is useful to discuss three categories of regulatory contexts for the purpose of describing how performance incentives might fit into each. These categories include: cost-of-service (COS) regulation, performance-based regulation (PBR), and new regulatory models. These regulatory contexts are summarized in Table 2 and discussed below.

It is important to emphasize that these three categories are simplistic, by design, relative to the many variations of regulatory elements in use today. Few states fall clearly into one category or another. The purpose of this table is simply to identify the key distinguishing features among these three frequently-discussed categories.

Table 2. Three Categories of Regulatory Systems

Regulatory Element	Cost of Service Regulation	Performance-Based Regulation	New Regulatory Models Proposed to Date
Basis for initial rates	Based on cost-of-service studies using a test year	Based on cost-of-service studies using a test year	Would likely be based on cost-of-service studies; may be influenced by utility business plans
Frequency of rate cases	Utilities apply for rate cases as needed or required, typically to recover large capital investments or revenue attrition	Pre-determined, fixed period of time (e.g., five years) to encourage efficient management and operations	Pre-determined, fixed period of time (e.g., eight years) to encourage efficient management and operations
Base rate adjustments between rate cases	Generally none	Price cap modified to account for factors such as inflation and productivity	Price cap may be modified to allow for inflation, productivity, or costs included in utility business plans
Cost trackers	Generally limited to costs beyond utility control	May include trackers for capital costs not easily accounted for in the price cap	Would likely include trackers for capital costs identified in utility business plans
Prudency reviews	Generally applied after the fact, where excessive costs become obvious	Applied after the fact, in cases where excessive costs become obvious	Applied after the fact; would likely be limited, based on utility business plans
Resource Planning	Option to include integrated resource planning	Option to include integrated resource planning	Strategic business plans would be used to inform cost trackers and adjustments between rate cases
Revenue regulation	Option to implement a decoupling mechanism	Option to include a revenue cap, instead of a price cap	Would likely include a revenue cap, instead of a price cap
Performance Incentive Mechanisms	Focus on areas of poor performance or opportunities for improvement	Focus on areas that may experience service degradation in response to pressure to reduce costs	Designed to create incentives to achieve a broad set of desired outcomes

Traditional Cost-Of-Service Regulation

Traditional cost-of-service regulation is characterized by the following elements:

1. Base rates are set in a rate case, typically based on known and measurable costs identified in a test year (historical, future, or a hybrid).

2. Frequency of rate cases, which typically occur at the request of the utility for the purpose of recovering major capital expenditures or addressing revenue attrition. Commissions generally have the authority to request that a utility file a rate case, but this rarely occurs in practice.

3. Base rates generally remain constant until the next rate case.

4. Cost trackers and rate riders may be applied to some costs that are partly or wholly beyond a utility's control.

5. A utility's allowed return on equity is set by the commission in a rate case, and this return is earned on all investments that are placed into the utility's rate base. Actual profits may deviate from the allowed return on equity, depending upon many factors both within and outside a utility's control.

6. Prudency reviews are used retrospectively (after the investment has occurred) to ensure costs are reasonable. Cost disallowances as a result of prudency reviews are rarely applied, and then only in cases of egregious mismanagement or cost overruns.

There are several significant, widely-recognized financial incentives underlying traditional cost-of-service regulation. The most significant incentives include the following:

Capital expenditures. When a utility's rate of return is greater than the cost of borrowing, utilities have a financial incentive to maximize their capital expenditures in order to increase rate base and thereby increase profits. This is often referred to as the Averch-Johnson effect. In theory, prudency reviews can mitigate some of the incentive to maximize capital expenditures. However, in practice prudency reviews and disallowances are rare, burdensome, and are mostly applied to large capital expenditures.

Sales. Traditional cost-of-service regulation creates an incentive for a utility to maximize sales in order to increase profits. Whenever a utility's short-term marginal costs are lower than its average costs (i.e., the costs embedded in rates), then it can increase profits by increasing sales. This "throughput incentive" poses a significant financial disincentive to utilities with regard to energy efficiency and distributed generation. This incentive to increase sales, combined with the utility focus on capital expenditures, significantly undermines utility motivation to apply least-cost planning principles and to develop the most cost-effective balance of supply-side and demand-side resources. As a consequence, customers must cover significantly higher energy costs than necessary.

Regulatory lag. Regulatory lag refers to the period between rate cases when the utility is incurring costs, but rates have not yet been adjusted to recover these outlays. Some industry observers claim that regulatory lag provides utilities with incentives for efficient management and cost control, because utilities are able to benefit from any cost savings that they create between rate cases. On the other hand, regulatory lag can pose financial challenges for a utility, causing it to apply for rate cases more frequently. In general, the incentive created by regulatory lag depends upon whether the utility's average costs are decreasing or increasing relative to revenues (Costello 2014).

Risk. Under traditional cost-of-service regulation, utilities are generally permitted to recover all capital costs, with a profit. This certainty of cost recovery provides little incentive to reduce risks associated with major capital expenditures—expenditures that can involve considerable uncertainty and risk (Binz et al. 2012). Cost trackers and rate riders further eliminate risks to the utilities by shifting all of the risks associated with such costs to customers. For example, fuel adjustment charges can reduce incentives for the utility to optimize its generation portfolio to account for the risk of fuel cost increases.

Innovation. There is little incentive for utilities to adopt innovative practices, technologies, or resources under traditional cost-of-service regulation. Utilities have considerable certainty that regulators will allow them to recover costs of prudently incurred investments in conventional projects, but much less certainty about being allowed to recover costs associated with innovative practices and technologies with uncertain results.

Many states continue to rely upon some form of cost-of-service regulation, even in states that have restructured their electricity markets. Regulators in these states frequently employ a variety of tools to improve the alignment of regulatory incentives with the public interest, such as revenue decoupling, forward-looking costs on some items, and performance incentive mechanisms.

Performance incentive mechanisms under traditional cost-of-service regulation typically have been developed to improve service or reduce costs, for example, reliability, power plant performance, cost of renewable generation, or O&M costs. Some states have developed performance incentive mechanisms to support specific resource goals, such as increasing renewable energy generation, energy efficiency savings, and resource diversity.

Performance-Based Regulation

Performance-based regulation (PBR) was introduced in the US electric sector in the 1980s and became popular in the 1990s as an alternative to cost-of-service regulation, particularly in states that introduced retail competition (Sappington et al. 2001). One of the goals of PBR was to improve upon the financial incentives provided under traditional cost-of-service regulation, and to provide incentives more focused on operational efficiency and cost reduction.

Performance-based regulation is characterized by the following elements:

1. The time period between rate cases is fixed at the outset of each period, and is designed to be long enough to provide the utility with incentives to reduce operating costs and keep the operational savings between rate cases.

2. A price cap (or a revenue cap) is used to set prices for a fixed period of time.

3. Automatic adjustments to the price (or revenue) cap may be established to account for expected cost changes between rate cases. These frequently include automatic increases to account for inflation, coupled with automatic reductions to encourage productivity improvements. Many states adopted the "RPI – X" formula, where RPI is the retail price index and "X" is a productivity factor.

4. Trackers may be established to allow the utility to recover certain types of costs outside of the price (or revenue) cap, typically costs that are volatile and beyond a utility's control. Some states also allow trackers for major capital expenditures, because these costs are large and lumpy, and may therefore be difficult to accommodate in a fixed price (or revenue) cap.

5. Performance incentives are applied for key aspects of customer service, in order to ensure that utilities do not allow service to degrade in their pursuit of reduced costs and greater efficiencies.

6. Earnings sharing mechanisms are established to ensure that the utility's earned profits are neither excessive nor insufficient.

There are many different variations of PBR used in the United States today, incorporating different forms of the elements listed above.[3] The WIEB report *New Regulatory Models* referenced above provides several examples (Aggarwal and Burgess 2014). Also, there are many terms used to describe different combinations of these elements. The term "alternative ratemaking" is sometimes used synonymously with PBR. Some states use the term "multi-year rate plan" to refer to rates that are set for a fixed period of time, with automatic adjustments and cost trackers between rate cases. Such multi-year rate plans may or may not include performance incentives.

In theory, PBR is intended to provide more direct financial incentives for utilities to reduce costs, without heavy-handed, ongoing oversight from regulators. The key to this incentive is the fixed period between rate cases. If the utility succeeds in keeping its costs below its allowed revenues, it can keep the excess revenues. Capital investments made during the period should lead to reduced operations and maintenance costs, which would accrue to the utility until the next rate case.

In practice, there are many incentives embedded in PBR mechanisms, with various implications:

- The fixed period between rate cases should provide utilities with an incentive to reduce operating costs. However, the impact of this incentive depends upon the length of time between rate cases, where relatively shorter periods will result in more muted incentives.

- The productivity factor should provide an incentive to increase productivity. However, establishing the right productivity factor can be difficult, particularly when (a) there are few comparable peer utilities for comparison purposes; (b) utilities need to replace aging infrastructure; (c) utilities (or the industry) are in a period of rapid transition, in terms of markets, technologies, or operations; and (d) historical costs and practices are not a good indication of what future costs and practices will be.

- Placing certain types of costs into trackers eliminates the utility's incentive to optimize those costs and transfers the risks associated with those costs to ratepayers.

- If major capital expenditures are recovered through a fully reconciling cost tracker, utilities have little incentive to ensure that those costs are planned and managed as efficiently as possible. In such a case, it may be important to design a major capital cost tracker so as to provide such

[3] For a relatively recent survey, see Lowry, Makos, and Waschbusch 2013.

incentives, for example by establishing a mechanism that requires the utility to absorb a significant portion of any cost overruns.

- If major capital expenditures are not recovered through a cost tracker, it can become much more challenging to establish a price (or revenue) cap and a productivity index that provides cost control incentives while allowing the utility to adequately recover capital costs and protect consumers.[4]

- Performance incentives can be useful to prevent service degradation in light of pressures to reduce costs, or to improve performance in some areas. However, performance incentives must be designed carefully to achieve the desired results. The effective design of performance incentives is discussed throughout later chapters of this report.

In recent years, several PBR investigations have attempted to address some of the challenges associated with the incentives and implications listed above.[5] In addition, many of these issues have been investigated and addressed by Ofgem, the electricity and gas regulator in the United Kingdom, the first regulator to apply PBR to electricity utilities, and the creator of the model upon which many US PBR designs were based. After several decades of experience with PBR, Ofgem has significantly modified its PBR mechanism. The new mechanism being developed in the UK is referred to as RIIO (Revenues = Inputs + Incentives + Outcomes), and is discussed in some detail in Appendix A.

New Regulatory Models

In many states, electricity load growth has slowed significantly due to many factors, including increased use of distributed energy resources (DER) such as energy efficiency and distributed generation. At the same time, the electric industry is experiencing many forces that frequently increase costs, including: the need to replace aging infrastructure, increased transmission needs, requirements to reduce environmental impacts, and pressure to modernize the electric grid. Combined, these factors are simultaneously increasing the need for utility capital expenditures while reducing the revenue from sales growth they have historically relied upon. Traditional cost-of-service regulation and traditional PBR mechanisms may be ill-equipped to handle these challenges, and may not provide utilities with the incentives or the regulatory guidance needed to address them.

Some jurisdictions and stakeholders have begun to investigate new regulatory and utility business models to address the limitations of the current systems.[6] Several proposals in these contexts focus on

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[4] See, for example, Direct Testimony of Tim Woolf before the Maine Public Utilities Commission in Docket No. 2013-168, *Central Maine Power Request for Approval of an Alternative Rate Plan (ARP 2014)*, December 12, 2013.

[5] See, for example, Maine Public Utilities Commission Docket No. 2013-168 and Hawaii Public Utilities Commission Docket No. 2013-0141.

[6] See, for example, the New York Public Service Commission Case Number 14-M-0101, *Reforming the Energy Vision*; Hawaii Public Utilities Commission, Decision and Order No. 32052, Exhibit A: *Commission's Inclinations on the Future of Hawaii's Electric Utilities,* and Hawaii Public Utilities Commission Docket 2013-0141; e21 Initiative 2014; GTM Research 2015; and Lehr 2013.

PBR mechanisms, with the overall goal of creating financial incentives that are based more on performance and less on recovery of costs.[7]

These proposals include several modifications to the way that PBR is currently applied in the United States. For example:

1. Expand the types of performance metrics applied to utilities to include emerging performance areas such as system efficiency, customer engagement, network support services, or environmental goals (see Section 3.2). This is intended to provide regulatory guidance and financial incentives regarding the variety of outcomes that are important for delivering quality service and meeting state energy policy goals.

2. Shift the financial incentive away from investments in rate base and towards achieving performance goals. This can be accomplished by reducing the portion of revenue requirements that a utility recovers from rate base, and comparably increasing the portion of revenue requirements that can be recovered from performance metrics.[8]

3. Establish longer periods between rate cases. This is intended to increase the magnitude of the financial incentive to increase productivity and reduce costs between rate cases.

4. Provide more up-front guidance from regulators and stakeholders with regard to future major capital expenditures. This is intended to provide utilities with greater flexibility and incentive to adopt innovative and emerging technologies and practices.

Many of these modifications are consistent with those that have been adopted recently in the UK RIIO model, suggesting that the lessons learned from the UK PBR experience may be relevant to the new regulatory and utility business models being considered in the United States. This is discussed in more detail in Appendix A.

Some states have already established performance metrics or incentive mechanisms to address emerging performance areas, such as customer retail choice, grid modernization, and distributed generation interconnections. Examples and further discussion of metrics and incentives to address these emerging areas are provided in Chapter 3.

Performance Metrics and Incentives Can Be Applied in Any Regulatory Context

One of the advantages of performance metrics and incentives is that they can be used in any regulatory context. However, it is critical that performance metrics and incentives be specifically tailored to the

[7] See, for example, Energy Industry Working Group 2014; Malkin and Centolella 2014; Blue Planet Foundation 2014; e21 Initiative 2014; Massachusetts Grid Modernization Steering Committee 2013.

[8] For example, under RIIO, the British distribution utilities face rewards and penalties of approximately five percent of their base distribution revenues (CEPA LLP 2013).

existing (or anticipated) regulatory context in each state, to ensure that they adequately complement and balance the financial incentives provided by that regulatory context.

In a state with traditional cost-of-service regulation, performance metrics and incentives might be especially important to address areas with historically poor performance, or areas where regulators see opportunities for greater efficiencies or reduced costs. Performance metrics and incentives should be designed to complement the existing regulatory incentives, such as incentives associated with capital investments, regulatory lag, increased sales, risk, and innovation.

In a state with performance-based regulation, performance metrics and incentives might be especially important to prevent the degradation of service as a result pressures to reduce costs. Performance metrics and incentives should be designed to complement the existing regulatory incentives, such as those provided by price (or revenue) caps, fixed periods between rate cases and cost trackers.

In a state developing new regulatory and utility models, performance metrics and incentives might be especially important to re-direct utility management priorities toward desired performance outcomes, and shift the source of utility revenues away from capital investments and toward those desired outcomes. Performance metrics should be applied to the priority performance areas, and performance incentives should be designed to complement, offset, or mitigate existing financial incentives.

In any state, performance metrics and incentives can be used to promote resources that are not supported or encouraged by the existing regulatory system, such as energy efficiency and renewable resources.

In any state, performance metrics and incentives can be used to provide guidance on how utilities can meet state regulatory policy goals, such as improving reliability and resiliency, empowering customers to reduce bills, or minimizing the cost of complying with the EPA Clean Power Plan.

In any state, performance metrics and incentives can be used to encourage utilities to investigate and adopt innovative technologies that are not otherwise supported by the existing regulatory system, such as distributed generation, grid modernization, storage technologies, or practices to support electric vehicles.

3. PERFORMANCE METRICS

3.1. Introduction

There are significant advantages of establishing performance metrics—even without administering financial incentives. Reporting utility performance facilitates regulatory oversight and encourages utilities to strive for better performance, as subpar performance is likely to result in negative public response and greater regulatory scrutiny. Implementing tracking and reporting metrics is straightforward and low risk. It can be designed to present little administrative burden on either regulators or utilities, while providing valuable information.

3.2. Performance Dimensions That May Warrant Metrics

Performance incentive mechanisms have historically been used to help achieve traditional goals of reliable, safe, and low-cost utility service. Today, new incentives are being proposed to attain a whole new set of energy policy objectives, such as environmental quality, fuel diversity, fast-responding resources, and customer empowerment, to name a few.

For example, states throughout the West are facing stricter environmental standards for criteria air pollutants, water use, and carbon emissions, and many states are experiencing rapid growth in rooftop solar PV.[9] In response to these new regulations and the growth of distributed generation, utilities are investing billions of dollars in new renewable energy capacity[10] and transmission and distribution infrastructure (including smart grid technologies), and will need to procure significant amounts of resources to accommodate variations in net load (including demand response, advanced wind and solar control technologies, and storage).[11]

To ensure that utilities are operating efficiently and meeting energy policy goals, regulators may wish to track a variety of dimensions of utility performance, and possibly also implement financial rewards or penalties in areas where additional incentive is needed. The figure below highlights a variety of dimensions of utility performance that may warrant tracking and reporting or incentives. Performance dimensions generally fall into three categories: traditional goals, new business models, and environmental goals. Some aspects of utility performance have been important in more than one area;

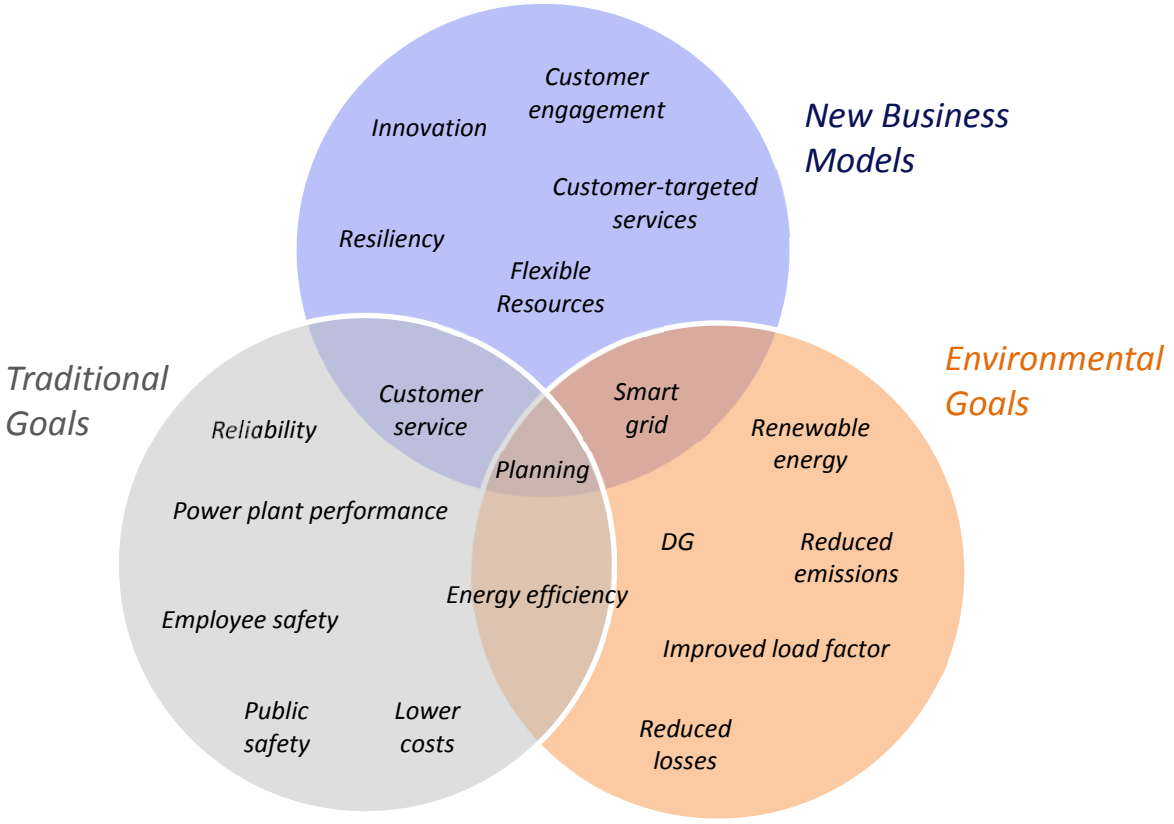
[9] Residential installations of PV are expanding at a rate of more than 50 percent year-over-year, with California, Arizona, and Colorado among the top states (SEIA/GTM Research 2013).

[10] The Western Electricity Coordinating Council (WECC) predicts that renewable resources in the West (excluding conventional hydro) will produce nearly 17 percent of the region's energy by 2022 (WECC Staff 2013).

[11] During certain times of the year, total system load net of solar and wind changes rapidly producing an effect known as the "duck curve." These very fast changes to net load (total load minus the output of variable resources) require fast-ramping resources to mitigate reliability impacts caused by the sudden appearance or departure of variable energy resources (Lazar 2014).

for example, successful implementation of cost-effective energy efficiency can reduce emissions associated with fossil generation (an environmental benefit) and defer or avoid new generation, capacity, transmission, and distribution resources, resulting in cost savings (a traditional focus of utility performance regulation). Planning has a critical role in informing regulatory outcomes across all three areas, and thus it takes a central location in the Venn diagram below.

Figure 2. Dimensions of Utility Performance That May Warrant Tracking or Incentives



Traditional Performance Areas

Several aspects of utility performance have a long history of being tracked and reported to state utility commissions, federal regulatory agencies, or otherwise made publicly available. These traditional performance areas are reliability, safety, customer satisfaction, power plant performance, and costs; as indicated in Table 3.

Metrics for monitoring these traditional performance areas are generally well developed, and the data readily available. Where standard metric definitions exist and have been adopted by utilities, regulators may wish to track and compare performance across utilities within a state or across the region. (However, peer group comparisons may not be appropriate for the determination of rewards and penalties without controlling for differences among utilities. This is discussed in greater detail in later sections.)

Table 3. Traditional Performance Areas

Performance Dimension		Purpose
	Reliability	To indicate the extent to which service is reliable and interruptions are remedied quickly
	Employee Safety	To ensure that employees are not subjected to excessive risks
	Public Safety	To ensure that the public is not subjected to excessive risks
	Customer Satisfaction	To ensure that the utility is providing adequate levels of customer service
	Plant Performance	To indicate the performance of specific generation resources
	Costs	To indicate the cost of supply side resources

Innovative and Emerging Performance Areas

In order to address evolving industry challenges, regulators are beginning to focus attention on new aspects of utility performance, including overall system efficiency such as system load factor, use per customer, etc.; customer engagement (including tools to empower customers to better manage their bills); network support services; environmental impacts; and clean energy goals. Examples of these emerging performance areas and metrics for tracking them are provided in Table 4.

Table 4. Emerging Performance Areas

Performance Dimension		Purpose
	System Efficiency	To indicate the extent to which the utility system as a whole is being operated more efficiently
	Customer Empowerment	To indicate the extent to which customers are participating in demand-side programs or installing demand-side resources
	Network Support Services	To indicate the extent to which customers and third-party service providers have access to networks
	Environmental Goals	To indicate the extent to which the utility and its customers are reducing environmental impacts, particularly related to climate change

3.3. Defining Metrics

Simply defined, a metric is a standard of measurement. In assessing utility performance, metrics play a central role in enabling regulators to determine how well a utility is performing in the areas of interest. Defining a metric typically involves the following:

- Specific data definitions
- A precise formula used to quantify each metric

- Data collection and analysis practices and techniques, including identification of the entity responsible for collecting and reporting the data
- Requirements for measurement and reporting
- Verification techniques and entity responsible for verifying data

For example, a common metric for measuring reliability is the sustained average interruption duration index, SAIDI. The data include the average number of utility customers and the number of sustained outages, and may or may not exclude outages from major storms. However, to employ this metric, the definition of both a "sustained outage" and "major storm" needs to be clarified, the frequency of measurement (e.g., annual or quarterly) defined, and a verification process established.

Table 5 through Table 10 contain metrics for traditional performance areas that regulators may find useful for measuring utility performance, including metrics for reliability, employee safety, public safety, customer satisfaction, plant performance, and costs. Table 11 through Table 14 contain metrics for emerging performance areas, including system efficiency, customer engagement, network support services, and environmental goals.

These tables are intended to cover a wide range of issues of importance to regulators, but do not exhaust the universe of metrics that regulators may wish to consider. Nor are these metrics necessarily the "best" means of measuring performance in a certain area. The first step in determining which metrics will best serve the needs of a particular state is to articulate the policy goals that the state wishes to achieve. Regulators should then design metrics that are capable of accurately and reliably measuring progress toward these goals. The metrics includes in the tables below (and their formulas) provide examples of existing or potential metrics that could be implemented, but may not necessarily suit a particular jurisdiction's needs.

Examples of Innovative Performance Metrics

As the electric industry transforms, new metrics are being proposed to measure how well utilities meet evolving customer needs. Many of these existing or proposed performance metrics are described in more detail in the appendix, including:

- *Peak load reductions (Illinois)*
- *Stakeholder engagement (Illinois, Hawaii)*
- *Customers accessing energy usage portals (Illinois)*
- *Effective resource planning (Hawaii)*
- *System load factor (Illinois)*
- *Line loss reductions (UK, Illinois)*
- *Distributed generation interconnections (UK, Illinois, Hawaii)*
- *Cost of renewable energy (California)*
- *Carbon intensity (Hawaii)*
- *Renewable energy curtailments (Hawaii)*

See Appendix A for detailed case studies describing some of these metrics and performance incentive mechanisms.

Table 5. Reliability Performance Metrics

Metric	Purpose	Metric Formula
System Average Interruption Duration Index (SAIDI)	Indicator of sustained interruptions experienced by customers	Total customer minutes of sustained interruptions / total number of customers
System Average Interruption Frequency Index (SAIFI)	Indication of how many interruptions are experienced by customers	Total number of customer interruptions / total number of customers
Customer Average Interruption Duration Index (CAIDI)	Indicator of the length of interruptions experienced by customers	Total minutes of sustained customer interruptions / total number of interruptions
Momentary Average Interruption Frequency Index (MAIFI)	Indicator of momentary interruptions experienced by customers	Total number of momentary customer interruptions per year / total number of customers
Power quality	Indicator of voltage changes, which can cause damage to end use equipment and frequency deviations	Numerous metrics indicating changes in voltage including transient change, sag, surge, undervoltage, harmonic distortion, noise, stability, and flicker; CPS 1 and 2 that measure frequency excursions

Table 6. Employee Safety Performance Metrics

Metric	Purpose	Metric Formula
Total Case Rate (TCR)	Indicator of employee injuries, fatalities, and productivity losses due to work-related incidents	(Number of work-related deaths, days away from work, job transfers or restrictions, and other recordable injuries and illnesses times 200,000) / Employee hours worked[12]
Days Away, Restricted, and Transfer (DART) case rate	Indicator of employee injuries, restrictions, and productivity losses due to work-related incidents	(Number of work-related days away from work and job transfers or restrictions due to work accidents times 200,000) / Employee hours worked
Days Away From Work (DAFWII) case rate	Indicator of employee injuries and productivity losses due to work-related incidents	(Number of work-related days away from work due to work accidents times 200,000) / Employee hours worked

Table 7. Public Safety Performance Metrics

Metric	Purpose	Metric Formula
Incidents, injuries, and fatalities (electric)	Indicator of incidents, injuries, and fatalities associated contact with the electric system by members of the public	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by type of activity
Emergency response time (electric)	Indicator of speed of response to emergency situations involving the electric system	Percent of electric emergency responses within 60 minutes each year
Incidents, injuries, and fatalities (gas)	Indicator of incidents, injuries, and fatalities associated with the gas system by members of the public	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by apparent cause
Emergency response time (gas)	Indicator of speed of response to emergency situations involving the gas system	Average minutes for gas emergency response
Leak repair performance (gas)	Indicator of speed of response to non-emergency situations involving the gas system	Average days for repair of minor and non-hazardous leaks

[12] 200,000 represents the number of working hours per year for 100 full-time equivalent employees (40 hours a week for 50 weeks). (U.S. BLS 2013)

Table 8. Customer Satisfaction Performance Metrics

Metric	Purpose	Metric Formula
Call center answer speed	Indicator of customer ease of contacting utility	Percentage of calls answered within 30 seconds
Transaction surveys	Indicator of how well the utility is meeting customer needs based on recent contact with utility	Percentage of customers satisfied with their recent transaction with the utility
Customer complaints	Indicator of how well the utility is meeting customer needs	Formal complaints to commission (per 1,000 customers) over a set period. May also track complaints resolved.
Order fulfillment	Indicator of response time to service requests and outages	Speed with which orders for service installation and termination, outage responses, and meter re-reading are fulfilled
Missed appointments	Indicator of how well the utility is meeting customer needs	Percentage of appointments not met for meter replacements, inspections, or any other appointments in which the customer is required to be on the premises
Avoided shutoffs and reconnections	Indicator of efficient provision of services to low income customers	Disconnects and reconnections avoided by customer percentage of income payment plans or other means
Residential customer satisfaction	Indicator of how well the utility is meeting the needs of residential customers	Electric Utility Residential Customer Satisfaction index, Gas Utility Residential Customer Satisfaction index
Business customer satisfaction	Indicator of how well the utility is meeting the needs of business customers	Electric Utility Business Customer Satisfaction index, Gas Utility Business Customer Satisfaction index

Table 9. Plant Performance Metrics

Metric	Purpose	Metric Formula
Fuel usage	Indication of the fuel consumption by specific generation resources	Quantity of fuel burned
Heat rate	Indication of the efficiency of specific generation resources	Average BTU per kWh net generation
Capacity factor	Indication of actual generation by a specific resource	Average energy generated for a period / energy that could be generated at full nameplate capacity

Table 10. Cost Performance Metrics

Metric	Purpose	Metric Formula
Capacity costs	Indicator of costs of peak consumption	Cost per kW of installed capacity
Total energy costs	Indicator of costs of all hours consumption	Expenses per net kWh
Fuel cost	Indicator of costs of fuel input	Average cost of fuel per kWh net gen and per Million BTU; total fuel costs
Effective resource planning*	Indicator of efficacy, breadth, and reasonableness of resource planning process	Numerous metrics regarding incorporation of stakeholder input, consideration of all relevant resources, use of appropriate assumptions and modeling tools, etc.
Cost-Effective Alternative Resources*	Indicator of system savings through use of cost-effective alternatives to traditional infrastructure	$/MW cost of alternative portfolio relative to the $/MW cost of traditional investment

**See Appendix A, New York and Hawaii case studies, for more information on these metrics.*

Table 11. System Efficiency Performance Metrics

Metric	Purpose	Metric Formula
Load factor	Indication of improvement in system and customer load factors over time	Sector average load / sector peak load
		Monthly system average load / monthly system peak load
Usage per customer	Indication of customers' energy consumption changes over time	Sector sales / sector number of customers
Aggregate Power Plant Efficiency	Indication of the efficiency and availability of supply-side generation resources in total	System average BTU per kWh net generation (heat rate)
		Equivalent Forced Outage Rate (EFOR) = Equivalent Forced Outage Hours / (Period Hours – Equivalent Scheduled Outage Hours)
		EFORd: variant of EFOR, measuring the probability that units will not meet generating requirements demand periods because of forced outages or derates
		Weighted equivalent availability factor: over a given operating period, the capacity-weighted average fraction of time in which a fleet of generating units is available without any outages and equipment or seasonal deratings
Flexible Resources	Indication of the capacity of supply side resources to quickly respond to changes in net load	MW of fast ramping capacity (load following resources capable of 15-minute ramping and regulation resources capable of 1-minute ramping)
System losses (electric)	Indication of reductions in losses over time	Total electricity losses / MWh generation, excluding station use
System losses (gas)	Indication of reductions in gas losses over time	Total gas losses / total sales

Table 12. Customer Engagement Performance Metrics

Metric	Purpose	Metric Formula
Energy efficiency (EE)	Indication of participation, energy and demand savings, and cost effectiveness of EE programs	Percent of customers per year
		Annual and lifecycle energy savings
		Annual and lifecycle peak demand savings (MW)
		Program costs per MWh energy saved
Demand response (DR)	Indication of participation and actual deployment of DR resources	Percent of customers per year
		Number of customers enrolled
		MWh of DR provided over past year
		Potential and actual peak demand savings (MW)
Distributed generation (DG)	Indication of the technologies, capacity, and rate of DG installations, and whether net metering policies are supporting DG growth	Number of installations per year
		Net metering installed capacity (MW)
		Net metering MWh sold back to utility
		Net metering number of customers
		MW installed by type (PV, CHP, small wind, etc.)
Energy storage	Indication of the technologies, capacity, and rate of customer-sited storage installations and their availability to support the grid	Number of installations per year
		MW installed by type (thermal, chemical, etc.)
		Percent of customers with storage technologies enrolled in demand response programs
Electric vehicles (EVs)	Indication of customer adoption of EVs and their availability to support the grid	Number of additions per year
		Percent customers with EVs enrolled in DR programs
Information availability	Indicator of customers' ability to access their usage information	Number of customers able to access daily usage data via a web portal
		Percent of customers with access to hourly or sub-hourly usage data via web
Time-varying rates	Indication of saturation of time-varying rates	Number of customers on time-varying rates

Table 13. Network Support Services Metrics

Metric	Purpose	Metric Formula
Advanced metering capabilities	Indication of metering functionality	Number of customers with AMI and AMR
		Energy served through AMI
Interconnect-ion support	Indication of DG installation support	Average days for customer interconnection
		Customer satisfaction with interconnect process
Third-party access	Indication of network access by third-party vendors	Open and interoperable smart grid infrastructure that facilitates third-party devices
		Third-party vendor satisfaction with utility interaction
Provision of customer data	Indication of customer access to relevant data	Customers able to authorize third-party access electronically
		Percent of customers who have authorized third-party access
		Third-party data access at same granularity and speed as customers

Table 14. Environmental Goals Performance Metrics

Metric	Purpose	Metric Formula
SO_2 Emissions	High-level indicator of emissions	Tons
Average NOx Rate	High-level indicator of emissions	lbs/MMBtu
CO_2 emissions	High-level indicator of emissions	Tons CO_2
Carbon intensity	Indicator of carbon emissions that accounts for changes in customers	Tons CO_2 / customer
System carbon emission rate	Indicator of carbon emissions that accounts for volume of generation	Tons CO_2 / MWh sold
Clean Power Plan (CPP) emission rate	Indicator of compliance with EPA's CPP	lbs CO_2 from fossil generators / (Fossil Fuel Generation (MWh) + 5.8% Nuclear Generation (MWh) + Renewable Generation (MWh) + Cumulative Energy Efficiency (MWh))
Fossil carbon emission rate	Indicator of carbon emissions accounting for improved efficiency and dispatch of fossil resources	Tons CO_2 / MWh fossil generation
Fossil generation	Indication of reduction in fossil fuel use	Fossil MWh percent of total generation
Renewable generation	Indicator of development of renewable power	Renewable percent of total generation

3.4. Design Principles

The following design principles should be considered when establishing performance metrics. Metrics should be:

1. Tied to the policy goal
2. Clearly defined
3. Able to be quantified using reasonably available data
4. Sufficiently objective and free from external influences
5. Easily interpreted
6. Easily verified

These principles are discussed in more detail below.

Metrics Should be Tied to Policy Goals

To be useful, metrics should help stakeholders understand the degree to which policy goals are being achieved. Too often, metrics report data without conferring useful information. For example, if a policy goal is to improve the system load factor by reducing peak demand, it is not meaningful to simply report the number of customers enrolled in a demand response program, as this provides no information regarding whether these customers actually reduced demand, and by how much, during peak periods. To be useful, a metric should reflect whether or not the underlying policy goal is being met; e.g., whether peak demand has decreased over the prior year.

Metric Definitions Should be Unambiguous

How a metric is calculated should be defined in a way that leaves little ambiguity regarding precisely what data are included and excluded, the units of measurement, the frequency of measurement, and the methods used to analyze and report it. Failure to do so may impair meaningful comparisons of performance across years or utilities, while potentially increasing contention during proceedings (see Nevada case study in sidebar).

Where possible, metrics should be defined in a manner consistent with national or regional standards and definitions in order to facilitate comparisons across utilities. However, regulators should not be constrained by these definitions; similar metrics that report slightly different data may be more useful for determining whether utilities are achieving a policy goal. In such cases, data under both the standard definition and the jurisdiction-specific definition could be reported.

Careful attention to metric definitions is necessary to simplify data review, ensure that metrics will be reported consistently over time, and enable meaningful comparisons. The specificity required for data definitions should not be underestimated. For example, although there exists a common industry standard for measuring and reporting reliability performance, few utilities adhere to this standard.[13] Thus standard metrics such as System Average Interruption Duration Index (SAIDI) are actually often reported in different ways, with definitions of "major events" or the length of a "sustained interruption" varying across utilities and jurisdictions. In fact, sometimes these metrics are reported inconsistently even within a jurisdiction.[14]

Metrics Should be Able to be Quantified Using Reasonably Available Data

Data that are not readily available may be costly to collect. Making use of existing industry standards and generally available data can ease administrative burdens to regulators and utilities alike, and, where appropriate, can facilitate benchmarking utility performance against others. Fortunately, a large amount of data is already reported by utilities to the Energy Information Administration (EIA), the Federal Energy Regulatory Commission (FERC), the Environmental Protection Agency (EPA), the North American Electric Reliability Corporation (NERC), and other entities. Specific data sources for many of the metrics presented in Tables 4 and 5 are provided in Appendix B.

Fuel Diversity in Nevada

Per Nevada administrative code NAC 704.9484, the Public Utilities Commission can grant critical facility (CF) status for the purpose of protecting reliability; promoting resource diversity; developing renewable energy resources; fulfilling specific statutory mandates; or promoting retail price stability. Owners of CFs may be granted special ratemaking treatment (e.g., deferral of incremental O&M costs) or other incentives (return on equity adder for the facility, or including construction work in progress in rates).

The criteria used to evaluate whether a facility meets the criteria for CF status have not been explicitly defined, however. This has resulted in ambiguity for resource developers, contentious proceedings, and uncertainty regarding whether policy goals are being achieved.

By 2010, all approved requests for CF status involved construction of gas-fired generation resources, leading to concerns about over-reliance on gas. Clearly articulated goals, metrics, and targets could have helped to avoid this over-investment in a single resource and reduced the litigation associated with related proceedings.

For more information, see PUC order dated July 28, 2010 in Docket Nos. 10-02009. 10-03022. and 10-03023.

[13] The Institute of Electrical and Electronics Engineers (IEEE) Standard 1366-2003 is intended to increase consistency among utility reliability reporting practices, but adoption of the standard is voluntary. Many utilities report reliability metrics (such as SAIDI and SAIFI) using somewhat different data definitions (Eto and LaCommare 2009).

[14] For example, the Maryland PSC staff noted that "the Maryland utilities have not been consistent with their treatment of planned outages when reporting reliability metrics to the Commission. The investor-owned utilities report reliability metrics excluding planned outages and the cooperatives report reliability metrics including planned outages" (MD PSC Staff 2011, 6).

Metrics Should Be Sufficiently Objective and Largely Free from Exogenous Influences

Regulators may wish to track many metrics in order to better understand what is happening in their state's electric system. However, not all of these metrics are good indicators of utility performance. To evaluate how utilities themselves are performing, and particularly to administer penalties or rewards, the metrics chosen should be sufficiently objective and free from exogenous influences. Otherwise, factors that the utility has no control over can influence the results, obscuring the role that utility management played in the outcome.

For example, average customer bills can be a tempting metric to use to evaluate utility efficiency. However, average bills are impacted by numerous factors, ranging from fossil fuel prices, costs of steel and other commodities, weather, and the economy. These exogenous factors prevent average bills from serving as a sufficiently objective metric.

Objectivity does not necessarily mean that all data must be purely quantitative or measured using physical units. For example, customer satisfaction surveys can be designed to be sufficiently objective through the use of specific, targeted survey questions (see sidebar). Surveys can be conducted in phases over time so that no single event (e.g., a storm related outage) has too strong of an influence on the results.

Customer Survey Results as an Objective Metric

A number of states require utilities to report customer satisfaction survey results. In Massachusetts, poor customer satisfaction survey scores may lead to substantial financial penalties. The application of penalties to survey results was recently opposed by many Massachusetts utilities, who argued that surveys are too subjective. However, the Massachusetts Department of Public Utilities reaffirmed that surveys can provide sufficiently objective information, if designed and administered well.

To enhance the quality of information collected in the surveys, the Massachusetts survey was modified from a more general question regarding customer satisfaction to very specific questions about whether customers' issues were resolved after the first contact with the utility, and how easy it was to conduct business with the utility. The specificity of these questions helps to control for the influence of other factors (such as electricity rates or media coverage) on customers' responses.

See DPU Order dated July 11, 2014, Investigation by the DPU on Its Own Motion Regarding the Department's Service Quality Guidelines, D.P.U. 12-120-B

Metrics Should Be Easily Interpreted

Metrics that are readily interpreted generally provide stakeholders with a better understanding of utility performance. To improve interpretability, metrics should exclude the effects of factors outside of the utility's control to the extent possible. For example, a metric that measures the time required to interconnect distributed generation could be limited to include only the time from when the application is deemed complete to the time when the application is approved. This definition would thereby exclude any delays due to customer inaction.

Another means of improving interpretability is to use per-unit metrics to facilitate comparison across time and across utilities. Examples include percentages (e.g., percentage line losses), per-kWh (e.g., average emissions per kWh of generation), and per-customer (e.g., O&M costs per customer). For example, if the objective is to increase utility efficiency by reducing costs, a metric based on O&M costs

per customer may be more informative than total O&M costs, as the number of customers may change over time.

Metrics Should be Verifiable

Data validity and reliability is essential for ensuring that utility performance is being accurately measured. For this reason, external verification of performance data is often relied upon, and the metrics chosen should lend themselves to such verification.

Where commissions have implemented performance tracking and reporting, commission staff frequently review and verify data, but independent third-party evaluators are also used, particularly when financial rewards or penalties are at stake. Greater use of third-party evaluators may help to prevent performance incentive gaming, such as that which occurred in California in the 1990s-2000s (see sidebar).

The use of straight-forward data collection and analysis techniques should be used where possible, as it improves transparency, enabling regulators and other stakeholders to more easily determine the data's accuracy. This makes manipulation of data more difficult and reduces the costs of oversight, as there is less need to hire specialized consultants (Costello 2010). In contrast, metrics that require complex data collection or analysis techniques make review and interpretation more difficult while increasing costs.

Gaming of Performance Incentive Mechanisms in California

In the late 1990s and early 2000s, Southern California Edison operated under a PBR plan with performance incentive mechanisms for customer satisfaction (as measured through surveys) and employee health and safety. The problems with the customer survey were many, but the most serious instances arose when utility employees sometimes falsified customer contact information to screen out customer interactions that might result in negative customer satisfaction surveys.

The employee health and safety performance mechanism was similarly problematic. Not only did the incentive mechanism actually discourage workers from reporting injuries in order to avoid jeopardizing safety incentive compensation for their group, but some supervisors participated in or encouraged under-reporting of data. Methods used to disguise injuries and avoid internal reporting included: employee self-treatment; treatment by personal physicians rather than the company doctor; and timecard coding of lost time as sick days or vacation. See Appendix A for further details.

3.5. Dashboards for Data Reporting

To be useful, performance metric data must be presented in an easily accessible, up to date, and properly contextualized manner. Without context, such as comparison of current performance to historical trends or benchmarks, utility performance data convey little meaningful information to regulators and stakeholders. Similarly, when performance statistics are not aggregated in a central location, but are provided only in filings made in various dockets on different reporting cycles, it becomes difficult and time-consuming to develop a holistic view of utility performance across multiple dimensions.

Data dashboards provide a means of collecting utility performance information in a central location and presenting the data in a transparent and meaningful way. A designated website—hosted either by the utility or the commission—provides a useful forum for displaying performance information, ideally through both interactive graphs and downloadable data. Dashboards allow data to be compared across years and between utilities. If a performance target is set, the dashboards enable all users to quickly determine whether the utility is meeting or failing to achieve the targets. Data dashboards should complement, rather than be a substitute for, prudency reviews.

Dashboards should be:

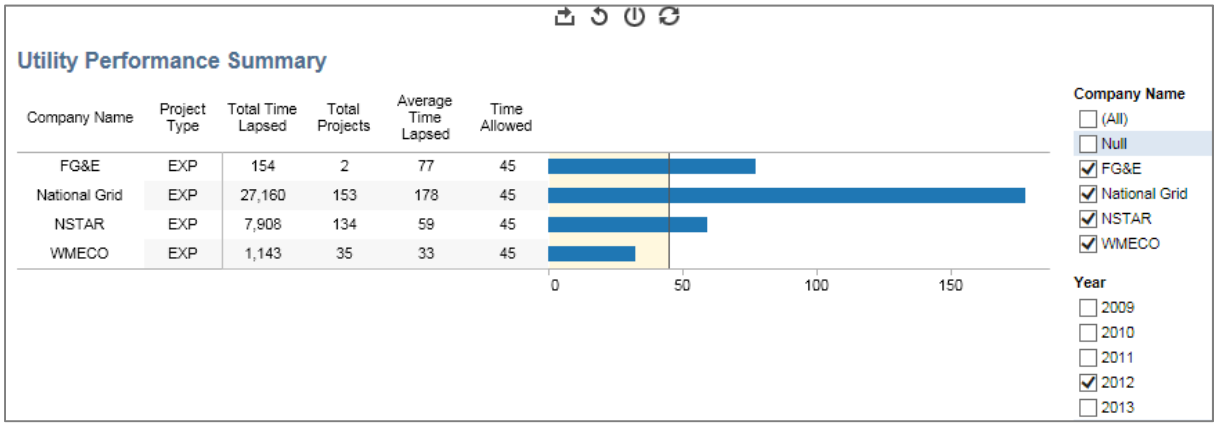
- **Accessible:** Performance data should be presented in a publicly-accessible manner, such as on a designated website, and should include a means for downloading the underlying data.
- **Contextualized:** Performance targets, historical performance data, peer performance, and explanations of any major events that impacted performance should be included in the data presentation.
- **Clear and concise:** Performance should be presented in graphs that are clear and easily interpreted. An explanation of how the metric is calculated should also be included. Highly technical terms should be adequately defined or avoided.
- **Comprehensive:** The dashboard website should provide data and graphs for all aspects of utility performance that the commission wishes to monitor.
- **Up to Date:** The data and graphs should be updated frequently. Many metrics may warrant quarterly updates, while others should be updated at least on an annual basis.

The Massachusetts Department of Energy Resources' (MA DOER) interactive graphs regarding interconnection of distributed generation provide an example of how such data can be effectively displayed and communicated to stakeholders. For example, Figure 3 shows a screen shot of one of the interactive graphs. The text accompanying the graph states:

> This chart helps you answer the question "On average how are utilities performing with regard to expedited projects that have not received a supplemental review?" Similar to the metric used in the DPU-approved Timeline Enforcement Mechanism (DPU 11-75-F), the average time lapsed is accounted for by dividing the total utility work time lapsed by the total number of projects by utility. Please note that only expedited projects without supplemental reviews, but with an "Interconnection Agreement Sent" date, are included. The other project types are not represented in this chart.

Users can select different combinations of utilities and data years, and are able to export the graph and download the underlying data. The vertical line in the graph demarcates the maximum interconnection time allowed and enables users to quickly determine whether a utility is meeting the target.

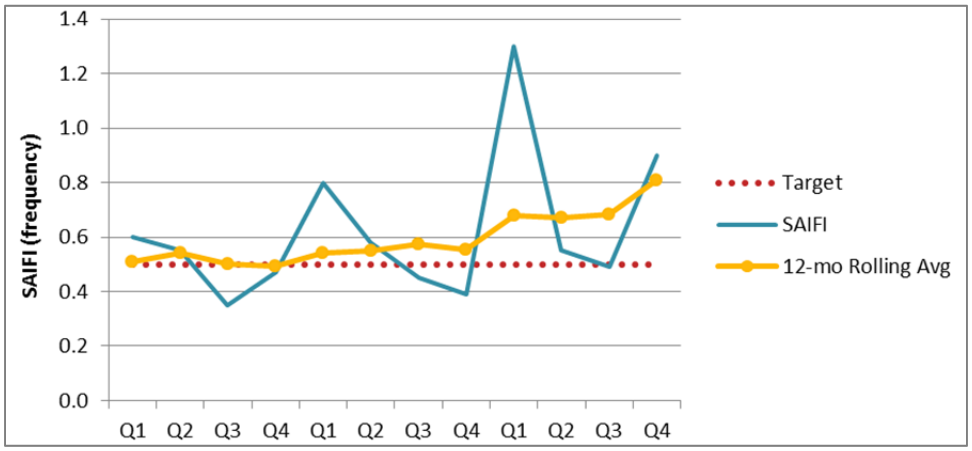
Figure 3. MA DOER Interactive Dashboard on Distributed Generation Interconnection Time



Source: Massachusetts Department of Energy Resources, Interconnection Utility Performance Summary Website. *https://sites.google.com/site/massdgic/home/interconnection/utility-performance-summary*[15]

Static graphs that display utility historical performance are also helpful. For example, the graph below presents hypothetical data for the frequency of utility outages, reported on a quarterly basis. Additional examples of data dashboards are provided in Appendix C.

Figure 4. Example Dashboard for Utility Outage Frequency



In sum, data dashboards can be an extremely useful tool for enabling regulators and other stakeholders to quickly review utility performance across a large number of performance areas.

[15] Note that although the interactive nature of the graphs is very helpful for comparing utility performance across years and utilities, the graphs appear to only display properly with Internet Explorer. In contrast, static graphs may have fewer technical issues.

4. PERFORMANCE TARGETS

A performance target defines the precise level of service or output that a utility is expected to achieve during a particular time period. Targets may be used simply to provide guidance for a utility, with neither penalty nor reward attached. Performance targets can also be used as the basis for providing a utility with a financial incentive to achieve desired outcomes.

4.1. Design Principles

The following design principles should be considered when setting performance targets:

1. Tie targets to regulatory policy goals
2. Balance costs and benefits
3. Set realistic targets
4. Incorporate stakeholder input
5. Use deadbands to mitigate uncertainty and variability
6. Use time intervals that allow for long-term, sustainable solutions
7. Allow targets to evolve

These principles are discussed more below.

Tie the Target to the Ultimate Policy Goal

Consider what level of performance is necessary to achieve policy goals, and state this explicitly. Doing so will help stakeholders evaluate whether performance targets are being set in a manner that moves toward achieving these policy goals and will help maintain momentum in that direction, while also allowing stakeholders to better determine when the underlying policy objective—as opposed to simply meeting the target—has been achieved.

Balance Costs and Benefits

Balance the costs to customers of achieving the target with the benefits to customers. Ratepayer surveys can help to identify ratepayers' priorities and how much they are willing to pay for higher levels of utility performance. For example, a 2010 survey of Ontarians found that 89 percent of residential customers were satisfied with current levels of electric reliability, and more than half of customers were not willing to pay more for increased reliability (Pollara 2010).

In theory, the optimal level of performance is obtained where the marginal benefits from improved performance are equal to the marginal costs of providing that increased level of performance. As explained by Baldwin and Cave,

> "as quality increases it becomes more expensive to raise it further; hence the marginal cost of quality improvement rises as quality rises. In contrast, as quality rises, the extra benefit consumers get from a further increase in quality declines. These two factors determine an optimal level of quality, where marginal benefit (to the customer) and marginal cost (to the utility company) are equal" (Baldwin and Cave 1999, 253).

Identifying the optimal level requires knowledge of both the utility's marginal cost curve, as well as customers' willingness to pay for different levels of reliability. Norwegian regulators have used surveys to construct a willingness to pay curve, and have internalized these values in the utility's decision-making process (see sidebar) (Growitsch et al. 2009). The Alberta Utilities Commission recently acknowledged the value of such customer willingness-to-pay surveys, but chose instead to rely on results from already-available customer satisfaction surveys to determine the acceptability of current levels of reliability for customers (Alberta Utilities Commission 2012).

In practice, especially for some performance areas, it may be difficult to quantify the marginal costs and benefits to determine the optimal performance target. In such cases, regulators may want to at least apply a qualitative assessment of what the costs and benefits to customers might be.

For example, if a commission were to establish a performance target related to the interconnection of distributed generation (in terms of average days for customer interconnection), it may be too burdensome to quantify all of the costs and benefits associated with reduced interconnection waiting time. Nevertheless, regulators, utilities, and others may be able to make a qualitative assessment of the value of increased distributed generation relative to the cost of reducing interconnection waiting time.

Balancing Reliability Costs and Benefits in Norway

Norway uses revenue cap regulation to provide a set amount of annual revenues to its electric utilities. Under this regulatory framework, utilities retain any savings achieved through cost reductions. This can create an incentive to cut costs at the expense of service quality. To combat this incentive, Norwegian regulators have internalized the costs of outages into the utility's profit-maximization function. This is done by adjusting utility revenues each year based on the costs of outages to customers.

If the utility reduces outages above a baseline level, it receives higher revenues the following year. In contrast, if outages increase, revenues are reduced. The amount of the increase or decrease in revenues is based on customers' willingness to pay for reliability, calculated separately by each customer sector. To maximize profits, the utility will increase expenditures up to the point where the marginal cost of increased reliability is equal to customers' willingness to pay (also referred to as the marginal benefit). The Norwegian utilities therefore face an incentive to provide the socially optimal level of reliability, where marginal costs are equal to marginal benefits.

Set a Realistic Target

The performance target should be realistically achievable by a well-managed utility. If utility performance is currently satisfactory, then the performance target could be set to simply maintain

recent performance levels (assuming that future operating conditions will be similar to current conditions). If a higher level of performance is desired, a reasonable target can be developed based on (1) historical performance, (2) peer utility performance, (3) frontier methods such as data envelopment analysis, or (4) utility-specific studies.

1. Historical performance. Under the first method, a utility's previous performance over a set period of time—for example, the past ten years—is used to set the target. This method presumes that the data have been collected in the past and are readily available; that there has been little fundamental change in the key factors influencing utility performance; and that historical performance was satisfactory. Although historical data may be useful in setting initial performance targets, continuing to use historical data may be problematic due to the ratchet effect. The ratchet effect refers to the performance standard being raised if the utility performs well, making it harder for the utility to meet the standard in the next period, and diluting the incentive for the utility to improve performance in the current period (Comnes et al. 1995).

2. Peer utility performance. The second method uses peer groups to determine the performance target. If a peer group is used, effort should be made to account for the utility's unique circumstances that may impact the ability of the utility to reasonably achieve the target, or recent external factors that significantly impacted performance, such as a major storm.[16] This can be done through one of two ways: choosing a peer group that is similar to the utility in question, or using econometric techniques to control for certain variables.

   Direct comparison with peer utilities is referred to as "indexing." To identify the relevant group of peer utilities, econometric analysis can be performed to identify the most significant variables affecting utility performance, such as the geographic region and operating scale. Then utilities that are similar in these respects may serve as a suitable point of comparison. Another means of identifying a peer group is through cluster analysis, which groups utilities according to certain characteristics using statistical software (Shumilkina 2010).

   Where data on a variety of external factors that impact performance are available, econometric modeling can be used to control for these factors and provide an indication of "average" utility performance. However, the accuracy of the model is highly dependent upon inclusion of the correct variables and specification of the correct functional form (Shumilkina 2010). Failing to include data on a relevant variable can lead to omitted variable bias, yet collecting all of the relevant data (on utility characteristics, weather, age of investments, etc.) can be time consuming and prone to error.

3. Frontier methods. A third method of analysis is frontier analysis, a form of which is Data Envelopment Analysis (DEA). DEA measures technical efficiency of firms based on a sample of

[16] Although reliability reporting and performance targets generally exclude the impacts of major storms, the definition of "major storm" varies from state to state.

firms, their input use, and their outputs. The analysis identifies the most efficient firms and creates an efficiency frontier based on these firms' input usage per unit of output. Other firms are then assigned a score based on their efficiency relative to the efficiency frontier (Shumilkina 2010). Factors that are outside of a utility's control should be taken into account in the DEA analysis, but this is not easily done. This technique also suffers from a lack of internal validation, such as misspecification tests or goodness-of-fit statistics. Nevertheless, DEA analysis has been used by energy regulators to determine price and revenue requirements for utilities in Finland, Norway, the Netherlands, Germany, Austria, and Australia (Australian Competition & Consumer Division 2012).

4. Utility-specific studies. Finally, regulators can use utility-specific economic and engineering studies to set targets. For example, integrated resource plans may provide detailed cost and benefit information regarding certain resource investments under specific planning assumptions. Energy efficiency and demand response potential studies can identify the amount of investments that would be cost-effective for the utility to make. Production cost simulations have been used to model efficient dispatch, operation, and purchasing decisions, providing benchmarks against which utility performance can be measured.[17] These studies can help regulators identify and define specific resource investment targets and costs.

Regardless of the manner in which targets are set, regulators should minimize the ability of the utility to game target-setting. If there is an expectation that performance targets will be set at a future date based on historical data, the utility has an incentive to underperform until the target is set in order to establish a more lenient target. Econometric and frontier models can present challenges in terms of transparency, as these models are complex and require careful specification (Shumilkina 2010), which could lead to manipulation of the model to achieve the desired results.[18] Finally, basing targets on utility-specific studies that have been developed by the utility may create an incentive for the utility to overstate cost forecasts in order to deliver projects at costs that are below the target.

Incorporate Stakeholder Input

Allowing for meaningful stakeholder input during the process of setting targets is likely to result in targets that meet state regulatory goals, result in desired outcomes, and minimizes the potential for manipulating or gaming the targets. In addition, a meaningful stakeholder process can enable

[17] San Diego Gas & Electric (SDG&E) operated under a generation and dispatch performance-based ratemaking (PBR) incentive plan from 1993 to 1997, and earned rewards during all three years that the plan was in operation. Year 1 and Year 2 awards were reported in SDG&E's *Electric Generation and Dispatch PBR Mechanism Final Evaluation Report*, April 1998, submitted pursuant to D.97-07-064 in A.92-10-017, and Year 3 awards were adopted in D.98-12-004 as part of the adopted settlement agreement.

[18] Econometric modeling requires that the modeler make a number of decisions regarding functional form, whether certain data points represent true outliers that should be excluded, whether to choose a model based on parsimony or goodness-of-fit, etc. These choices may all impact the final result and should thus be carefully reviewed.

stakeholder buy-in, and enhance the legitimacy of targets. Stakeholder input also reduces the likelihood of contentious disagreements once performance incentives are implemented and rewards and penalties start to be applied.

Energy efficiency performance standards sometimes use this approach, with good results. Some states have established advisory councils or collaboratives to help oversee and provide input to the efficiency program design and implementation, including the design and implementation of efficiency performance standards (e.g., Connecticut, Massachusetts, and Rhode Island – see sidebar). The stakeholders in these councils and collaboratives provide a considerable amount of input and review to the energy efficiency programs, which enables them to determine whether a particular performance incentive savings target is reasonable, or will be too easy or difficult to achieve. The stakeholders represent a broad range of views, including utility representatives, consumer advocates, environmental advocates, state agencies, and efficiency experts, which increases the chance that efficiency targets will be balanced and reasonable.

Stakeholder Engagement for Efficiency Standards

Efficiency councils have been established in Connecticut, Massachusetts, and Rhode Island—three of the leading states providing cost-effective efficiency programs. There are several key factors that make these three councils especially effective, including:

- *A broad representation of stakeholder interests.*
- *Frequent, well-organized meeting and communication systems to allow full access to information and debate.*
- *Efficiency experts available to provide technical support, with sufficient funding.*
- *Meaningful oversight by regulators, including a process where stakeholders can bring issues for resolution.*

Additional information is available at:

Connecticut - http://www.energizect.com/about/eeboard

Massachusetts - http://ma-eeac.org/

Rhode Island - http://www.rieermc.ri.gov/

Use Deadbands to Account for Uncertainty and Variability

Deadbands create a neutral zone around a target level in which the utility does not receive a reward or penalty. Deadbands can help to account for uncertainty regarding the optimal performance level, as well as allow for some performance variance based on factors outside of the utility's control (see sidebar for an example from Hawaii).

How large should deadbands be set? Deadbands are frequently set at one standard deviation of historical performance, but may be larger or smaller based on sample size and the tolerance for error. That is, if a large amount of historical data is available, then one standard deviation is likely to capture most of the normal variation in utility performance. If the sample size is small, for example three observations, then one standard deviation may not be large enough to capture the normal variation in utility performance. In such cases, a confidence interval can be constructed using the sample data and

the regulator's desired level of confidence that the interval will sufficiently represent the range of normal variation.[19]

Use Time Intervals That Allow for Long-Term, Sustainable Solutions

The timeframe for measuring performance can impact the compliance strategies that the utility implements. If performance is measured only over a short timeframe, such as over one year, the utility has an incentive to implement solutions that can be quickly implemented, but may only have short-term benefits. In some cases, these short-run solutions may in fact be contrary to long-term sustainability. For example, a utility may be encouraged to compromise safety in order to achieve short-term economic goals.

In contrast, solutions that are optimal for the long-term may result in slow but steady improvement. For example, implementing sound maintenance and operational practices will result in long-term safety and economic benefits, but may not achieve short-term capacity factor targets. Thus performance measurements over the longer-term, such as the use of three-year rolling averages, may better encourage the utility to adopt sound long-term practices (NRC 1991).

Deadbands for Heat Rate Targets to Account for Integration of Renewables

Many states allow utilities to recover fuel and purchased power costs through automatic pass-through mechanisms. To ensure that utilities retain an incentive to operate their power plants efficiently, some states have conditioned fuel cost recovery upon power plant performance factors. For example, Hawaii's Energy Cost Adjustment Clause (ECAC) contains a heat rate efficiency factor.

Although Hawaii's ECAC encourages maintaining the thermal efficiency of thermal generators, concerns were raised that the fixed sales target heat rate would penalize the utilities for introducing renewable energy, as lower capacity factors and higher ramping requirements can negatively impact thermal units' heat rates. In order to avoid the resulting disincentive for efficiency and renewable energy, a deadband of +/- 50 Btu/kWh sales was added to the heat rate target, and an agreement was reached to revisit the heat rate target upon the future addition of larger increments of renewable resources.

See HECO Final Revised Tariff Sheet Nos. 63-63E, filed on July 24, 2012, in Docket No. 2010-0080

Allow Targets to Evolve

In general, once a target is set, it should be adjusted only slowly and cautiously in order to provide utilities with the regulatory certainty required to make long-term investments. However, targets may need to evolve over time for two reasons. First, if performance needs to be improved, it may not be possible for the utility to immediately achieve the desired level of performance, as noted above. Some problems may take years to fully remedy, despite the utility undertaking immediate actions to remediate the situation. In such cases, the performance measurement time interval can be lengthened, or targets can be set to become more stringent over time, providing the utility with a glide path for achieving the ultimately desired level of performance.

[19] For more information on this approach, see Lowry et al. 2000.

Second, a target may need to evolve over time as technologies and policy goals evolve, or as the operating environment changes significantly. For example, smart grid investments may be able to dramatically improve outage duration rates. Therefore, if a utility makes significant investment in new smart grid technologies, then any reliability performance targets for that utility should be reviewed, and perhaps modified, to reflect the implications of the new technologies.[20]

[20] In addition, if the utility is using improved reliability as part of the justification for such smart grid investments, then the performance targets can be used to ensure that those benefits are actually achieved.

5. FINANCIAL REWARDS AND PENALTIES

5.1. Design Principles

Once performance targets have been defined, regulators can establish incentives to further induce the utility to accomplish the desired outcomes. Rewards and penalties are generally financial in nature, although other forms of incentives may be used.[21]

The following design principles should be considered when setting financial rewards and penalties:

1. Consider the value of symmetrical versus asymmetrical incentives
2. Ensure that any incentive formula is consistent with desired outcome
3. Ensure a reasonable magnitude for the incentive
4. Tie incentive formula to actions within the control of utilities
5. Allow incentives to evolve

Value of Symmetrical versus Asymmetrical Rewards and Penalties

Financial incentives are frequently designed to be symmetrical, in order to provide balance and to both discourage poor performance and encourage exemplary performance. Symmetrical incentives generally also mirror more closely how a utility would be compensated in a competitive environment. However, in some cases asymmetrical incentives may be more appropriate than symmetrical ones.

Penalty-only incentives may be appropriate when the outcome is either an essential requirement for the utility, or when performance above target outcomes provides little additional benefit to ratepayers. For example, customers might not be willing to pay for incremental improvements in reliability beyond the target level, particularly if customers would be required to pay for any reliability improvements through both rates (to recover utility expenses) and performance rewards. At the same time, utilities have a clear obligation to provide sufficient levels of reliability, therefore unsatisfactory performance might

Asymmetrical Incentives in Alberta

In a 2012 order, the Alberta Utilities Commission rejected providing utilities with a positive performance incentive for exceeding service quality, writing "…in a competitive market, a company may increase its service quality and charge a higher price, but risks losing customers. For monopoly utility companies, there is no risk of losing customers. Customers have no choice but to pay the higher price for a service quality level that they may not want or cannot afford" (Alberta Utilities Commission 2012, 194–195).

[21] For example, the UK allows expedited regulatory treatment of utility business plans for business plans that are well executed. This offers utilities the benefits of reduced regulatory burdens and risks. In addition, the UK uses "reputational" incentives, where utilities' success in reducing carbon emissions is compared and made publicly available.

warrant the applications of penalties. See the sidebar for an example of asymmetrical incentives in Alberta.

In other cases, it may be beneficial to administer incentives on a positive basis only. This is common for energy efficiency incentives where any megawatt-hour of energy saved through a cost-effective efficiency program results in a benefit to ratepayers. In addition, reward-only incentives tend to encourage utilities to be more innovative, and may result in more collaborative and less adversarial processes (NY PSC 2012).

Ensure Incentive Formula Is Consistent with Desired Outcome

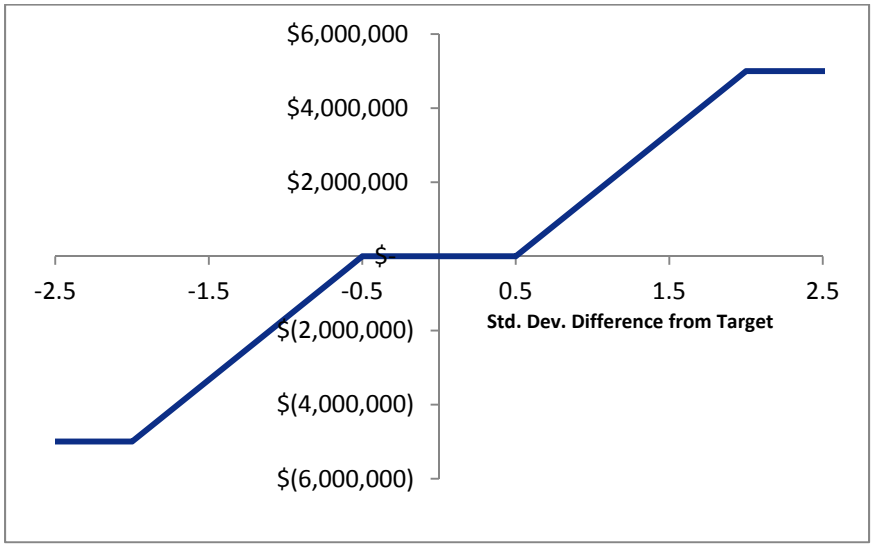
Incentive formulas can take numerous forms, including linear, quadratic, and step functions. It is important that the formula (and the shape and slope) of the incentive is consistent with the desired outcome and supports appropriate utility performance. The shape and slope of the formula determine how quickly the curves reach the maximum reward or penalty as performance deviates from the target (or the ends of the deadband). Below we present several possible incentive formulas and some of their benefits and drawbacks. Each graph shows how rewards or penalties (vertical axis) change as performance deviates from zero to two standard deviations from the target.

Linear Function with Deadband

Figure 5 depicts an incentive formula that has a deadband of 0.5 standard deviations, measuring how much performance varies from the average, on either side of the target. After 0.5 standard deviations, penalties and rewards increase in a linear fashion up to a maximum of $5 million. This formula is simple to understand and administer, and the deadband helps to control for normal fluctuations in performance due to factors that are outside the control of the utility.

A potential drawback is that a utility may be induced to perform at a level close to 0.5 standard deviations below the target, since such under-performance would not result in a penalty. The utility would especially have an incentive to operate close to -0.5 standard deviations from the target if the target is based on a rolling average of historical performance. This highlights the importance of monitoring utility behavior and making adjustments as necessary, such as narrowing the deadband over time, or delinking performance targets from historical performance.

Figure 5. Hypothetical Linear Formula with Deadband



Quadratic Function

A quadratic function (also referred to as a "parabolic function") can also be designed to provide increasing rewards or penalties as performance deviates from the target, but the rewards or penalties increase more slowly. Figure 6 presents a simple linear incentive function, as well as a quadratic incentive function with the same end points and central target.[22] As indicated, a quadratic formula acts similar to a deadband by providing little incentive near the central target. A quadratic function also results in an increasing slope as the performance deviates from the performance target.

Massachusetts has used a modified quadratic formula since 2001. In its order approving the formula, the Department of Public Utilities wrote: "While a linear formula may have the perceived advantage of simplicity, the Department considers a non-linear formula provides a stronger link between a utility's performance and the consequences of it failing to meet [service quality] measures" (MA DPU 2000, 25).

The formula for the quadratic function uses four inputs:

- Maximum reward or penalty (e.g., $5,000,000)
- Actual utility performance (e.g., a score of 1.75)
- A target (e.g., a score of 1.0)
- The standard deviation, σ (e.g., 0.5)

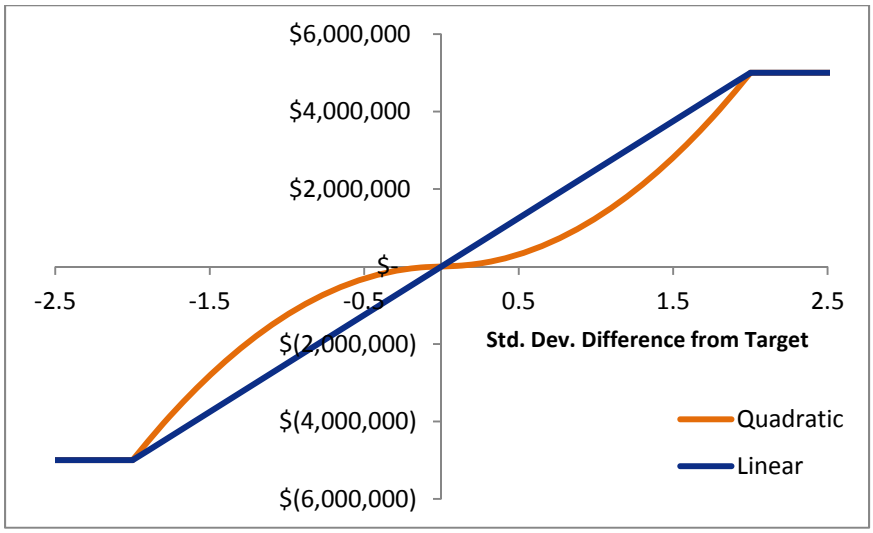
Penalties and rewards are maximized at two standard deviations from the target. A scalar of 0.25 is used to constrain the scores to values between 0 and 1, which is then multiplied by the maximum incentive.

[22] A linear function does not square the standard deviation difference from the target and uses a scalar of 0.5.
Reward or penalty = [(performance – target)/σ] x (0.5) x (maximum reward or penalty)

Reward or penalty = $[(\text{performance} - \text{target})/\sigma]^2 \times (0.25) \times (\text{Maximum reward or penalty})$

Using the example values from above: $[(1.75 - 1.0)/0.5]^2 \times (0.25) \times \$5{,}000{,}000 = \$2{,}812{,}500$

Figure 6. Quadratic Function Compared to a Linear Function

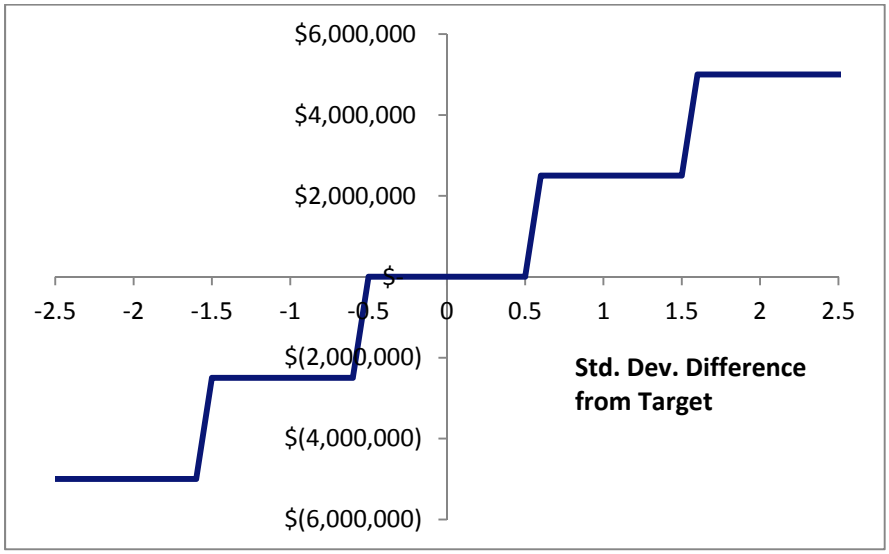


Step Functions

Step functions can be simple (e.g., two steps), or complex (multiple steps). Either way, the utility receives no incentive until it reaches a certain level of performance, at which there is a sharp change in the reward or penalty it receives. For example, in Figure 7 the utility receives no reward until it performs at 0.5 standard deviations above the target, at which point it receives a reward of $2.5 million. It continues to earn only $2.5 million until performance reaches 1.5 standard deviations above the target, at which point the reward increases to the maximum of $5 million.

Step functions are common and can be easy to administer, but they have several important drawbacks. When the amount of the penalty or reward can change dramatically with only a small change in performance (e.g., when performance increases from 0.49 standard deviations to 0.5 standard deviations from the target), the performance evaluation process can become very contentious. In addition, such sharp thresholds may induce a utility to engage in unsafe or unsound practices in order to avoid a large penalty or receive a large reward.

Figure 7. Hypothetical Step Function



Ensure a Reasonable Magnitude for the Incentive

When establishing the appropriate magnitude of financial incentives, regulators should generally seek to balance two competing objectives. Financial rewards and penalties should be large enough to capture utility management's attention and provide sufficient motivation to reach the desired outcome. On the other hand, rewards and penalties should not be disproportionate to the costs and benefits of the desired outcome. The reward should not unduly reward or penalize the utility, and rewards should not offset the benefits to ratepayers.

Performance incentive mechanisms should include a cap on the maximum penalty or reward, in order to ensure that the magnitude of the incentive will remain within a reasonable bound. Regulators should also consider the size of rewards and penalties within the context of the magnitude of existing incentives to ensure existing incentives and new incentives are properly balanced.

For utilities that are provided with multiple performance incentives, it is important to consider the potential impact on the total reward or penalty that might be applied. The total financial impact on a utility will depend on both the magnitude of the rewards and penalties and the likelihood of being assessed those rewards and penalties.

When establishing the magnitude of financial rewards and penalties, regulators may also need to consider the particular financial circumstances of the utility involved. This becomes especially important if the magnitude of the combined penalties and rewards are large enough to significantly impact the utility's financial position. Financial analysts and utility management typically pay special attention to the utility's financial position, thus it is important to recognize the financial implications of the penalties and rewards. This may involve several considerations:

- Financial analysts typically assess the risk associated with utilities, as well as the risk associated with regulatory systems and new regulatory measures. Therefore, it is important that the

performance incentive mechanism and the potential financial impacts are clearly defined and transparent.

- Many utilities motivate managers and employees with incentive systems based upon stock options and prices. If the performance incentives have a significant effect on stock prices, then this provides additional, personal incentives to those employees to help meet performance goals.
- One thing that might help place the magnitude of rewards and penalties in perspective is to present them in financial terms, such as in terms of basis points on the return on equity, or in terms of equivalent cents per share on utility stock prices. Presentation of financial incentives is discussed briefly in the subsection below.

Further, rewards and penalties should always be proportionate to the importance of the performance goal to ratepayers. In general, incentive payments should not exceed the net benefits to ratepayers.

Presentation of Financial Incentives

Rewards and penalties can be expressed in several different equivalent units to help place their magnitude in context. For example, they can be presented as dollars, cents per share, basis points of return on equity (ROE), percent of non-fuel operating expenses, percent of base revenues, or percent of total earnings. The table below demonstrates how an incentive amount of $2.5 million could be presented in order to help stakeholders understand the magnitude of the incentive in relation to the utility's return on equity, operating expenses, cents per share, and percent of earnings. Total earnings can also be shown to provide context.

Table 15. Hypothetical Presentation of Financial Incentives in Different Units

Maximum Reward or Penalty	Equivalent Basis Points	Equivalent % of T&D Revenues	Equivalent cents/share	Percent of Pre-Tax Earnings	Total Pre-Tax Earnings
$2,500,000	25	0.9%	2.47	3.1%	$80,645,000

Presenting financial rewards and penalties in multiple units is useful during the process of setting the financial incentives. However, administration of the incentives is generally simplest when done as dollars, as other units can be administratively complex and result in perverse incentives. For example, positive incentives that are set in terms of ROE basis points could provide an incentive for a utility to increase rate base. See Appendix A for an example of the perverse impacts of an ROE adder for certain investments.

Tie Incentives to Actions and Outcomes within the Control of Utilities

Financial incentives should be based upon actions and outcomes that are within the control of the utility. First, if an action or outcome is beyond the control of the utility, then the performance incentive would have little to no effect on achieving the desired outcome, and therefore should not be applied at all. Second, it is unfair for customers to pay for utility rewards that are not a result of utility actions. Third, it is unfair to penalize utilities for outcomes that are beyond their control.

While this principle seems obvious and important, it can be difficult to hold to it in practice for some performance areas and metrics. Some events might be beyond a utility's control (e.g., the incidence and types of severe storms), but there may be things a utility can do to mitigate the implications of those events (e.g., by having effective emergency preparedness and emergency response programs).

Some elements of utility performance might be beyond a utility's control but may appear to be reasonable to include in an incentive formula. For example, some states have established "shared savings" incentives, where utilities are allowed to keep a small portion of the savings that they achieve as a result of improved power plant performance. This approach makes intuitive sense because customers can be expected to experience only net benefits as a result of the incentive, and ideally the majority of the net benefits. However, the magnitude of the savings from such incentives is often based on avoided fuel costs, which can fluctuate wildly for reasons completely beyond the control of the utility. As a result, utilities can experience undue windfalls or penalties. (See Appendix A for a discussion of the financial incentive for the Palo Verde nuclear power plant, which was based on avoided power costs. These avoided costs, and thus the financial incentive, skyrocketed during the California Energy Crisis in 2000).

In some instances it may be appropriate to provide financial incentives for actions that are only partly within a utility's control. For example:

- Regulators could provide all utilities in a multi-utility state with rewards if a statewide energy efficiency goal is met. A reward based on achievement of a statewide goal has two effects: (a) it encourages utilities to work together and share best practices; and (b) it provides an incentive for utilities to continue to pursue the statewide goal, even if they are clearly not going to meet their individual utility target.
- Regulators could provide utilities with rewards for supporting other initiatives regarding efficiency standards, building codes or commercialization of clean energy technologies. Utilities can have a significant influence on such statewide initiatives, even if they are partly or mostly beyond their control.
- Regulators could provide utilities with rewards for achieving certain energy policy, public interest, or societal goals that are partly beyond utility control, such as reducing the fuel burden on low-income customers or meeting economy-wide pollution targets.

Allow Incentives to Evolve

As with other aspects of performance incentive mechanisms, financial incentives may need to be adjusted over time. Financial incentives are sometimes adjusted when the magnitude of the incentive is found to be unreasonably large or small, or the basis for the financial incentive (e.g., avoided fuel costs) is found to be excessively volatile, resulting in excessive penalties or rewards.

Excessive penalties and rewards can sometimes be addressed easily, such as with a cap on rewards or penalties. In other cases a correction might require fundamental redesign of the incentive mechanism, including a full stakeholder process. While regulators should expect performance incentives to evolve

over time in response to lessons learned in practice, it is also important to make any adjustments cautiously in order to preserve regulatory transparency and certainty to the greatest extent possible.

In order to avoid the possibility of overcompensation, it is advisable to begin with small financial incentives and adjust these gradually upward over time if needed. In some cases, a small financial incentive may be all that is needed in order to induce the utility to achieve the desired result, thus preserving the majority of benefits for ratepayers.

An incremental approach also allows utilities and regulators to gain experience with an incentive mechanism and manage any unforeseen consequences of the incentive without large impacts on ratepayers. As parties gain more confidence that the performance incentive mechanism does not suffer from any major flaws, the amount of compensation can be increased if needed.

5.2. Rewards and Penalties in the Context of New Regulatory Models

Several recent proposals for new regulatory models emphasize the goal of rewarding utilities for performance and desired outcomes. For example, a utility-stakeholder collaborative group in Minnesota writes:

> As its name suggests, a performance-based approach would tie a portion of a utility's revenue to achieving an agreed-upon set of performance metrics (e.g., measuring such things as energy efficiency, customer service, environmental sustainability, affordability, and competitiveness) so that utilities have a natural financial incentive to produce the outcomes customers want (e21 Initiative 2014, 3).

The RIIO model that is being developed and applied in the UK includes financial incentives that are roughly equal to 5 percent of utility revenues (see Appendix A). This is considered to be a relatively large portion of utility revenues to dedicate to financial incentives, and we are not aware of any states or countries that apply larger financial incentives.

Whether a set of performance incentives will result in "a natural financial incentive to produce the outcomes customers want" will clearly depend upon many factors, such as the type and scope of the outcomes targeted, the performance metrics, the targets chosen, the amount and type of financial incentives, and more. One of the key factors likely to determine how well the combination of incentives will lead to desired outcomes is the amount of money that is at stake. As described in Chapter 2, utilities already have many different financial incentives, some of which are aligned with customer interests, some of which are not. These existing financial incentives are very influential and exist in every regulatory context.

In thinking about new regulatory models, one key question that regulators should ask is: Will the set of new performance incentives be sufficient to modify, or at least balance against, the financial incentives of the existing regulatory model? Regulators should compare the magnitude of the proposed performance incentives with the magnitude of existing financial incentives. If new regulatory models are to result in a fundamental shift of incentives away from capital investments and toward performance

outcomes, then the magnitude of the financial rewards and penalties will need to be significantly larger than the amounts used to date in the United States, and may need to be larger than under the RIIO model used in the UK, discussed below.

In addition, new regulatory models will need to reduce the incentive that utilities currently have to increase their rate base. This could be achieved by reducing, or eliminating, the amount of profit that a utility earns from rate base, and replacing that amount of profit with revenues from performance incentives.[23] Ultimately, the combined impact of modified equity recovery plus financial incentives should meet the standard criterion of allowing the utility to recover prudently incurred costs plus an opportunity to earn a reasonable return on equity. In this case the opportunity to earn a reasonable return on equity would be based primarily, or entirely, on utility performance relative to the performance incentives.

When designing new regulatory approaches for utilities to recover revenues, regulators must also be cognizant of the implications for utility financial positions. First, utilities must be able to maintain a reasonable financial position for a reasonable level of performance. Second, as noted above, managers and analysts need to be able to assess the risk associated with new regulatory mechanisms, and shifting the sources of revenues could easily change the risk profile of a utility's financial position.

It may also be important to consider the timing of revenue recovery. If the recovery of equity costs is partially replaced by the recovery of performance incentives, then the timing should be properly aligned. Currently utilities are allowed to recover equity and debt costs over the full book life of a capital asset. If the financial incentives are recovered over a shorter time period, then there might be a misalignment of when customers experience the benefit and when they are charged for it. On the other hand, performance incentives typically work best when the rewards and penalties are applied relatively close in time to the performance outcomes themselves.

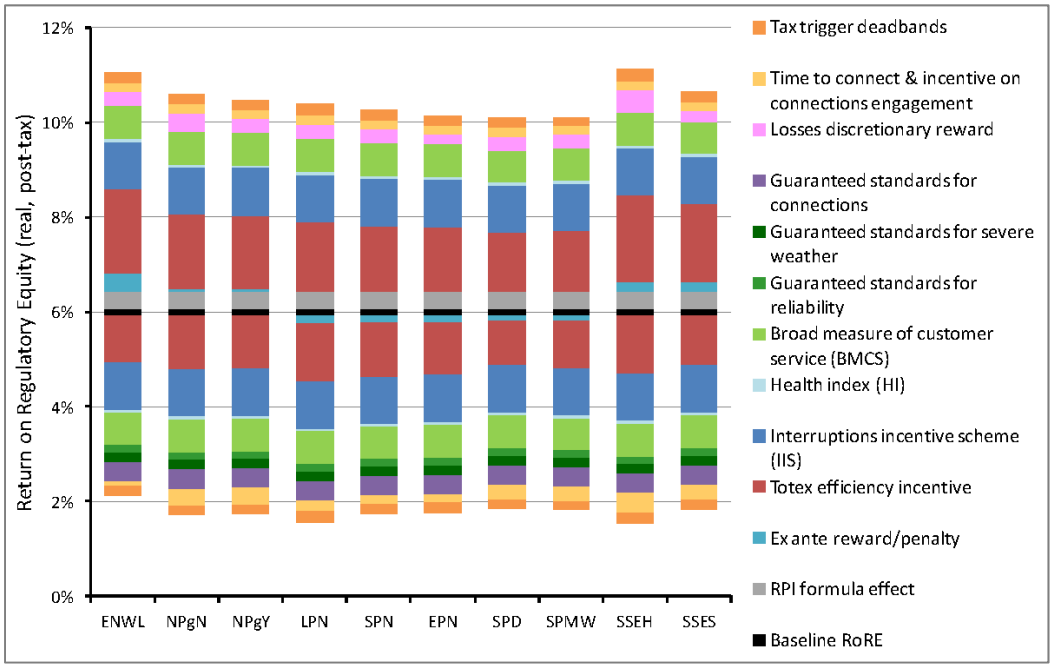
An Example: the RIIO Model

The UK's RIIO model bases a large amount of a utility's earnings on its performance. As detailed in Appendix A, potential rewards and penalties associated with environmental, customer satisfaction, social obligations, and connections performance incentive mechanisms equate to approximately 3 percent of utility annual base revenues. Reliability-related rewards and penalties carry with them the possibility of an additional 250 basis points in rewards or penalties. The results of Ofgem's modeling suggest that utilities' realized return on equity may fluctuate by approximately +/- 300 basis points due to these performance incentive mechanisms (Ofgem 2014b).

[23] Under RIIO, capital expenditures and operating expenditures are combined into one category: "total expenditures," or "totex." The utility then earns a return on a pre-determined portion of totex, regardless of whether the utility's capital expenditures are higher or lower than that amount. This treatment seeks to balance the incentive to invest in capital versus non-capital projects.

These performance incentive mechanisms are part of a revenue cap plan that provides for annual revenue increases at the rate of inflation and allows utilities to retain a large portion of any cost savings they achieve. Allowed revenues are set using a 6 percent return on equity, but actual earnings may vary significantly based on utility performance. According to Ofgem's modeling, the actual ROEs for "slow-track" utilities are likely to range from approximately 2 percent to more than 10 percent, as shown in the figure below (Ofgem 2014b).

Figure 8. Plausible ROE Range for UK Distribution Utilities



Source: Ofgem 2014b, page 46

This wide variability of potential utility returns is by design, as Ofgem determined early on that high-performing utilities should have the opportunity to earn an ROE of greater than 10 percent, while poorly performing utilities could earn an ROE of less than the cost of debt. Ofgem notes that the results shown in the figure above indicate that the package of risk and incentives has been "appropriately calibrated" (Ofgem 2014b, 46). The relatively large magnitude of incentives under RIIO not only helps to focus management attention on the attainment of the established targets, but may also help to provide the revenues necessary for innovating and implementing new technologies.

6. IMPLEMENTATION

6.1. Questions to Help Inform Regulatory Action

Regulators may wish to ask themselves, as well as relevant stakeholders, several questions that would help inform their decisions on whether and how to proceed with performance metrics and incentives. For example:

1. **How well does the existing regulatory framework support utility performance?**

   Are the utilities already achieving standard regulatory goals, such as providing low-cost, safe, reliable service? Are there specific areas of performance where utility performance has been questionable, or where customers have raised complaints? What activities or investments are currently the key profit centers for the utilities?

2. **How well does the existing regulatory framework support state energy goals?**

   What are the priority state energy policy goals, and how well do the utilities achieve them? These may include a variety of goals related to costs, reliability, clean energy resources, grid modernization, customer protections and more. Regulators should recognize that policy goals may evolve, and may require different incentives and regulatory models over time.

3. **What are the policy options available to improve utility performance?**

   As described in Chapter 2, there are many regulatory policies that will provide utility incentives and influence utility performance. Regulators may wish to modify or implement any of these other policy options in concert with, or in lieu of, performance metrics and incentives.

4. **Is the industry, market, or regulatory context expected to change?**

   If change is expected to occur, utilities may benefit from additional regulatory guidance regarding the preferred response, or may require additional incentives that were not necessary previously. There may also be emerging policy goals that the commission wishes to emphasize.

5. **Does the commission prefer to oversee investments, or to guide outcomes?**

   Traditional regulation typically allows regulators to oversee the utility investments and activities that are intended to achieve desired outcomes (e.g., during a rate case). In contrast, performance metrics and incentives allow regulators to provide more guidance on the desired outcomes, and less guidance on the means to achieve them.

6. **Does the commission wish to specify the outcomes in advance?**

   Traditional regulation typically allows regulators to oversee major capital investments and review expenses after the costs are incurred (typically during a subsequent rate case). As a result, there is little regulatory guidance provided before investments are made, at a time when alternative actions or investments can be considered. Integrated resource planning, where it is

practiced, provides an exception to the common practice that regulation only takes place after the fact, after the money has been invested or spent. Performance metrics and incentives, on the other hand, provide greater regulatory guidance up front, and are therefore more likely to influence the outcomes.

The answers to these questions will help regulators determine what level of performance regulation is appropriate for their jurisdiction, and what type of performance metrics and incentives to implement.

6.2. Implementation Steps

Once a determination has been made to implement performance metrics or incentive mechanisms, the following steps can be implemented. These can be implemented incrementally, to allow for each step to inform the subsequent step, or they can be implemented several steps at a time, or all at once.

1. Articulate goals**.** The first step is to identify and articulate all the energy policy goals that are applicable to utility regulation, whether the goals are current or anticipated.

2. Assess current incentives**.** Next it is critical to assess and understand the financial incentives, including those in place within company management and provided by utility interactions with investor analysts, which are created by the current or anticipated regulatory, management, and financial context. Performance incentives should then be designed to modify, balance or supplement these existing incentives. (See Chapter 2.)

3. Identify performance areas that warrant performance metrics**.** These performance areas may include traditional performance areas or new and emerging performance areas, depending on the needs of the particular jurisdiction. (See Chapter 3.)

4. Establish performance metric reporting requirements**.** Use performance metrics to monitor those areas identified in Step 3. Review the results over time to identify any performance areas that may require targets. (See Chapter 3.)

5. Establish performance targets, as needed**.** Establish targets to provide utilities with a clear message regarding the level of performance expected by regulators. Review the results over time to determine whether any performance areas warrant rewards or penalties. (See Chapter 4.)

6. Establish penalties and rewards, as needed. Establish reward or penalties to provide a direct financial incentive for maintaining or improving performance. (See Chapter 5.)

7. Evaluate, improve, repeat. Creating effective performance incentive mechanisms is an iterative process. The effectiveness of the mechanisms should be monitored closely and evaluated to determine which aspects are working well, and which are not. Targets, financial incentives, and other components of the mechanisms may need to undergo several adjustments before they achieve their full potential. (See Section 6.4)

6.3. Pitfalls to Avoid

No performance incentive mechanisms can be said to be perfectly designed, but those that work well succeed in providing greater benefits than costs to all parties. Unfortunately, there are also many examples of performance incentive mechanisms that have not succeeded, for a variety of reasons. Below we address some common pitfalls that regulators should endeavor to avoid when designing performance incentive mechanisms.

Disproportionate Rewards (or Penalties)

Performance incentive mechanisms can sometimes provide rewards (or penalties) that are too high relative to customer benefits or to the utility costs to achieve the desired outcome. Rewards (or penalties) can also be unduly high if they are based on volatile or uncertain factors, especially factors that are primarily beyond a utility's control.

It is critical that regulators avoid the pitfall of over-rewarding utilities for performance. When utility rewards exceed the benefits to customers, particularly when they are first implemented, the entire concept of incentive mechanisms is undermined. Higher-than-expected rewards can also result in substantial backlash against performance incentive mechanisms that might have otherwise worked well.

Potential Solutions

One way to avoid this pitfall is for regulators to adopt an incremental approach: begin with small rewards and monitor and adjust over time. Another option is to establish caps on rewards (and penalties), to ensure that they stay within reasonable bounds.

Avoided Costs and Disproportionate Rewards

To encourage improved nuclear power plant performance, California implemented incentive payments for electricity produced by several of its nuclear reactors. In 1988, a settlement established the payment rate for electricity produced by Diablo Canyon, based on then-current avoided costs of fossil generation. This rate was to remain fixed, escalated only for inflation. By the mid-1990s, Diablo Canyon was earning more than $0.12/kWh, while Western Market wholesale power prices were approximately $0.03/kWh.

Later, a similar performance incentive mechanism was established for Palo Verde Nuclear Generating Station, but in this case the payment was set at the avoided cost of replacement power. Unfortunately, by the summer of 2000 the California energy crisis was in full swing, and the cost of replacement power had increased more than ten-fold. Again, the volatility of the markets had resulted in utility rewards much higher than intended. Both of these performance incentive mechanisms were subsequently modified, and further details can be found in Appendix A.

Another tool that can help prevent excessive compensation to utilities for some PIMs is shared savings. For example, when a utility implements a cost-saving measure, shared savings mechanisms pass on a portion of utility profits to ratepayers. Again, it is advisable to begin with a shared-savings mechanism

that passes most profits to ratepayers, and reduce this proportion over time if needed in order to provide the utility with greater incentives.[24]

Unintended Consequences

Perhaps the most challenging aspect of designing performance incentive mechanisms is anticipating and avoiding unintended consequences. A common effect of establishing an incentive for one aspect of utility performance is to shift management's attention to the areas with incentives, to the detriment of areas that do not have incentives.

Unintended effects can also result from failing to recognize the linkages between various aspects of the utility's system. For example, providing an incentive for achieving high capacity factors at certain utility power plants could create several perverse incentives, such as encouraging the utility to: (1) increase sales, (2) operate units out of merit order, (3) engage in otherwise uneconomic off-system sales, or (4) defer needed maintenance outages.

Potential Solutions

Avoiding unintended consequences requires significant attention to the myriad incentives utilities face and the ways in which the performance target may influence other aspects of the utility's system. Strategies to minimize negative impacts include:

- Implement a diverse, balanced set of incentives to avoid concentrating management attention on only one area.
- Focus on performance areas that are relatively isolated from others, where possible. Energy efficiency is a good example of an area that may have relatively little impact on other aspects of utility performance.
- Explicitly assess up front how performance standards might influence other performance areas that do not have standards. Solicit input from multiple stakeholders and learn from experiences in other states.
- Allow for performance incentives to evolve over time to correct for unintended consequences.

Regulatory Burden

[24] Shared-savings mechanisms can also be structured to give a greater proportion of early savings to one of the parties (either shareholders or ratepayers), and a smaller proportion of later savings to that same party. A regressive sharing mechanism gives more of the early savings to shareholders, but less of the later savings. A progressive savings mechanism works in reverse by providing more of the early savings to ratepayers. An advantage of the progressive shared savings mechanisms is that it protects ratepayers against uncertainty, since if the performance target is miscalculated and set too low, ratepayers still retain a large portion of the savings. Progressive sharing mechanisms also create a stronger incentive for the utility to achieve high levels of savings. However, if the target is set where it is already difficult for the utility to meet and already delivers significant value to ratepayers, a regressive mechanism may be appropriate for equity reasons. For more discussion, see Testimony of William B. Marcus, PBR Economic Issues, JBS Energy, in California PUC Docket A. 98-01-014, July 3, 1998.

If performance incentive mechanisms are not designed well they can be too costly, too time-consuming, or too much of a distraction, for the utility, the regulators, and other stakeholders. Data reporting and verification can be resource intensive. Determining appropriate targets can be time-consuming and contentious, and disputes over penalties can be expected, particularly when large sums of money are at stake. These activities can divert limited resources away from more important issues, becoming an unnecessary distraction.

Potential Solutions

To avoid unnecessary regulatory burden, regulators should endeavor to streamline performance incentive mechanisms by using existing data and protocols where possible, and relying on simple mechanism designs. If a specific PIM is becoming a distraction, it may be because too much money is at stake. Ensuring that the reward or penalty is commensurate with the importance of the policy goal will help to ensure limited resources are appropriately allocated.

Reducing Regulatory Burden in New York

In 2012, the New York Public Service Commission issued an order that abolished the penalty portion of energy efficiency incentives. The Commission's experience was that the threat of penalties "created an adversarial approach to setting targets and budgets, undue aversion to risk, and short-term allocation of resources that may not serve the long-term interests of a balanced program." In addition, consideration of mitigating circumstances presented a substantial drain on staff and utility resources that could have been better spent on administering programs. See NY PSC 2012, 5-6.

Uncertainty

Metrics, targets, and financial consequences that are not clearly defined create uncertainty, introduce contention, and are less likely to achieve policy goals. In addition, significant and frequent changes to incentives create uncertainty for the utilities, thereby inhibiting efficient utility planning and encouraging utilities to focus on short-term solutions.

Potential Solutions

A critical step in reducing uncertainty is to carefully specify metric and target definitions, soliciting utility and stakeholder input where possible. If historical data are available, it can be instructive to use such data to provide examples of how the performance data will be assessed and rewarded or penalized in the future. As discussed in the case study in Chapter 3, such an approach may have helped Nevada utilities and stakeholders avoid much of the litigation and controversy regarding whether a certain type of facility would be designated as a "critical facility" eligible for enhanced return on equity.

The speed with which performance metrics and incentives are reported and applied can help reduce uncertainty. Information regarding the achievement of targets and the magnitude of incentives should be provided as quickly as possible, to minimize uncertainty and allow for mid-course corrections as soon as possible.

Regulatory certainty is equally important for ensuring that long-term utility investments are made efficiently, and incentives are not diluted. To this end, regulators should adjust targets and financial

consequences only cautiously and gradually so as to reduce uncertainty and encourage utilities to make investments with long-term benefits.

Gaming and Manipulation

Every performance incentive mechanism carries the risk that utilities will game the system or manipulate results. "Gaming" refers to a utility taking some form of shortcut in achieving a target so that the target is reached, but not in a way that was intended. For example, if a performance incentive were set that rewarded a utility for increasing a power plant's capacity factor above a certain threshold, the utility might understandably respond by increasing its off-system sales from that power plant, even at an economic loss. Thus the utility would be able to meet or exceed the target capacity factor, but ratepayers would be worse off.

Manipulation of the results refers to the deliberate alteration or obscuring of unfavorable performance data, whether through use of dubious analysis methods, improper data collection techniques, or direct alteration of data. An example of this occurring in California is provided in Appendix A, as well as in a call-out box in Chapter 3.

Potential Solutions

The ability of utilities to game an incentive typically points to the need to refine how a metric is defined. In the example above, the metric could be redefined to exclude energy sold at a loss or energy from a unit that is operated out of merit order. This pitfall can be quickly remedied by ensuring that regulators carefully monitor how well performance incentive mechanisms are achieving their intended results, and step in quickly to make necessary adjustments, particularly where an incentive is clearly being gamed. In addition, the potential for gaming makes it all the more important that financial rewards and penalties are set conservatively in the beginning, and only increased once regulators and utilities gain experience with the performance incentive mechanism.

Manipulation can be more difficult to detect, particularly when data are collected and analyzed by the utility. To reduce the risk of manipulation, verification methods should be adopted and independent third parties used to collect, analyze, and verify data where practical. Complex data analysis techniques that are difficult to audit should generally be avoided, as they reduce transparency.

6.4. Summary of Key Performance Incentive Mechanism Design Principles

The table below provides a recap of the key principles for performance incentive mechanism design.

Table 16. Key Principles and Recommendations

Regulatory Contexts **(Chapter 2)**	• Articulate policy goals • Recognize financial incentives in the existing regulatory system • Design incentives to modify, supplement or balance existing incentives • Address areas of utility performance that have not been satisfactory or are not adequately addressed by other incentives
Performance Metrics **(Chapter 3)**	• Tie metrics to policy goals • Clearly define metrics • Ensure metrics can be readily quantified using reasonably available data • Adopt metrics that are reasonably objective and largely independent of factors beyond utility control • Ensure metrics can be easily interpreted and independently verified
Performance Targets **(Chapter 4)**	• Tie targets to regulatory policy goals • Balance costs and benefits • Set realistic targets • Incorporate stakeholder input • Use deadbands to mitigate uncertainty and variability • Use time intervals that allow for long-term, sustainable solutions • Allow targets to evolve
Rewards and Penalties **(Chapter 5)**	• Consider the value of symmetrical versus asymmetrical incentives • Ensure that any incentive formula is consistent with desired outcomes • Ensure a reasonable magnitude for incentives • Tie incentive formula to actions within the control of utilities • Allow incentives to evolve

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APPENDIX A – DETAILED CASE STUDIES

California

California has a long history of employing various performance incentive mechanisms, and much can be learned from the successes and failures of these experiments. Here we discuss a few of the performance incentive mechanisms that have been employed in California, focusing particularly on the lessons that have been learned along the way.

It is often easier to point out instances of when mechanisms have gone awry than where mechanisms have functioned well, due to the amount of attention garnered by the former. For this reason, much of the discussion below highlights the challenges that have been encountered along the way and strategies for avoiding similar difficulties in the future. This should not be taken to imply that performance incentive mechanisms always or often encounter these problems. Indeed, California's willingness to continue to experiment with performance incentive mechanisms indicates that regulators continue to believe that they are a useful regulatory tool.

Nuclear Power Plant Performance

Diablo Canyon Nuclear Incentives

The 1980s were characterized by numerous nuclear power plant cost overruns and generally low industry-wide nuclear plant capacity factors. Pacific Gas and Electric's (PG&E's) $5.5 billion Diablo Canyon power plant was one example of a power plant that exceeded its estimated construction budget by several billion dollars.

In 1988, the California Public Utilities Commission (CPUC) authorized a settlement regarding Diablo Canyon that was intended to protect ratepayers from the significant cost overruns of the plant, while encouraging the plant to operate efficiently. Instead of allowing PG&E to recover all of the costs of the plant automatically, the settlement based a large portion of the cost recovery on the amount of electricity that would be generated by Diablo Canyon. Energy from the plant was to be paid a set price per kilowatt-hour, and the utility would only recover all of its costs if the plant operated at a high capacity factor. Further, the utility and its shareholders assumed responsibility for all repairs and additional investments at Diablo Canyon (CPUC 1988).

The settlement shielded ratepayers from the risk that the plant would perform poorly or incur significant additional costs. However, there were three aspects of the performance incentive mechanism in the settlement that would ultimately work to the disadvantage of ratepayers:

- First, the target capacity factor above which PG&E would earn a profit was set based on industry averages, rather than based on the much higher-than-average capacity factor of Diablo Canyon at the time of the settlement.[25]

- Second, the financial reward to PG&E for generating electricity from the plant was set at a fixed price (escalated for inflation), rather than being flexible to account for changing market conditions. As a result, ratepayers continued to pay a set price per kWh of electricity from Diablo Canyon even when it would have been more economical to use energy from other sources (such as oil or gas) (CPUC 1988). Although the price set for electricity from Diablo Canyon appeared reasonable at the time, in later years Diablo Canyon power became significantly more expensive than power sold on the West Coast wholesale market.[26]

- The performance incentive mechanism contained no shared savings component or other safety valve that would have reduced the consequences of getting either of the above two elements wrong.

PG&E successfully operated the Diablo Canyon power plant, achieving capacity factors much higher than the industry average at the time of the settlement agreement, and producing profits for shareholders. In this way, the incentive mechanism can be said to have been successful in providing an incentive for the utility to operate the nuclear power plant efficiently, but the choice of a target capacity factor and locking in the power plant's energy price did not generate the intended benefits for ratepayers. The performance incentive mechanism ultimately proved to be unstable and was modified in later years and finally eliminated in 2002 through Decision 02-04-016.

A more tenable performance incentive mechanism might have also have (a) included a shared savings component, whereby ratepayers would receive a portion of any profits generated, or (b) tied the price paid for Diablo Canyon power to the avoided cost of power from fossil generators. These components would have distributed the risk more equitably between ratepayers and the utility.

Palo Verde Nuclear Incentives

In the 1990s, California adopted additional performance incentive mechanisms for other nuclear power plants, including the Palo Verde Nuclear Generating Station. The terms of this incentive mechanism were modified from those of Diablo Canyon: the utility would receive a reward for generation above a capacity factor of 80 percent, and the reward would be calculated based on the difference between Palo Verde's incremental variable cost and the cost of replacement power. In addition, the performance incentive mechanism initially included a provision for sharing of benefits between shareholders and ratepayers in later years, although this provision was eliminated before it took effect (CPUC 2001).

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[25] The capacity factor from the date of commercial operation through June 30, 1988 was 67.7% for Unit 1 and 76.7% for Unit 2, as compared to an industry average of 58% for similar large nuclear power plants (CPUC 1988, 112, 114).

[26] In 1994, Diablo Canyon was earning more than 12 cents/kWh, while Western Market wholesale power prices were approximately 3 cents/kWh (Smeloff and Asmus 1997, 82).

Although this performance incentive mechanism incorporated greater protections for ratepayers than the PIM for Diablo Canyon, it ultimately also proved to be unstable. When the PIM was initially developed, the cost of replacement power was expected to be in the range of $0.03 to $0.05 per kilowatt-hour, but by summer 2000, these costs had escalated to more than ten times higher. For this reason, stakeholders lobbied for a limit on the incentive payments and the commission instituted a cap of $0.05 per kilowatt-hour (CPUC 2001).

The Palo Verde incentive mechanism was initially designed to expire at the end of 2001, at which point Palo Verde would be returned to cost-of-service ratemaking. Upon petition by SCE, the incentive mechanism was continued until SCE's next general rate case, effective May 22, 2003 (Southern California Edison 2006a).

Lessons Learned

California's experience with nuclear power incentives highlight just how difficult it can be to set a reasonable target and incentive payment. These difficulties can be mitigated by using shared savings mechanisms or instituting safety valves—such as Palo Verde's cap on the incentive payment.

Gaming and Manipulation of Performance Incentive Mechanisms

In 1990, the CPUC began an investigation into incentive-based ratemaking for gas utilities (R90-02-008 and I90-08-006), finding that a PBR plan with indexing could "provide substantial benefits in increased efficiency, innovation, ratepayer protection, risk allocation, and regulatory simplicity" (CPUC 1991, 1). Beginning in 1993, the CPUC approved gas procurement mechanisms for the gas utilities that replaced after-the-fact reviews of gas procurement with market-based gas price benchmarks.

Soon, the CPUC began to also approve PBR mechanisms for electric utilities. PBR was introduced as an alternative to cost-of-service regulation, which the Commission felt had become "too complex to allow us to regulate utilities effectively" (CPUC 2008, 2). The Commission hoped that PBR plans would help them find "new ways to reduce regulatory interference with management decisions and to allow utilities more flexibility in their day-to-day operations" (CPUC 2008, 3).

A PBR plan was adopted for Southern California Edison (SCE) though Decision (D.) 95-12-063 and modified by D.96-09-092. Three categories of service incentives were created: reliability, customer satisfaction, and health and safety.

SCE's Customer Satisfaction Incentive Mechanism terminated at the end of 2003, while some form of Employee Health & Safety Incentive Mechanism continued through 2005 (Southern California Edison 2006b). From 1997 to 2000, SCE received $48 million in rewards under the customer satisfaction and health and safety incentive mechanisms. Subsequently, SCE requested $20 million in customer satisfaction rewards for 2001 to 2003 and $15 million in health and safety rewards for 2001 and 2002. However, in a 2008 decision, the CPUC ordered SCE to refund these rewards and forgo the additional rewards requested, as well as pay a fine totaling $30 million. The problems leading to this decision are briefly described below, followed by remarks regarding how such results might be avoided in the future.

Customer Survey Problems

Under the Customer Satisfaction Incentive Mechanism, customer satisfaction was measured through the use of third-party administered surveys with rewards and penalties in four areas: field services, local business offices, telephone centers, and service planning. Each area received a score of 1 to 5+, where 1 was low. Scores were then averaged across the four service areas to obtain the overall average score (CPUC 2008).

The original target for the overall customer satisfaction score was set to 64% of scores being 5 or 5+, with a deadband of plus or minus 3%. Beyond the deadband, the utility received a reward or penalty of $2 million for each percentage point change in the average result, up to a maximum of $10 million per year. In addition, if any one area received a score of less than 56%, a penalty would be assessed. In D.02-04-055, the Commission increased the customer satisfaction target from 64% to 69%, based on the average of the then most recent nine years of survey results (CPUC 2008).

The problems with the customer survey began with the selection of customers for the survey pool. This exercise was left to the meter readers themselves, who were supposed to push a button on a handheld device they carried every time they had a meaningful interaction with a customer (whether it was positive, neutral, or negative). However, there was no practical means of ensuring that meter readers actually did record interactions that were both positive and negative. In addition, SCE employees sometimes falsified the contact information to screen out customer interactions that might result in negative customer satisfaction surveys (CPUC 2008).

Further, some SCE employees attempted to skew survey results favorably by requesting that customers give them a good score when surveyed, giving customers collateral materials (such as golf balls and ball point pens), or telling customers that a survey score of less than 5 would represent a failing score that might lead to disciplinary action against the utility employee (CPUC 2008).

Thus despite using a third party to administer the customer satisfaction survey, the performance incentive mechanism failed because the data collection process was exposed to data manipulation and gaming by utility employees. The issue only came to light when a whistle blower wrote an anonymous letter to an SCE senior vice president. Even then, the initial review of the allegations concluded that any survey problems were inadvertent. After another anonymous letter was received with more serious allegations (including that SCE managers and high-level directors were aware of the conduct), an independent investigation was launched that began uncovering the misconduct. Ultimately, the California Public Utilities Commission found that from 1997 through 2003, SCE "manipulated and skewed survey results, artificially inflated survey outcomes, and received PBR rewards" (CPUC 2008, 16).

Underreporting Employee Health and Safety Incidents

Employee health and safety was measured by the number of first aid incidents and lost time incidents, based on historical averages as reported to OSHA. Based on that data, the benchmark was set at 13.0 injuries and illnesses per 200,000 hours worked with a dead band of +/-0.3. In 2002, the target was reduced to 9.8 injuries and illnesses based on the most recent seven years of data, and in 2003 it was

further reduced to 8.6 injuries and illnesses. Results above or below the dead band would result in rewards or penalties (CPUC 2008). Unfortunately, from the beginning this performance incentive mechanism was deeply flawed.

As with the customer surveys, the first problem with the Employee Health and Safety Incentive Mechanism was that data were not appropriately collected – both in the establishment of the performance target and for compliance reporting. To begin with, the utility did not establish a system to track all first aid incidents, leading to underreporting of the data used to establish the performance target, as well as the compliance data. Further, SCE maintained different standards for internal safety performance measures than for compliance with the performance incentive mechanism. The unsurprising result was that only a small fraction of first aid incidents were reported.

Second, the existence of the incentive mechanism actually discouraged employees from reporting injuries. The Commission found that particularly "when safety incentives are group-based (as they are in some business units), injured employees may want to avoid reporting their injuries and jeopardizing safety incentive compensation not just for themselves, but also for the rest of their group" (CPUC 2008, 60)

In addition, some supervisors participated in or encouraged under-reporting of data. "Among the methods used to disguise injuries and avoid internal reporting are: employee self-treatment; treatment by personal physicians rather than the company doctor; timecard coding of lost time as sick days or vacation; etc." (CPUC 2008, 60).

Lessons Learned

In both the customer satisfaction and health and safety incentive mechanisms, data collection was seriously flawed. These experiences highlight the need to validate data frequently and to employ independent third parties for data collection where possible. However, the disincentive for employees to self-report health and safety data may be too great to overcome. Because of the great importance of maintaining a safe work environment, some jurisdictions have elected to eliminate performance incentives for health and safety in order to avoid creating perverse incentives. This does not mean that such data cannot or should not be tracked, but financial rewards or penalties should be carefully considered.

Recent Experience with Performance Incentives in California

In the early 2000s, California abandoned performance-based ratemaking and returned to "a transparent regime of cost-based ratemaking" (CPUC 2004, 288). However, the Commission elected to continue to use performance incentive mechanisms, as

> "they provide a more responsive approach to deviations in service adequacy and quality than our other ratemaking mechanisms.… They can be carefully adapted to the cost-of-service regime and enhance our ability to regulate in the public interest, providing both financial incentives to guide utility activities and an early warning of longer-term trends

> that we can use to guide more intrusive regulatory interventions such as complaints and investigations. They represent a calibration, not a contradiction, of our cost-of-service principles" (CPUC 2004, 289).

Although the customer service and health and safety performance incentive mechanisms as described above have been discontinued, the California Public Utilities Commission has continued to experiment with performance incentive mechanisms where warranted. Under a cost-of-service regime, however, the CPUC requires that the need for such incentives be fully justified, stating:

> "We will consider whether the proposed performance incentives are necessary for achieving one or more of our regulatory objectives and are likely to be cost-effective; we do not believe that performance incentives should be adopted solely on the basis of their mere consistency with a particular objective. Since rates set through our conventional approach to ratemaking are intended to provide the funding required to meet the regulatory objectives of safe and reliable service, we must ask why the utility needs the possibility of additional ratepayer funding, or threat of reduced funding, to get the utility to do what it is already funded and expected to do. The burden is on the proponents of performance incentives to prove they are necessary, cost-effective, and otherwise reasonable" (CPUC 2004, 290).

Renewable Energy Procurement Costs

California has long had a Renewable Portfolio Standard (RPS), but certain provisions in the enforcement rules caused CPUC become concerned that construction delays and contract failures could jeopardize PG&E's compliance with the RPS (CPUC 2010). The RPS enforcement rules contained loopholes to deal with the cumbersome, short annual compliance period that was required by legislation, such as allowing retail sellers to incur a certain percentage of their annual procurement obligation as a deficit without explanation. As another example, the rules allowed "earmarking" of future contracted deliveries for the current compliance period, even if deliveries were not anticipated to commence in the current compliance period (CPUC 2014a).

In February 2009, PG&E filed a proposal—with no performance incentive component—to implement and recover costs of a photovoltaic (PV) program. In response to recommendations by other parties, the CPUC approved the program but adopted a price cap of $246 per MWh and a cost savings incentive mechanism "to better align PG&E's financial interests with those of ratepayers" (CPUC 2010, 31).

The program target called for installing 50 MW of utility-owned PV capacity per year for five years (for a total of 250 MW of utility owned generation). PG&E could also enter into power purchase agreements (PPAs) for up to 250 MW of PV. Under the cost savings incentive mechanism, PG&E shareholders were permitted to retain 10% of cost savings if actual average capital costs over the life of the PV Program fell below $3,920 per kW, representing PG&E's capital cost estimate with no contingency amount. Ratepayers were entitled to retain 90% of the cost savings below $3,920 per kW. Although the CPUC did not specify a penalty, capital costs above $4,312 per kW were subject to a reasonableness review.

Notably, PG&E opposed the cost cap and cost savings incentive mechanism, largely on the grounds that these elements exposed PG&E to uneven risks and rewards (CPUC 2010, 55–56).

In December 2012, PG&E requested to terminate its PV Program after the second PV PPA solicitation and to procure the remaining capacity using the Renewable Auction Mechanism (RAM) process adopted by the CPUC in D.10-12-048 instead. The CPUC rejected the request on procedural grounds. In February 2014, PG&E resubmitted its request, claiming that terminating the PV Program and using the RAM process to procure the remaining capacity would create significant administrative efficiencies, would reduce customer costs, and was appropriate given that the PV sector had significantly transformed since the PV Program was approved in 2010 (PG&E 2014). In November 2014, the CPUC granted PG&E's request to close the PV Program, noting that the CPUC's goals in establishing the program were substantially achieved and the availability of other procurement tools for smaller scale RPS-eligible products, making the PV program duplicative and administratively burdensome (CPUC 2014b, 14).

Lessons Learned

The experience with the PV Program cost savings incentive mechanism suggests that asymmetrical risk and reward mechanisms are likely to garner opposition by utilities. In this case, PG&E shareholders were permitted to retain only 10% of the cost savings below its capital cost estimate excluding contingency, and costs above the cost cap would be subject to regulatory review. On the other hand, ratepayers were entitled to retain 90% of the cost savings below $3920 per kW, and they were protected from the downside by a cost cap provision.

Another lesson from this experience involves consideration of administrative burden and redundancy. The potential rewards for the company were apparently not enough to outweigh the administrative burden of maintaining the PV Program. Given that the RAM process had matured since the inception of the PV Program, the latter became redundant.

The UK RIIO Model

When the British energy distribution and transmission utilities were privatized in 1990, a performance-based regulatory framework was adopted with a price control mechanism to regulate the utilities. This form of PBR was referred to as "RPI-X," as it allowed revenues to grow at the rate of the retail price index (RPI), less an X-factor which was designed to capture improvements in productivity, rewards and penalties, or other elements. The term of each PBR period was set at five years in order to incentivize efficiency improvements and cost reductions (the savings from which the utilities would retain until the end of the price control period). In order to prevent service quality degradation, the RPI-X plans also specified certain outputs that the utilities were required to deliver.

Over the past twenty-five years, this performance regulation framework has evolved to adapt to changing policy priorities and industry challenges. In 2008, the British Office of Gas and Electricity Markets ("Ofgem"), launched a fundamental review of the regulatory framework. Out of this review and stakeholder discussion was borne a revised form of PBR, one more comprehensive and performance-based than the RPI-X system. This new framework is referred to as "RIIO," an abbreviation for Revenue = Incentives + Innovation + Outputs.

RIIO seeks to improve upon the RPI-X model and respond to concerns that:

- The RPI-X framework focused the utilities on achieving cost savings, but not on delivering other outputs, such as improved quality of service.
- The five-year duration of the RPI-X price control period was not sufficient to encourage companies to focus on long-term trade-offs and effects of investments, innovation, and service quality.
- The RPI-X framework was not flexible enough to respond and adapt to step-changes in technology. Additional incentives were felt to be needed to stimulate innovation and adequately respond to sector-wide need to transition to a low-carbon energy industry (Jenkins 2011).

RIIO was designed to address these concerns by (a) shifting the focus from cost control to delivery of outputs through the use of performance incentives, (b) increasing the price control period to eight years, (c) increasing the focus on innovation through financial incentives and an innovative projects competition, and (d) increasing the emphasis on competition where possible. It is expected that these adjustments will encourage utilities to innovate to deliver cost savings and value for customers, as the utilities will retain most of the efficiency savings they generate for a longer period and they have the potential to earn rewards for over-delivering in certain performance areas.

Base revenues under RIIO are determined through utility business plans. These plans must be well-justified and designed to establish a long-term corporate strategy for delivering "value for money" to customers. In developing their business plans, the utilities are required to assess alternative options for delivering outputs, evaluate the long-term costs and benefits for each alternative, and incorporate stakeholder input. Once approved, the business plans form the basis for revenue adjustments over the

next eight years, with annual true-ups to account for differences in actual versus projected sales. A sharing mechanism allows utilities and customers to share any savings or overages relative to the budget, with the majority of shared savings generally accruing to the utility (ENA 2014; Ofgem 2013a).[27]

In addition to the base revenues established through utility business plans, utilities may be rewarded or penalized based on their performance in delivering specific outputs. As discussed in detail in the following sections, these rewards and penalties can have a relatively large impact on each utility's realized return on equity, with impacts of up to approximately +/- 300 basis points (Ofgem 2014b).[28]

The electric distribution network price control period will begin on April 1, 2015 and last until March 31, 2023. At the time of writing, the electric utilities had submitted their business plans to Ofgem for review, and Ofgem had approved (with modification) all of the plans. One utility's plan was "fast tracked" and accepted in full, due to it being of sufficiently high standard. The fast-tracked utility also received a reward equal to 2.5 percent of "totex" (capital expenditures + operating expenditures). The other five utilities' plans were approved, but with allowed revenues of approximately 5 percent less than requested in their business plans (Ofgem 2014b).

RIIO Outputs

Outputs are a core element of the RIIO regulatory framework, falling in six categories:

1. Safe network services
2. Environmental impact
3. Customer satisfaction
4. Social obligations
5. Connections
6. Reliability and availability

Within each of these categories, "secondary deliverables" have been identified upon which utilities will be required to deliver. For example, one of the secondary deliverables under the environmental impact category is a utility's total CO_2 equivalent emissions.

A series of working groups was established in order to identify specific metrics and incentives for each of these deliverables. Ofgem also received input from the Consumer Challenge Group, a small group of

[27] The percent of savings that the utility can retain under the "efficiency incentive" ranges from 45 percent to 70 percent, depending on whether the utility is fast-tracked or not, and the degree to which the utility's forecasts align with Ofgem's models. This sharing rate is set as part of the Informational Quality Incentive (Ofgem 2013a).

[28] The financial impacts of the performance incentive mechanisms associated with specific outputs are in addition to total expenditure efficiency incentives, informational quality incentives, and rewards associated with compiling a high-quality business plan. These other incentives could have an additional impact of more than 100 basis points in either direction. See Figure 10 for the total impact of these factors.

consumer experts that work to ensure consumers' interests are fully considered. Targets for many metrics are set by the Ofgem with input from stakeholders, while for some metrics (such as asset health), utilities propose the targets themselves in their business plans. All targets proposed by utilities must be justified in terms of costs and benefits to customers and informed by stakeholder engagement (Ofgem 2012a).

Not all outputs under RIIO have financial incentives. For example, the Reliability and Safety Working Group rejected the use of incentives (financial or reputational) for safety, as it was felt they could result in unwanted implications for incident reporting (as occurred in California, described in the previous section). Moreover, utilities are already required to comply with health and safety standards set by another governmental agency, and would be subject to enforcement action from that agency in the event of non-compliance (Ofgem 2012a).

Some categories of outputs have "reputational" incentives, where results are published and utility performance compared against other utilities, but no financial incentives are imposed. For example, under the Business Carbon Footprint metric, each utility submits an annual report of its total CO_2 equivalent emissions, as well as the actions it has taken to reduce emissions relative to their baseline. This allows utilities to share best practices and learn from one another, while also providing time to refine data collection and analysis techniques to provide more reliable data prior to administering rewards and penalties (Ofgem 2012a).

In addition, Ofgem is careful to ensure that in areas where competition exists (such as connection services) no incentive benefits are provided to utilities that are not also available to independent providers. The total package of incentives are intended to be clear and balanced in order to prevent perverse incentives, and to ensure that utilities that provide value for customers' money earn a relatively high rate of return, while utilities that fail to deliver value earn low returns (Ofgem 2012a).

The following subsections summarize the performance incentive mechanisms currently in use or under development for RIIO. Utilities must also report on several performance metrics (such as noise, sulfur emissions) that do not have corresponding financial or other incentives and are therefore not listed in the table below. For more information, see Ofgem 2013a and Ofgem 2013b.

Environmental Impact

Currently two performance incentive mechanisms are associated with the environment impact category: electricity losses and business carbon footprint. UK utilities are contractually obligated to reduce losses as much as practicable, and can be found in violation of their license agreement if they fail to do so. If utilities are particularly successful or innovative in reducing losses, they may qualify for a reward, which increases over the duration of the PBR period in order to incentivize implementation of long-term solutions.

The incentive under the business carbon footprint is unusual in that it is reputational only, due to Ofgem's determination that data are not sufficiently reliable to form the basis for financial rewards or penalties (Ofgem 2012a).[29] Under this mechanism, utilities' performance is reported annually and made public by Ofgem. All utilities' results are aggregated into one table to facilitate comparisons across utilities.

Table 17. RIIO Environmental Impact Performance Incentive Mechanisms

Deliverable	Penalty or Reward	Metric and Target Description
Electricity losses	Discretionary reward of up to £4 million in year 2, £10 million in year 4, and £14 million in year 6 for utilities that exceed the loss reduction commitments in their business plans.	Utilities report annually on loss reduction activities undertaken, improvements achieved, and actions planned for the following year. Performance will be measured according to multiple criteria, including the effectiveness of actions taken to reduce losses, engagement with stakeholders, innovative approaches to loss reductions, and sharing of best practices with other companies.
Business Carbon Footprint (BCF)	Reputational	Annual reporting requirement on CO_2 equivalent emissions, actions taken to reduce emissions over the past year and their effectiveness. All utilities' performance on this metric summarized in one table.

Source: Ofgem 2012 and Ofgem 2013

[29] A distribution utility's business carbon footprint is in part based on contractor emissions, which may not be sufficiently reliable.

Customer Satisfaction and Social Obligations

Three performance incentive mechanisms are in place to measure customer satisfaction and the degree to which utilities fulfill social obligations such as assistance to vulnerable customers. Two of these performance incentive mechanisms, complaints and stakeholder engagement, are asymmetrical. Complaints are associated with a penalty only, while stakeholder engagement can only result in a reward.

Table 18. RIIO Customer Satisfaction and Social Obligations Performance Incentive Mechanisms

Deliverable	Penalty or Reward	Metric and Target Description
Customer satisfaction survey	Reward or penalty up to 1% of annual base revenue	A survey is used to measure the satisfaction of customers who have required a new connection, have experienced an interruption to their supply, or have made a request for a service or job to be completed. Performance is measured based on the response to the question: "Overall how satisfied were you with the service that you received?" The target score will be set at the beginning of the period, and will be set at a level that "can be objectively assessed to represent a good level of performance."
Complaints	Penalty of up to 0.5% of annual base revenue. No reward.	Complaints and their weightings are measured based on: (a) percentage of complaints that are outstanding after one day (10% weighting); (b) percentage of complaints that are outstanding after 31 days (30% weighting); (c) percentage of complaints that are repeat complaints (50% weighting); and number of Energy Ombudsman decisions that go against the utility as a percentage of total complaints (10% weighting). An industry target is set.
Stakeholder engagement	Reward of up to 0.5% of annual base revenue. No penalty.	The regulator will develop a mechanism for assessing the utilities' use of data and customer insight to understand and identify effective solutions for vulnerable consumers, as well as their ability to integrate this into core business activities.

Source: Ofgem 2012 and Ofgem 2013

Connections

In addition to the customer satisfaction survey (which measures, in part, satisfaction with the utility's service in interconnecting new customers or distributed generation facilities), two performance incentives encourage the utilities to efficiently interconnect residential customers and respond to the needs of large customers (including distributed generation). These incentives are asymmetrical; a reward (but no penalty) can be earned for the time required to process small customer interconnections, while the incentive for large connections (including distributed generation) is penalty-only.

Table 19. RIIO Connections Performance Incentive Mechanisms

Deliverable	Penalty or Reward	Metric and Target Description
Time to Connect Incentive for Small Connections	Reward of up to 0.4% of annual base revenue. No penalty.	Measures the time taken from initial application received to the issue of a quotation and the time taken from quotation acceptance to connection completion. Target based on historical performance data, and target will become more stringent over the period.
Incentive on Connection Engagement (ICE) for Large Connections	Penalty of up to 0.9% of annual base revenue. No reward.	Each utility must submit evidence of how they have identified, engaged with, and responded to the needs of their customers. These submissions will be compared to a set of minimum requirements, which will likely to require each utility to demonstrate how they have engaged with a broad range of customers, established relevant performance indicators, and developed a forward-looking work plan of actions to improve performance (with associated delivery dates). Separate submissions will be required for different market segments, including distributed generation customers. A penalty will be assessed for failing to meet the minimum requirements for that market segment. The regulator will also continue to engage with stakeholders to identify key issues and gather feedback on utility performance.

Source: Ofgem 2012 and Ofgem 2013

Reliability and Availability

Several performance incentive mechanisms are in place to ensure reliability and availability. These performance incentives carry sizeable rewards and penalties, based largely on studies of customers' willingness to pay. The interruptions incentive scheme is most comparable to SAIDI and SAIFI rewards and penalties in the United States, but has separate components for unplanned versus planned outages. Because the utilities provide prior notice to customers regarding planned outages, they are less disruptive to customers. For this reason, planned outages carry a lesser financial reward or penalty as compared with unplanned outages (Ofgem 2012b; Ofgem 2013b).

The guaranteed standards of performance incentives reflect a 2010 law (SI No. 698, 2010.27) that requires utilities to make payments to customers whenever performance falls below a certain level. For example, the 2010 law requires a payment from the utility directly to affected customers who experience outages lasting more than 18 hours, or who experience four or more outages a year. RIIO maintains or strengthens these existing standards.

Finally, RIIO also penalizes or rewards utilities that under- or over-deliver on the health and load indices of their assets. Utilities target a certain level of output delivery in their business plans, which then form the basis for their allowed revenues in this area. (These performance levels must be justified through both cost-benefit analysis and stakeholder engagement.) Under-performance therefore results in both a penalty and a downward adjustment to future allowed revenues, while over-performance results in a reward and higher future allowed revenues (Ofgem 2012b; Ofgem 2013b).

Table 20. RIIO Reliability and Availability Performance Incentive Mechanisms

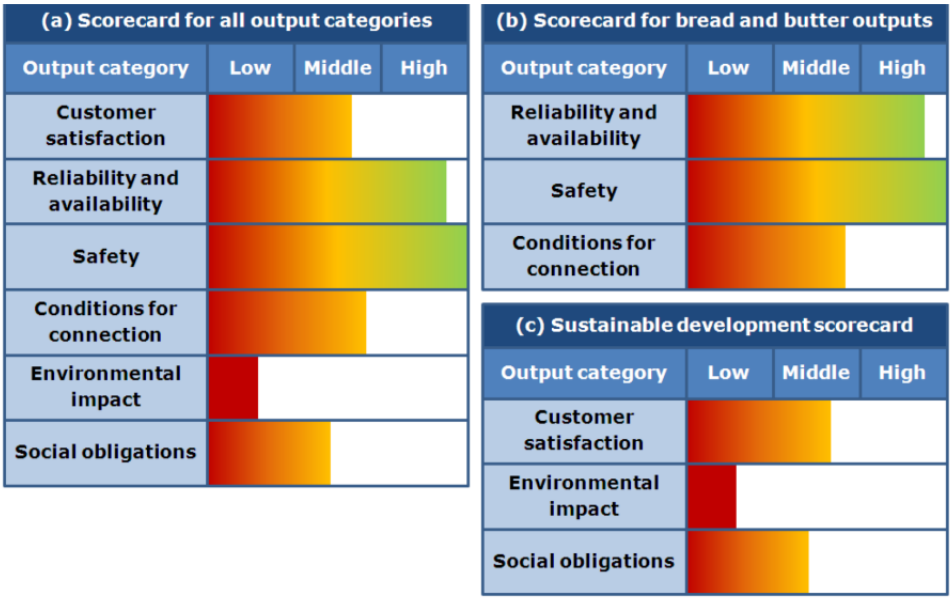
Deliverable	Penalty or Reward	Metric and Target Description
Interruptions Incentive Scheme	Penalty or reward of up to 250 basis points on rate of return per annum	Utilities are incentivized on the number and duration of network supply interruptions versus a target derived from benchmark industry performance. Planned and unplanned outages have separate targets, and planned outages are rewarded and penalized 50% less than unplanned outages. Annual utility targets for planned interruptions are set using a three-year rolling average, with a two-year lag. (That is, the 2015-16 target would be the average over the 2011-12 to 2013-14 period.) Unplanned outage targets are set using a combination of utility and industry average for Low Voltage (LV), Extra High Voltage (EHV), and 132kV. Exceptional events are excluded from the performance data. Utilities can propose alternative targets in their well-justified business plans.
Guaranteed Standards of Performance	Penalty: Direct payments to each customer affected, typically of approximately £30/customer	Customers are eligible for direct payment of specific fixed amounts where a utility fails to deliver specified minimum levels of performance. For example, if the duration or frequency of interruptions exceed a pre-specified level, the utility must make a payment to a customer. Vulnerable customers on the Priority Service Register will receive automatic payments, while other customers will need to apply to their utility for payment.
Health and Load Indices	Penalty for under-delivery equal to reduced future allowed revenues and 2.5% of the value of the under delivery, or a reward for over-delivery equal to 2.5% of the incremental costs associated with over delivery and an upward adjustment to future allowed revenue.	Risk reduction associated with the condition and loading of assets. These metrics encourage longer-term strategies by linking the longer-term reliability benefits of healthier and less highly-loaded assets to a measurable deliverable within the price control.

Source: Ofgem 2012b, Ofgem 2013b

Scorecard for Outputs

To facilitate comparison across companies, Ofgem intends to develop scorecards for each of the companies' performance across the categories of output. Although the details have not yet been fleshed out, the scorecard will measure performance relative to a normalized baseline, as presented in the illustrative example below.

Figure 9. Illustrative Scorecard for Outputs



Source: (Ofgem 2010)

Lessons Learned

Under RIIO, a suite of performance incentive mechanisms, together with a comprehensive revenue cap mechanism, has been designed to encourage utilities to meet the needs of their customers in a cost-effective manner. Even though this new PBR framework is still being developed and has yet to be applied, several lessons can be drawn from the UK experience.

The evolution of the UK PBR framework provides an indication of the limitations to the simpler version of performance-based regulation that has been in place in the US, and the UK experience mirrors some of the challenges with PBR that US regulators have wrestled with in recent years. Many of the new RIIO elements described above (e.g., expanding the price control period, more focus on outputs, more attention to future planning in the business plans, increased use of capital cost trackers), reflect the aspects of simple PBR that have been insufficient in achieving PBR's ultimate goals. Regulators in the US who are looking to PBR as a new utility regulatory model should take note of the implications of these new RIIO elements.

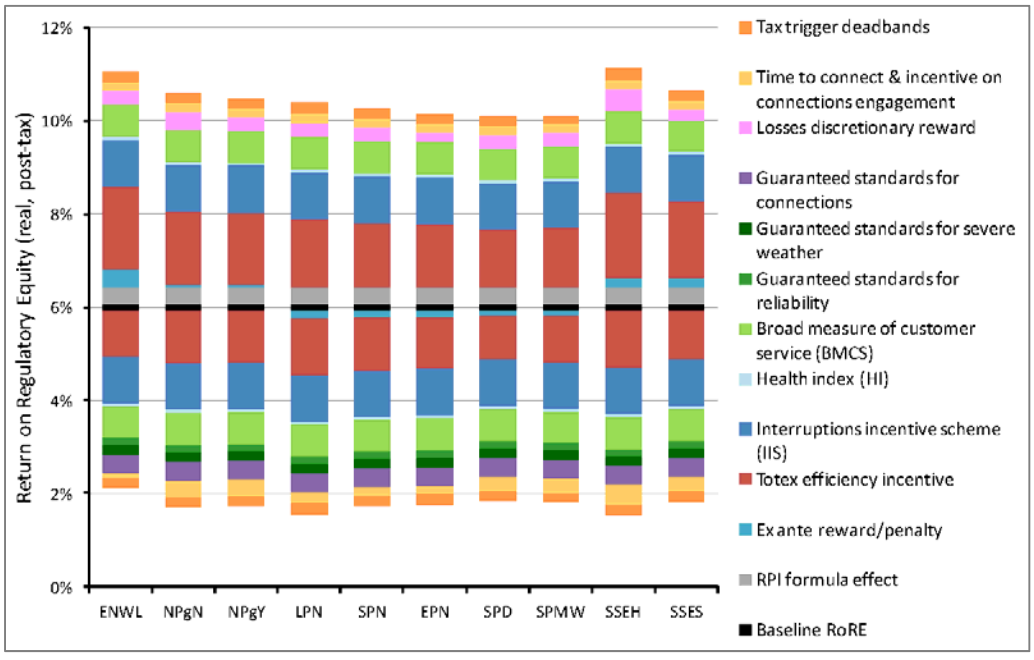
One of the key lessons from the evolution of PBR in the UK relates to regulatory engagement. When PBR was introduced in the UK, and shortly after in the US, it was referred to as "hands-off" regulation. For example, the California PUC wrote that it hoped that PBR plans would help them find "new ways to reduce regulatory interference with management decisions and to allow utilities more flexibility in their day-to-day operations" (CPUC 2008, 3). However, the experience from the UK is just the opposite. It is clear that the new RIIO mechanism will requires significant utility and regulatory resources up front due to the extensive nature of the business plan development and review process, as well as the up-front effort necessary to create balanced and effective performance incentive mechanisms. Note that over

the last five years, the number of Ofgem employees have doubled to more than 700 full-time employees.[30] Even after the development and approval of the utility business plan, Ofgem will probably need to dedicate considerable resources to the oversight and implementation of the performance incentives and the other components of the RIIO mechanism.

Relative to performance incentive mechanisms in the United States, RIIO places a large amount of revenues at stake. Potential rewards and penalties for outputs under the environmental, customer satisfaction, social obligations, and connections categories equate to approximately 3 percent of utility annual base revenues. Reliability-related rewards and penalties carry with them the possibility of an additional 250 basis points in rewards or penalties. The results of Ofgem's modeling suggest that utilities' realized return on equity may fluctuate by approximately +/- 300 basis points due to these performance incentive mechanisms (Ofgem 2014b).

These performance incentive mechanisms are integrated into a revenue cap plan that increases revenues each year at the rate of inflation and provides utilities with the ability to retain a significant portion of any cost efficiency savings. Allowed revenues are set using a 6 percent return on equity, but actual earnings may vary significantly based on utility performance. According to Ofgem's modeling, the actual ROEs for "slow-track" utilities are likely to range from approximately 2 percent to more than 10 percent, as shown in the figure below (Ofgem 2014b).

Figure 10. Plausible ROE Ranges for UK Distribution Utilities



Source: Ofgem 2014b, page 46

[30] The number of permanently-employed staff at Ofgem has grown from 310 employees in 2008/2009 to 761 in 2013/2014 (Ofgem 2009; Ofgem 2014a).

This wide variability of potential utility returns is by design, as Ofgem determined early on that high-performing utilities should have the opportunity to earn an ROE of greater than 10 percent, while poorly performing utilities could earn an ROE of less than the cost of debt. Ofgem notes that the results shown in the figure above indicate that the package of risk and incentives has been "appropriately calibrated" (Ofgem 2014b, 46). The relatively large magnitude of incentives under RIIO not only helps to focus management attention on the attainment of the established targets, but may also help to provide the revenues necessary for innovating and implementing new technologies.

The RIIO process for developing performance incentive mechanisms relied upon significant amounts of stakeholder feedback, ranging from utilities to consumer groups. However, not all of the performance incentive mechanisms appear to have been fully developed yet, particularly for stakeholder and customer engagement. This is perhaps not surprising, as metrics based upon more qualitative data are difficult to define and can be difficult to administer. Lessons learned from the UK's experience with these more qualitative performance incentive mechanisms will be instructive for the development of similar valuable, but difficult-to-quantify performance targets elsewhere.

RIIO's performance targets are generally linked directly to utility business plans or industry-wide performance levels, which helps to ensure that the targets are reasonable and that the utilities will have the funds required to make investments to meet these targets. In some cases, such as interruptions and availability, rewards and penalties are based on customer willingness-to-pay surveys in order to balance the value of improved reliability with the associated costs.

Lastly, RIIO's use of "reputational" incentives for reducing carbon emissions provides an example of how simply displaying a comparison of utility performance in an easily and publicly accessible manner can encourage utilities to take steps to improve their performance, particularly for areas that are important for customers, such as carbon emissions. While the reputational incentive may not always be sufficient for achieving the level of performance desired, it represents a relatively simple and risk-free first step. Moreover, it allows data collection processes and definitions to be standardized and clarified prior to applying high-stakes financial incentives.

New York

During the 1990s, New York experimented with numerous performance incentive mechanisms for its electric and gas utilities. For example, the 1991 Measured Equity Return Incentive Program (MERIT) for Niagara Mohawk Power Company was designed to address a variety of aspects of the company's operations, including nuclear plant performance, the amount of payments to outside law firms, and environmental performance. The program resulted in significant improvements at Niagara Mohawk, and various performance incentive mechanisms were subsequently adopted at other New York utilities, generally under a comprehensive PBR plan with a price cap (Biewald et al. 1997).

The breadth of performance incentive mechanisms in use in New York was substantially reduced following restructuring as generation assets were spun off and subjected to the discipline of the market. Recently, however, New York has developed a renewed interest in performance incentive mechanisms as a means of reshaping utility incentives. In April 2014, the New York Public Service Commission (PSC) initiated the Reforming the Energy Vision docket with the goal of better aligning utility interests with state energy policy objectives. Although the docket is currently on-going, the initial straw proposal envisions moving toward a more "outcome-based approach to ratemaking" with metrics based on state energy policy goals (NY DPS Staff 2014).

A key component of the Reforming the Energy Vision (REV) proceeding is the desire to place distributed energy resources on a level playing field with traditional investments. While the REV proceeding is expected to develop a new ratemaking framework to achieve this goal, New York is already taking steps toward a new regulatory paradigm. In December 2014, the PSC approved incentives to reward the use of cost-effective distributed energy resources through a project called the Brooklyn Queens Demand Management (BQDM) program.

The Brooklyn Queens Demand Management program was proposed by Consolidated Edison Company (ConEd) to address load growth in the Brooklyn and Queens areas of New York. Rather than constructing a new area substation, a new switching station, and new subtransmission feeders (at a cost of approximately $1 billion), ConEd proposed to implement a portfolio comprised of distributed energy resources and other low-cost traditional utility-side solutions to address the forecasted summer overloads at a much lower cost (NY PSC 2014).

The PSC found that the BQDM project and associated incentives represented a valuable opportunity to explore changes to traditional utility operations and ratemaking, stating "this Commission must itself innovate in order to support innovation by utilities and third parties" (NY PSC 2014, 15). In order to ensure that the utility is indifferent to investments in distributed energy resources and traditional infrastructure investments, the Commission approved several financial incentives for ConEd. Specifically, the PSC approved:

- A regulated return on the alternative investments,
- A 10-year amortization period for the investments,

- A 100 basis point ROE adder on BQDM program costs tied to the achievement of specific outcomes related to achieving a certain capacity of alternative measures, increasing diversity of distributed energy resource vendor market, and implementing a portfolio that has a lower cost than the traditional solution. These performance incentives are defined in Appendix B of the order as follows (NY PSC 2014):

  1) Quantity of Alternative Measures:

     a. Metric: Capacity of alternative measures installed

     b. Target: 41 MW

     c. Financial incentive: 45 basis points for meeting or exceeding target

  2) Diversity of DER Vendor Marketplace:

     a. Metric: Normalized entropy index, calculated as follows:

$$normalized\ entropy\ index = \frac{\sum_{i=1}^{N} S_i \ln(S_i)}{\ln(N)}$$

        Where N is the number of DER Providers and S_i is the share, in MWh, of each provider in the selected portfolios.

     b. Target: Baseline set at 0.75; maximum reward occurs at 1.0

     c. Financial incentive: One basis point earned for each 0.01 increase in the normalized entropy index above the baseline (up to 25 basis points).

  3) Reduction in Dollar/MW Costs:

     a. Metric: Assembling a portfolio of solutions that achieves a lower $/MW lifecycle cost (based on the net present value) than the traditional investment solution (30 basis points). The lifecycle costs will be calculated by January 31, 2017, using the Company's then-applicable Weighted Average Cost of Capital.

     b. Target: Baseline set at $6 million/MW based on the Company's estimated NPV revenue requirement of 915.6 million to achieve a total capability of 152 MW.

     c. Financial Incentive: For every full 1% reduction in the $/MW of the BQDM Program portfolio and associated investments relative to the baseline, the Company may earn 1 basis point (up to 30 basis points.)

Initial Assessment of the BQDM Performance Incentive Mechanisms

The adoption of the above performance incentive mechanisms provides a clear signal to New York's utilities that distributed energy resources should be valued in a manner similar to traditional investments, and that reducing costs for consumers will be rewarded. The three performance incentive

mechanisms (quantity of alternative resources installed, diversity of market, and cost) simultaneously address several of the commission's objectives.

In addition, the commission's choice of incentive formulas appears reasonable. The Company will only be rewarded if it installs the amount of alternative resources required (41 MW), but will not be rewarded more for installing more resources than needed, thereby avoiding an incentive to procure excessive amounts of alternative resources. The choice of linear financial rewards for the diversity index and cost provide incentives to achieve the highest levels reasonably possible, while rewarding the Company proportionately for any improvements made.

However, two aspects of the performance incentive mechanism have some room for improvement: (1) the linkage between rate base and the financial incentive, and (2) the definition of the diversity index. The financial reward's direct link to rate base (through virtue of being an ROE adder) implies that increasing rate base will in turn increase the Company's financial reward, which may exacerbate the Averch Johnson effect and lead the utility to make unnecessary rate base investments. This issue is explored in more detail in the FERC Transmission Bonus ROE case study later in this appendix.

The second issue concerns the diversity index definition. On January 12, 2015, ConEd filed a petition requesting clarification and modification to several aspects of the performance incentive mechanism (ConEd 2015):

- First, the Company pointed out that, as currently defined, the diversity index focuses on the number of vendors who are awarded contracts through the BQDM Program, but does not include direct customers and subcontractors. It is likely that the Commission is also interested in increasing the number of customers who provide distributed energy resources (such as commercial buildings providing demand response) and vendor subcontractors, and therefore the diversity index should be expanded to include these entities.

- Second, the diversity index, as currently defined, does not measure diversity of technologies. If this is a priority for the Commission, this measure of diversity should also be included in the index.

- Third, the specific calculation of the entropy index appears to reward equal contributions of capacity more than the number of vendors. That is, under the current metric definition, the Company would earn the maximum reward if two vendors each contribute 50% or if five vendors each contribute 20% of the capacity.

For these reasons, ConEd has proposed that Staff and the Company collaborate to modify the diversity index metric.

Illinois

In October 2011, the Energy Infrastructure Modernization Act (EIMA) was signed into law by Illinois Governor Pat Quinn. The law authorized 10-year, $2.6 billion smart grid investment by Commonwealth Edison (ComEd) designed to modernize and upgrade its electric system, including investments in smart grid infrastructure ranging from distribution automation and substation upgrades to smart meters for customers.

To ensure that customers receive benefits from the upgrades, the law also set reliability and other performance metrics to be achieved incrementally over ten years. These metrics include:

- 20% improvement in SAIDI
- 15% improvement in CAIDI
- 20% improvement in SAIFI
- Improvement in total number of customers who exceed service reliability targets by 75%
- 90% reduction in estimated bills
- 90% reduction in consumption on inactive meters
- 50% reduction in unaccounted for energy
- $30 million reduction in uncollectible expense

The performance incentives were set to be penalty only, with progress required in equal segments for each goal in each year. For each year that a goal is unmet, the utility faces a reduction in return on equity by 5-7 basis points per goal, with the penalty increasing over time. To avoid a penalty, 100% progress is required on reliability goals, and 95% progress required on other goals (220 ILCS 5 §16-108.5).

While explicitly addressing the basic aspects of electricity delivery listed above, the performance incentive mechanisms established by EIMA failed to address numerous other potential benefits of smart grid investments for consumers and the environment. For this reason, several consumer and environmental groups initiated discussions with ComEd to track numerous additional performance metrics.

Expansion of Performance Metrics

In 2013 environmental and consumer groups reached an agreement with ComEd to track numerous additional performance metrics. The list of performance metrics co-developed by the utility and stakeholders is extensive, and includes the following (ComEd 2014):

- Reductions in greenhouse gas emissions (as measured through load shifting, system peak reductions, and reduced truck rolls due to smart meters)
- Load served by distributed resources

- Time required to connect distributed resources to grid
- Peak load reductions (enabled by demand response)
- Products with grid interoperability (retail product market animation)
- Customers enrolled in time-varying rates (e.g., peak time rebates)
- Customer awareness and use of ComEd's web portal for viewing usage information

Although these performance metrics do not include any rewards or penalties, they provide valuable information for regulators and stakeholders to monitor whether customers are receiving the full benefit of the multi-billion dollar smart grid infrastructure investment. In addition, these metrics provide valuable information going forward for regulators if it is determined that a financial reward or penalty is warranted.

Metric Definitions

More than sixty performance metrics were developed to be tracked. The table below lists and defines many of these metrics. A nearly complete list can be found in ComEd's 2014 Smart Grid Progress Report, while the greenhouse gas metric details were filed in Illinois Commerce Commission Case Number 14-0555.

Table 21. Selected Smart Grid Metrics in Illinois

Customers enrolled in Peak Time Rebate, Real Time Pricing, and other dynamic and time variant prices	Residential Customers: Number of customers on a time-variant or dynamic pricing tariff offered by ComEd. Expressed also as a percentage of customers in each delivery class.
	Residential Customers: Number of customers served by retail electric suppliers for which the supplier has requested monthly Electronic Data Interchange delivery of interval data. Expressed also as a percentage of customers taking supply from a retail electric supplier in each delivery class.
	Small Commercial Customers: Number of customers on a time-variant or dynamic pricing tariff offered by ComEd. Expressed also as a percentage of customers in the delivery class.
	Small Commercial Customers: Number of customers served by retail electric suppliers for which the supplier has requested monthly Electronic Data interchange delivery of interval data. Expressed also as a percentage of customers taking supply from a retail electric supplier in the delivery class.
Customer-side-of-the-meter devices sending or receiving grid related signals	Number of ComEd AMI meters with consumer devices registered to operate with the Home Area Network ("HAN") chip by tariffs under which customer receives delivery.
AMI Meter failures	Number of advanced meter malfunctions where customer electric service is disrupted.

Customers with net metering	Number of customers enrolled on Net Metering tariff and the total aggregate capacity of the group.
Peak load reductions enabled by demand response programs	Load impact in MW of peak load reduction from the summer peak due to AMI enabled, ComEd administered demand response programs such as the PTS program as a percentage of all demand response in ComEd's portfolio.
Customer Complaints	Number of formal ICC complaints, informal ICC complaints, and complaints escalated to ComEd's Customer Relations or Customer Experience departments related to AMI Meter deployment, broken down by type of complaint and resolution. AMI Meter deployment includes AMI Meter installation, functioning or accuracy of the AMI meter, and HAN device registration.
Customer premises capable of receiving information from the grid	Number of installed AMI Meters as of the last day of the calendar year that communicate back to the head end system.
	Number of installed AMI Meters as of the last day of the calendar year that communicate back to the head end system, divided by the total number of AMI meters installed.
	Number of customers who have accessed the web-based portal as of the last day of the calendar year as a percentage of customers with AMI Meters and as a percentage of ComEd customers in that delivery class.
	Number of customers who can directly access their usage data as of the last day of the calendar year as a percentage of customers with AMI Meters and as a percentage of ComEd customers in that delivery class.
Peak load reductions enabled by demand response programs	Load impact in MW of peak load reduction from the summer peak due to AMI enabled, ComEd administered demand response programs as a percentage of all demand response in ComEd's portfolio.
Reduction in greenhouse gas emissions enabled by smart grid	Load shifting: ComEd will calculate marginal emissions changes due to load shifting for smart meter customers versus non-smart meter customers at an hourly level.
	Reduction in system peak: ComEd will partner with a third-party entity to conduct a dispatch study of the impact of load shifting and peak load reduction enabled by smart meters, including increased adoption of electric vehicles, on PJM's system, and determine a GHG metric around resulting changes in generator dispatch and expected plant closures.
	Reduced truck rolls: ComEd will compare the aggregate annual GHG emissions of all meter reading vehicles assigned to a specific operating center in the year in which Smart Meters are deployed in that same operating center, to the average aggregate annual GHG emissions of the three years prior to the year in which Smart Meter installation for that specific operating center is completed. GHG emissions will be calculated by measuring fuel consumption and converting into fuel emissions via the Climate Registry emission factor.

Distributed generation projects	Number of locations and total MWs of customer owned distributed generation connected to the transmission or distribution system, broken down by connection to transmission and distribution system.
	Number of locations and total MWs of customer owned distributed generation connected to the transmission or distribution system, broken down by connection to transmission and distribution system.
Load served by distributed resources	Total sales of electricity to the grid from distributed generation (Rider POG or POG-NM customers) divided by zone energy plus distributed generation sales, with all data provided in sortable format.
System load factor and load factor by customer class	Total annual consumption for AMI meters (including, separately, small commercial customers) divided by the average demand across all AMI meters over the 5 peak hours multiplied by 8760 hours by customer class.
Products with end-to-end interoperability certification	ComEd will conduct an annual survey through a third-party provider to evaluate how products are being introduced in the smart grid enabled marketplace.
Network nodes and customer interfaces monitored in "real time"	Network nodes and customer interfaces monitored in "real time"
Grid connected energy storage interconnected to utility facilities at the transmission or distribution system level	Number of locations and total MWs of utility owned or operated energy storage interconnected to the transmission or distribution system as measured at storage device electricity output terminals.
	Number of locations and total MWs of utility owned or operated energy storage interconnected to the transmission or distribution system as measured at storage device electricity output terminals.
	ComEd will conduct an annual survey through a third-party provider to estimate similar measures of non-utility storage units.
Time required to connect distributed resources to grid	ComEd's response time to a distributed resource project application, and time from receipt of application until energy flows from project to distribution grid.
	ComEd's response time to a distributed resource project application, and time from receipt of application until energy flows from project to transmission grid.
Grid assets that are monitored, controlled, or automated	Number and percentage of ComEd substations (Distribution Center Substations ("DCs"), Substations ("SSs") Transmission Substations ("TSSs") and Transmission Distribution Centers ("TDCs")) monitored or controlled via Supervisory Control and Data Acquisition ("SCADA") systems.
	Number and percentage of ComEd distribution circuits (4kV, 12kV and 34kV) equipped with automation or remote control equipment including monitor or control via SCADA systems.

Customers connected per automated circuit segment	Average number of customers per automated three phase 12kV line segment. (An "automated line segment" is a segment of 12 kV three phase mainline circuit between automated devices which include circuit breakers, reclosers, automated switches, etc.)
Improvement in line loss reductions enabled by smart grid technology	Stakeholders agreed upon several research priorities for research about line loss reductions. ComEd is conducting a feasibility study regarding use of Voltage Optimization. Voltage Optimization is combination of Conservation Voltage Reduction and Volt-VAR Optimization. These programs are intended to reduce end use customer energy consumption and peak demand while also reducing utility distribution system energy losses.
Voltage and VAR controls	Number and percentage of distribution lines using sensing from an AMI meter as part of ComEd's voltage regulation scheme.
Tracking Actual Costs	The actual cost of the AMI deployment costs that ComEd has incurred, including both one-time and on-going operating costs.
Customer Applications	Bill impacts associated with the costs for implementation of ComEd's AMI Plan for low, average, and higher usage level customers pursuant to approved rates and surcharges.
	Number of customers that have created and viewed an account on ComEd.com – by usage levels, customer class, and low income customers. An account on ComEd.com is necessary for viewing the web portal.
	Number of customers with ComEd.com accounts that have viewed the web portal - by usage levels, customer class, and low income customers
	Change in customers' energy consumption for customers that have viewed the web portal. ComEd will work with the web presentment vendor to define business processes necessary to track an energy usage impact of accessing the web portal.
	Number of customers enrolled in the Residential Real Time Pricing ("RRTP") program (ComEd's hourly pricing program) by usage levels, customer class, and low income customers.
	Number of customers enrolled in ComEd's PTR program by usage levels, customer class, and low income customers.
Customer Outreach & Education	Awareness and Education - Awareness and understanding of AMI technology and benefits (survey metric)

Hawaii

In 2010, Hawaii adopted revenue decoupling for its electric utilities in order to encourage renewable resources, distributed generation, and energy efficiency. When it adopted the decoupling mechanism, the Commission declined to adopt any performance incentive mechanisms, as the decoupling mechanism did not place a hard cap on allowed revenues. In 2013, however, the Commission determined that it was appropriate to reexamine the decoupling mechanism, particularly its revenue adjustment mechanism, and determine whether any performance metrics or performance incentive mechanisms should be adopted.

Performance Metrics

Numerous parties suggested performance metrics for tracking the utilities' ability to achieve renewable energy goals, ensure reliability, and reduce costs. As a result, the Hawaii Public Utilities Commission adopted nearly 30 performance metrics, including:

- **System Reliability:** System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), and Momentary Average Interruption Frequency Index (MAIFI)
- **Generator Performance:** Equivalent Availability Factor (EAF), Equivalent Forced Outage Rate Demand (EFORd), Equivalent Forced Outage Factor (EFOF)
- **Independent Power Producer (IPP) energy:** Measured as IPP energy / Net to System Energy
- **Renewable Energy:** System renewable energy (excluding customer-sited generation), total renewable energy (including distributed generation), renewable energy curtailments, and RPS compliance
- **Safety:** Public safety incidents, employee injury and illness rate, employee lost time rate, emergency response time
- **Distributed Energy Resources:** Number of net metering program participants and capacity of net metering program, demand response and storage enrollments
- **Customer service:** call center performance, customer complaints, appointments met, metering and billing accuracy, survey responses
- **Cost:** Metrics providing breakdowns of the contributing cost components to customer rates, and unaccounted for energy (HI PUC 2014).

Further, the Commission ordered that these metrics be posted on the Companies' websites in order to facilitate ease of access for utility customers.

Proposed Performance Incentive Mechanisms

During the second phase of the proceeding, parties proposed various forms of revenue cap mechanisms together with performance incentive mechanisms thought to be readily quantifiable, objective, and immune from gaming. Proposals varied widely, from traditional reliability and call center performance incentive mechanisms, to innovative mechanisms targeting reductions in fossil fuel use and the quality of utility resource planning.

Blue Planet, an intervenor in the case, proposed two environmental performance incentive mechanisms:

1) Reduction in carbon intensity of generation (as measured from the current baseline trend), with a potential reward of up to three cents per share.

2) Interconnection and utilization of non-utility, non-fossil generation and demand response resources, with a potential reward of several cents per share.

The Consumer Advocate proposed several performance incentive mechanisms, the most innovative of which was a mechanism for measuring the quality of the utilities' resource planning process, including stakeholder engagement, range of resources modeled, and follow-through on previous plans. The basis for this performance incentive mechanism was the Commission's IRP Framework, which was initially adopted in 1992 and revised in 2011. This PIM is described in greater detail below.

Resource Planning Performance Incentive Mechanism

Under this PIM, performance will be scored based on compliance with six principles and their associated metrics:

1) **Stakeholder Engagement:** The planning process should allow for meaningful stakeholder involvement throughout the planning process, and should incorporate stakeholder recommendations in the planning process as appropriate.[31]

   Metrics: Whether stakeholder input was adequately considered in establishing:

   a. Planning objectives
   b. Range of scenarios
   c. Resource options
   d. Assumptions, risks, and constraints
   e. Screening of options
   f. Criteria for ranking of resource plans
   g. The choice of final plan

[31] This principle measures the extent to which the Companies have complied with the Framework requirement V.B.1.b, which states: "consider the input, comments and suggestions provided by Advisory Group members and the general public, to the extent feasible," as well as compliance with requirement V.C.4.a (identification of planning objectives with input from advisory group).

2) **Evaluation of Resources:** The planning process should investigate a wide array of existing and emerging supply-side resources, including generation, transmission, and distribution opportunities, including utility-side smart grid options; as well as a wide array of existing and emerging demand-side options such as energy efficiency, demand response, distributed generation, storage technologies, and customer-facing smart grid options.[32]

Metrics:

a. Were appropriate modeling tools used?
b. Were existing system and conditions adequately characterized?
c. Was the range of new resources considered adequate?
d. Were new resource options analyzed on a consistent and comparable basis, using reasonable estimates of the benefits and costs?
e. Was adequate analysis performed to determine the risks and constraints of new resources?
f. Did the analysis produce credible and reasonable results?

3) **Resource Scenarios and Resource Plans:** The planning process should include a transparent approach to identifying a reasonable set of resource scenarios and resource plans. From this set, the resource plans should be transparently prioritized or ranked based on previously identified key criteria such as minimization of the present value of revenue requirements, meeting environmental goals, maximizing customer benefits, and balancing risks.[33]

Metrics:

a. Was an appropriate range of scenarios examined (e.g., appropriate incorporation of various uncertainties; were scenarios extremes, or did they resemble what might actually occur)?
b. Was there evaluation of an appropriate number of resource plans to ensure results of the process are meaningful?
c. Were the criteria for determining the best resource plan clearly articulated at the outset?

[32] This principle measures compliance with several of the Framework requirements identified in section V.C., including V.C.2 ("Characterization of existing system and conditions"), V.C.3 ("Identification of uncertainties and factors that affect utility planning"), V.C.5 ("Determination of planning scenarios and forecasts"), V.C.6 ("Identification of resource options"), V.C.7 ("Models"), and V.C.8 ("Analyses").

[33] This principle measures compliance with Framework requirements V.C.8. (Analyses), V.C.6.d (screening out infeasible or inappropriate resource scenarios), V.C.4.b and V.C.4.c (use of planning principles), and V.C.9 (determination of resource plans).

d. Was the weighting and ranking to determine the best resource plans transparent and did it incorporated principles and objectives previously identified?

e. Was sufficient consideration given to whether resource plans are able to meet state energy policy goals?

f. Were measures and strategies identified to address limitations and constraints that may impact the utility's ability to achieve state energy policy goals.

4) **Action Plan:** The planning process should include an action plan that enables the utility to translate the results of its analyses into development of actual resources.[34]

Metrics:

a. Does the Action Plan articulate next steps for implementing those resources that will be implemented in the short-term?

b. Does the Action Plan identify and address barriers to developing identified short-term resources?

5) **Strategic Planning:** This principle is intended to ensure that the companies' investments are guided by a long-term strategic vision that addresses the challenges faced by the companies and positions them to allow for agile response to changing system conditions.[35]

Metrics:

a. Do the companies clearly define a long-term strategic vision?

b. Does the strategic vision discuss steps that the companies need to take in order to move toward a more sustainable business model?

c. Does the strategic vision discuss the companies' strategy for ensuring that the investments made will enable the Companies to respond with agility to a range of possible future circumstances?

d. Are specific desired outcomes defined and initiatives identified to achieve such outcomes?

6) **Follow-Through on Previous Action Plans:** Demonstrated progress should be made in undertaking and successfully completing initiatives identified in the previous action plan. The companies should not be penalized for making prudent adjustments to the action plan in light of new information or changed circumstances, but any such changes must be sufficiently justified by the companies.

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[34] This principle measures compliance with Framework requirements V.C.9.

[35] This principle addresses the desire of the Commission to ensure that the Companies face adequate "incentives to make necessary and/or appropriate changes to utility strategic plans and action plans," as evidenced by this being a major topic for comment in Order No. 31635.

Metrics:

Metrics should be set at the conclusion of each major planning process, based on the specific investments, activities, and costs identified in the action plan. How well these are achieved will then be evaluated at the commencement of the following planning process.

Example: Did the Companies develop X resource in Y timeframe within Z cost?

Utility performance on each metric would be rated as "inadequate," "adequate," or "exemplary." A rating of "inadequate" would correspond to a score of 1.0, while "exemplary" would correspond to a score of 3.0. The scores for each metric would then be averaged for each principle.

The overall scorecard would be completed by an independent evaluator for the IRP process or similar entity in another planning process. The scorecard would be completed by the independent evaluator through a two-step process:

1) For the first principle regarding stakeholder engagement, stakeholders would complete a survey. If a stakeholder wished to score performance on a metric as either "inadequate" or "exemplary," the stakeholder would be required to provide a detailed explanation describing their rationale. The independent evaluator would then review all of the stakeholder scores and assign a composite score for each metric, taking into account the evidence presented by stakeholders.

2) The independent evaluator would conduct an evaluation of the planning process and score the companies' performance on each metric.

The scoring of the companies' planning performance would not replace the current evaluation process in which the independent evaluator files interim reports and a certification report to the commission, but would occur in addition to this process. The PIM scorecard would serve to summarize the overall conclusions of the independent evaluator.

The completed scorecard would then be filed together with any other final certification or process report by the independent evaluator. The companies would then be allowed to respond to and rebut the scores received. The commission may, at its discretion, also allow other stakeholders to comment on the scorecard and the companies' rebuttal. After considering any responses, the commission would then issue a final ruling regarding any penalty or reward.

Current Status of Performance Incentive Mechanisms

As of this writing, the commission had yet to issue an order regarding the proposed performance incentive mechanisms.

Performance Incentives Related to Fuel Adjustment Clauses

Fuel adjustment clauses have been widely adopted in many states to reduce the need for frequent rate cases due to fluctuations in fuel costs. However, these fuel adjustment clauses can reduce the incentive for utilities to operate efficiently, and can skew utilities' resource investment decisions, as the utilities are insulated from fuel price volatility. To address this, some jurisdictions modified their fuel cost pass-through mechanisms to allow only partial pass-through, or to make the pass-through contingent on the utility achieving a certain level of power plant efficiency. For example, prior to restructuring, New York adopted a mechanism by which utilities would absorb a portion (ranging from 20% to 40%) of fuel costs above its forecast. If costs came in below the forecast, the utility would retain a portion (20% to 40%) of the savings (Knittel 2002).

In Hawaii, the Energy Cost Adjustment Clause (ECAC) contains a heat rate efficiency factor. However, concerns were raised that the fixed sales target heat rate would penalize the utilities for introducing renewable energy, as lower capacity factors and higher ramping requirements can negatively impact thermal units' heat rates. In order to avoid the resulting disincentive for efficiency and renewable energy, a deadband of +/- 50 Btu/kWh sales was added to the heat rate target, and an agreement was reached to revisit the heat rate target upon the future addition of larger increments of renewable resources.

Conditioning cost recovery on power plant efficiency or using shared savings mechanisms can help distribute risk between the utility and ratepayers, and have been shown to be effective for improving power plant efficiency. A 2002 study analyzed the impacts of modified fuel adjustment clauses by comparing the efficiency of power plants under a full fuel cost adjustment clause with the efficiency of plants under a modified mechanism in which the utility must bear some of the risk for fuel cost overruns and can keep a portion of such savings. The author found that modified fuel adjustment clauses resulted in 9 percent more output produced for a given amount of input than mechanisms that passed through all of the fuel costs (Knittel 2002). This finding suggests that full fuel adjustment clauses do not encourage efficiency, but that a modified approach that incorporates shared savings can improve efficiency.

On a cautionary note, shared savings approaches related to fuel costs can be vulnerable to manipulation. For example, Nicor Gas, the largest gas utility in Illinois, has been ordered to refund more than $72 million to ratepayers due to allegations of fraud. The utility operated under an incentive that set a gas cost benchmark, and then allowed Nicor to keep half of any savings it achieved. According to allegations, the company manipulated its gas storage operation by improperly releasing low-cost gas put in storage under very low prices years before to artificially produce "savings" (Daniels 2013).

FERC's Bonus ROE for Transmission Projects

Pursuant to the Energy Policy Act of 2005, the Federal Energy Regulatory Commission (FERC) developed incentive-based rate treatments for transmission investments. As part of FERC's Order No. 679, transmission developers (utilities and stand-alone transmission companies) received higher rates of return on equity for new transmission investment in order to improve reliability and reduce congestion in order to lower delivered energy costs.

In practice, however, the incentive may have had effect of increasing delivered energy costs. By applying the ROE adder to the project's actual costs, developers were given a perverse incentive to *increase* the project costs (through, for example, delaying the construction), because they would earn the higher ROE on the total costs of the project. In this way, the incentive actually rewarded projects that came in over budget (American Forest & Paper Association, et al. 2011). It has been estimated that consumers in New England will pay more than an additional $100 million in adder charges for transmission projects because these projects have greatly exceeded their original costs (New England Conference of Public Utility Commissioners v. Bangor Hydro-Electric Co 2008).

Compounding this effect was the inability to demonstrate that the incentive would result in net benefits, as the Order did not require quantifying the benefits in relationship to the costs of the incentives. Further, applicants seeking the incentives were not required to show that the project would not be developed without the incentives (American Forest & Paper Association, et al. 2011).

Jim Tracy, Sacramento Municipal Utility District Chief Financial Officer, was one of many interveners who submitted comments in response to the FERC's Notice of Inquiry regarding the incentive mechanism. Having been involved in financing a large number of infrastructure projects, including transmission, distribution, and generation projects, Mr. Tracy noted that even if the net impact of the incentive was positive, the "costs of the incentives were almost certainly more than needed" (American Forest & Paper Association, et al. 2011, 143). He further commented that Commission's incentive rate may have resulted in excess transmission capacity.

According to Mr. Tracy, lenders are not influenced by higher rates of return for specific types of projects, but rather by the availability of mechanisms that reduce the risk that revenues will be interrupted during the recovery period. Further, because a utility's investment funds are limited, higher returns on certain types of projects can result in skewing the utility's investment choices away from alternatives that may be better for ratepayers (American Forest & Paper Association, et al. 2011).

APPENDIX B – DATA SOURCES AND AVAILABILITY

The following tables contain data sources for the metrics discussed in this handbook. Table 22 includes metrics, metric formulas, and data sources, and Table 23 includes notes about the availability of data and weblinks. Note that the data sources presented below may not provide all the data needed for performance metrics, and we have not assessed the quality or reliability of the data in these sources.

Many of the metrics discussed in this report can be obtained or calculated using data from federal agencies and other national organizations. Where data are not available from a national source, regulators can collect them directly from their utilities (indicated by "Collect from utility" in the Data Source column). However, regulators should assure that the data collected from utilities are well-defined, consistent across utilities, and well understood, as discussed in Chapter 3.

Table 22. Metric Formulas and Data Sources

Performance Dimension	Metric or metric group	Metric formula	Data Source
Reliability	System Average Interruption Duration Index (SAIDI)	Total minutes of sustained customer interruptions / total number of customers	EIA Form 861
	System Average Interruption Frequency Index (SAIFI)	Total number of sustained customer interruptions / total number of customers	EIA Form 861
	Customer Average Interruption Duration Index (CAIDI)	Total minutes of sustained customer interruptions / total number of interruptions	Collect from utility
	Momentary Average Interruption Frequency Index (MAIFI)	Total number of momentary customer interruptions per year / total number of customers	Collect from utility
	Power quality	Numerous metrics indicating changes in voltage including transient change, sag, surge, undervoltage, harmonic distortion, noise, stability, and flicker.	Collect from utility
Employee Safety	Total Case Rate (TCR)	(Number of work-related deaths, days away from work, job transfers or restrictions, and other recordable injuries and illnesses times 200,000) / Employee hours worked[36]	OSHA Form 300

[36] 200,000 represents the number of working hours per year for 100 full-time equivalent employees (40 hours a week for 50 weeks). (U.S. BLS 2013)

Performance Dimension	Metric or metric group	Metric formula	Data Source
	Days Away, Restricted, and Transfer (DART) case rate	(Number of work-related days away from work and job transfers or restrictions times 200,000) / Employee hours worked	OSHA Form 300
	Days Away From Work (DAFWII) case rate	(Number of work-related days away from work times 200,000) / Employee hours worked	OSHA Form 300
Public safety	Incidents, injuries, and fatalities (electric)	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by type of activity	Collect from utility
	Emergency response time (electric)	Percent of electric emergency responses within 60 min. each year	
	Incidents, injuries, and fatalities (gas)	Number of incidents per year, by severity of outcome (non-injury, minor, severe, and fatal) and by apparent cause (corrosion, natural forces, excavation, other outside force, pipe/weld/joint/equipment failure, incorrect operation, other cause)	PHMSA Form F 7100.1
	Emergency response time (gas)	Average minutes for gas emergency response	Collect from utility
	Leak repair performance (gas)	Average days for repair of minor and non-hazardous leaks	
Customer Satisfaction	Call center answer speed	Percentage of calls answered within 30 seconds	Collect from utility
	Transaction surveys	Percentage of customers satisfied with their recent transaction with the utility	Collect from utility
	Customer complaints	Formal complaints to the Commission (number per 1,000 customers)	Collect from utility
	Order fulfillment	Speed with which orders for service installation and termination, outage responses, and meter re-reading are fulfilled	Collect from utility
	Missed appointments	Percentage of appointments not met for meter replacements, inspections, or any other appointments in which the customer is required to be on the premises	Collect from utility
	Avoided shutoffs and reconnections	Disconnects and reconnections avoided by customer percentage of income payment plans or other means	Collect from utility
	Residential customer satisfaction	Electric Utility Residential Customer Satisfaction index, Gas Utility Residential Customer Satisfaction index	J.D. Power Electric Utility Residential Customer Satisfaction Study℠, J.D. Power Gas Utility Residential Customer Satisfaction Study℠

Performance Dimension	Metric or metric group	Metric formula	Data Source
	Business customer satisfaction	Electric Utility Business Customer Satisfaction index, Gas Utility Business Customer Satisfaction index	J.D. Power Electric Utility Business Customer Satisfaction Study[SM], J.D. Power 2014 Gas Utility Business Customer Satisfaction Study[SM]
Plant Performance	Fuel usage	Quantity of fuel burned	FERC Form 1
	Heat rate	Average BTU per kWh net generation	FERC Form 1
	Capacity factor	Average energy generated for a period / energy that could be generated at full nameplate capacity	FERC Form 1
Costs	Capacity costs	Cost per kW of installed capacity	FERC Form 1
	Total energy costs	Expenses per net kWh	FERC Form 1
	Fuel cost	Average cost of fuel per kWh net gen and per Million BTU; total fuel costs	FERC Form 1
	Effective resource planning*	Numerous metrics regarding incorporation of stakeholder input, consideration of all relevant resources, use of appropriate assumptions and modeling tools, etc.	third-party evaluator
	Cost-Effective Alternative Resources*	$/MW cost of alternative portfolio relative to the $/MW cost of traditional investment	Collect from utility
System Efficiency	Load factor	Sector avg load / sector peak load	Collect from utility
		Monthly system average load / monthly system peak load	FERC Form 1
	Usage per customer	Sector sales / sector number of customers	FERC Form 1 (electric), Form EIA-176 (gas)
	Aggregate Power Plant Efficiency	System average BTU per kWh net generation (heat rate)	FERC Form 1
		Equivalent Forced Outage Rate (EFOR) = Equivalent Forced Outage Hours / (Period Hours – Equivalent Scheduled Outage Hours)	NERC Generating Availability Data System
		EFORd: variant of EFOR, measuring the probability that a unit will not meet its generating requirements demand periods because of forced outages or derates	NERC Generating Availability Data System
		Weighted equivalent availability factor: over a given operating period, the capacity-weighted average fraction of time in which a fleet of generating units is available without any outages and equipment or seasonal deratings	NERC Generating Availability Data System
	Flexible Resources	MW of fast ramping capacity (load following resources capable of 15-minute ramping and regulation resources capable of 1-minute ramping)	Collect from utility
	System losses	Total electricity losses / MWh generation, excluding station use	FERC Form 1
		Total gas losses / total sales	Form EIA-176

Performance Dimension	Metric or metric group	Metric formula	Data Source
Customer Engagement	Energy efficiency (EE)	Percent of customers per year participating in EE programs	Collect from utility
		Annual and lifecycle energy savings	EIA Form 861 (electric), collect from utility (gas)
		Annual and lifecycle peak demand savings (MW)	EIA Form 861
		Program costs per unit of energy saved (MWh or therm)	EIA Form 861 (electric), collect from utility (gas)
	Demand response (DR)	Percent of customers per year	EIA Form 861 and FERC F1
		Number of customers enrolled	EIA Form 861
		MWh of DR provided over past year	EIA Form 861
		Potential and actual peak demand savings (MW)	EIA Form 861
	Distributed generation (DG)	Number of installations per year	Collect from utility
		Net metering installed capacity (MW)	EIA Form 861
		Net metering MWh sold back to utility	EIA Form 861
		Net metering number of customers	EIA Form 861
		MW installed by type (PV, CHP, small wind, etc.)	EIA Form 861
	Energy storage	Number of installations per year	Collect from utility
		MW installed by type (thermal, chemical, etc.)	Collect from utility
		Percent of customers with storage technologies enrolled in demand response programs	Collect from utility
	Electric vehicles (EVs)	Number of EVs added to the grid each year	Collect from utility
		Percent customers with EVs enrolled in DR programs	Collect from utility
	Information availability	Number of customers able to access daily usage data via a web portal	EIA Form 861
		Percent of customers with access to hourly or sub-hourly usage data via web	Collect from utility
	Time-varying rates	Number of customers on time-varying rates / total customers	EIA Form 861
Network Support Services	Advanced metering capabilities	Number of customers with AMI and AMR	EIA Form 861
		Energy served through AMI	EIA Form 861
	Interconnection support	Average days for customer interconnection	Collect from utility
		Customer satisfaction with interconnect process	Collect from utility
	Third party access	Open and interoperable smart grid infrastructure that facilitates third-party devices	Collect from utility
		Third party vendor satisfaction with utility interaction	Collect from utility
	Provision of customer data	Customers able to authorize third-party access electronically	Collect from utility
		Percent of customers who have authorized third-party access	Collect from utility
		Third party data access at same granularity and speed as customers	Collect from utility

Performance Dimension	Metric or metric group	Metric formula	Data Source
Environmental Goals	SO_2 Emissions	Tons per year	EPA Air Markets Program Data
	Avg NOx Rate	lbs/MMBtu	EPA Air Markets Program Data
	CO_2 emissions	Tons CO_2 per year	EPA Air Markets Program Data
	Carbon intensity	Tons CO_2 / customer	EPA Air Markets Program Data and EIA 861
	System carbon emission rate	Tons CO_2 / MWh sold	EPA Air Markets Program Data and EIA 861
	Clean Power Plan (CPP) emission rate	lbs CO_2 from fossil generators / (Fossil Fuel Generation (MWh) + 5.8% Nuclear Generation (MWh) + Renewable Generation (MWh) + Cumulative Energy Efficiency (MWh))	Collect from utility
	Fossil carbon emission rate	Tons CO_2 / MWh fossil generation	EPA Air Markets Program Data and EIA 861
	Fossil generation	Fossil percent of total generation	EIA Form 923 and EIA Form 860
	Renewable generation	Renewable percent of total generation	EIA Form 923 and EIA Form 860

**See Appendix A, New York and Hawaii case studies, for more information on these metrics.*

Table 23. Data Sources and Notes on Availability

Source	Notes on Availability	Link to Data
EIA Form 176	Form EIA-176 is designed to collect data on natural, synthetic, and other supplemental gas supplies, disposition, and certain revenues by state. It must be completed by interstate and intrastate natural gas pipeline companies; gas distribution companies; underground gas storage operators; synthetic natural gas plant operators; field, well, or processing plant operators that deliver natural gas directly to consumers (including their own industrial facilities) other than for lease or plant use or processing; field, well, or processing plant operators that transport gas to, across, or from a state border through field or gathering facilities; and liquefied natural gas (LNG) storage operators, both peaking facilities and marine terminals. (U.S. EIA 2015a)	http://www.eia.gov/cfapps/ngqs/ngqs.cfm?f_report=RP1
EIA Form 860	Form EIA-860 collects data on the status of existing, grid connected electric generating plants with a nameplate capacity of 1 MW or greater and associated equipment (including generators, boilers, cooling systems and air emission control systems) in the United States, and those scheduled for initial commercial operation within 10 years (coal or nuclear) or 5 years (other energy sources). (U.S. EIA 2015b)	http://www.eia.gov/electricity/data/eia860/
EIA Form 861	All electric power industry entities complete 861, including: electric utilities, all DSM Program Managers, wholesale power marketers, energy service providers (registered with the states), and electric power producers. (U.S. EIA 2014c)	http://www.eia.gov/electricity/data/eia861/
EIA Form 923	Form EIA-923 collects information on the operation of electric power plants and combined heat and power (CHP) plants in the United States. Form EIA-923 is a mandatory report for all grid-connected electric power and CHP plants that have a total generator nameplate capacity (sum for generators at a single site) of 1 MW or greater. (U.S. EIA 2015b)	http://www.eia.gov/electricity/data/eia923/
EPA Air Markets Program Data	Data are available for power plants that are subject to various market-based regulatory programs, including the Acid Rain Program, NOx Budget Trading Program, and Clean Air Interstate Rule.	http://ampd.epa.gov/ampd/QueryToolie.html
FERC Form 1	FERC Form 1 is required for each major electric utility, licensees, or other (as classified in the Commission's Uniform System of Accounts Prescribed for Public Utilities and Licensees Subject To the Provisions of The Federal Power Act (18 C.F.R. Part 101)). Major is defined as having in each of the three previous calendar years, sales or transmission service that exceeds one of the following: (1) 1,000,000 MWh or more of total annual sales; (2) 100 MWh of annual sales for resale; (3) 500 MWh of annual power exchange delivered; or (4) 500 MWh of annual wheeling for others (deliveries plus losses). (FERC 2015)	http://www.ferc.gov/docs-filing/forms/form-1/data.asp

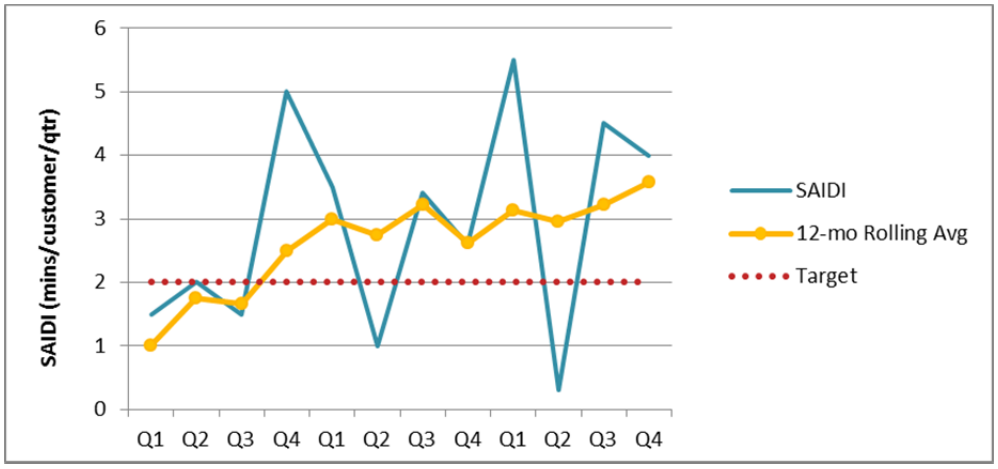
J.D. Power Electric Utility Business Customer Satisfaction Study℠	Within each of the four geographic regions included in the study, utility providers are classified into one of two segments: large (serving 85,000 or more business customers) and midsize (serving between 25,000 and 84,999 business customers). The study is conducted annually. The 2014 Electric Utility Business Customer Satisfaction Study is based on responses from > 23,700 online interviews with business customers that spend at least $250 monthly on electricity.	http://www.jdpower.com/press-releases/2014-electric-utility-business-customer-satisfaction-study
J.D. Power Electric Utility Residential Customer Satisfaction Study℠	The Study ranks midsize and large utility companies in four geographic regions: East, Midwest, South and West. Companies in the midsize utility segment serve between 100,000 and 499,999 residential customers, while companies in the large utility segment serve 500,000 or more residential customers. The Study has been conducted annually for 16 years. The 2014 Study was based on responses from 104,460 online interviews conducted from July 2013 - May 2014 among residential customers of the 138 largest electric utility brands across the U.S.	http://www.jdpower.com/press-releases/2014-electric-utility-residential-customer-satisfaction-study
J.D. Power Gas Utility Business Customer Satisfaction Study℠	The study measures business customers' satisfaction with the nation's 55 largest gas utilities in four U.S. geographic regions: East, Midwest, South, and West. The study examines satisfaction across six factors—billing and payment; corporate citizenship; price; communications; customer service; and field service.	http://www.jdpower.com/resource/us-gas-utility-business-customer-satisfaction-study
J.D. Power Gas Utility Residential Customer Satisfaction Study℠	The study ranks large and midsize utility companies in four geographic regions: East, Midwest, South and West. Companies in the midsize utility segment serve between 125,000 and 399,999 residential customers, and companies in the large utility segment serve 400,000 or more residential customers. The Study has been conducted annually for 13 years. The 2014 Gas Utility Residential Customer Satisfaction Study is based on more than 69,800 responses from residential customers of 83 large and midsize gas utilities across the continental United States. The study was fielded between September 2013 and July 2014.	http://www.jdpower.com/press-releases/2014-gas-utility-residential-customer-satisfaction-study
NERC Generating Availability Data System	For conventional generating units with a nameplate capacity of 20 MW and larger, GADS reporting is mandatory. Renewable generation (i.e., wind and solar) is not required to report. Conventional generating units less than 20 MW nameplate are invited to report to GADS on a voluntary basis.	http://www.nerc.com/pa/RAPA/gads/Pages/default.aspx
OSHA Form 300	The Occupational Safety and Health (OSH) Act of 1970 requires certain employers to prepare and maintain records of work-related injuries and illnesses. OSHA Form 300 is only available for a small portion of all private sector establishments in the U.S. (80,000 out of 7.5 million total establishments).	https://www.osha.gov/pls/odi/establishment_search.html, http://ogesdw.dol.gov/views/searchChooser.php
PHMSA Form F 7100.1	Title 49 of the Code of Federal Regulations (49 CFR Parts 191, 195) requires pipeline operators to submit incident reports within 30 days of a pipeline incident or accident. The CFR defines accidents and incidents, as well as criteria for submitting reports to the Office of Pipeline Safety.	http://www.phmsa.dot.gov/pipeline/library/data-stats

APPENDIX C – DASHBOARD EXAMPLES

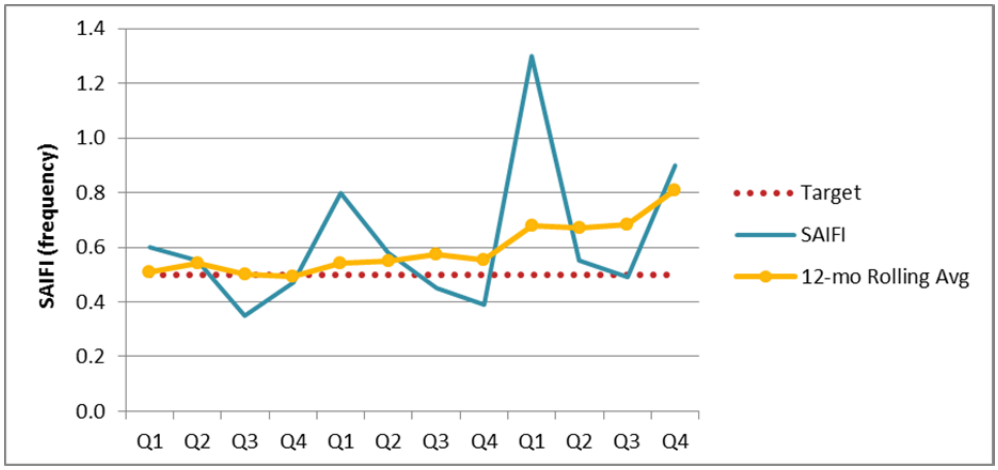
The following examples show how data dashboards can provide visual context for performance targets in terms of historical utility performance and trends. These examples are based on actual data (for unnamed utilities in western US states or on data for the entire United States) or they were fabricated for illustrative purposes.

Reliability

SAIDI is an indicator of sustained interruptions experienced by customers. SAIDI is defined as total minutes of sustained customer interruptions divided by total number of customers, over a period of time. This illustrative example shows a hypothetical utility's system wide SAIDI and 12 month rolling average over a three year period, along with its target.

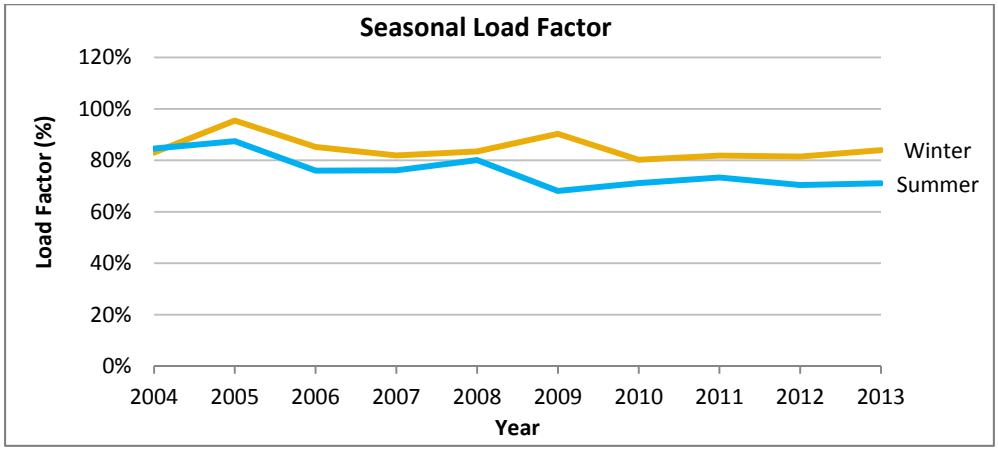


SAIFI is an indication of how many interruptions are experienced by customers over a period of time. SAIFI is defined as total number of sustained customer interruptions divided by total number of customers. This illustrative example shows a hypothetical utility's system wide SAIFI and 12 month rolling average over a three year period, and its performance target.



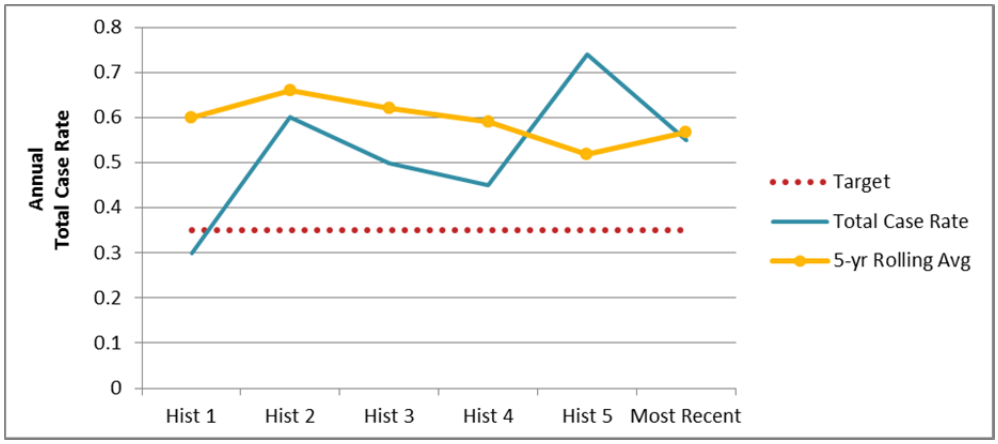
System Efficiency

As one metric for the efficient use of the electric system, load factor indicates the extent to which load occurs during peak periods. It is defined as the average load over a period of time divided by peak load. A dashboard can be used to show load factors for the entire system and for each customer sector over time. The example below shows the seasonal load factor for a western electric utility over ten years, obtained from FERC Form 1 data. Although FERC Form 1 provides energy and peak demand for the system as a whole, ideally load factors should be considered by consumer sector to allow for a targeted policy response.

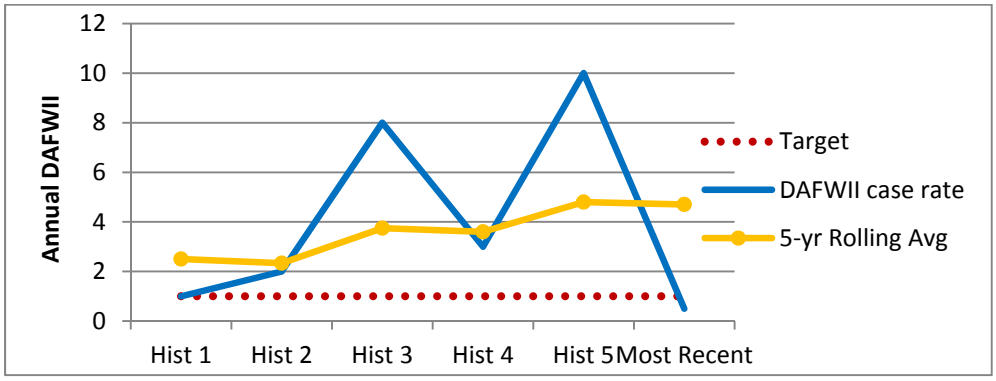


Safety

Employee safety can be measured using metrics. Standard metrics defined and reported by OSHA include work-related deaths, injuries, and illnesses (the Total Case Rate, or TCR); the Days Away from work, Restricted, or Transfer (DART) case rate; and the Days Away From Work (DAFWII) case rate. Because OSHA collects data from only a small fraction of companies, regulators should consider collecting data directly from utilities. Below is an illustrative example of a TCR for a hypothetical utility over a period of six years.

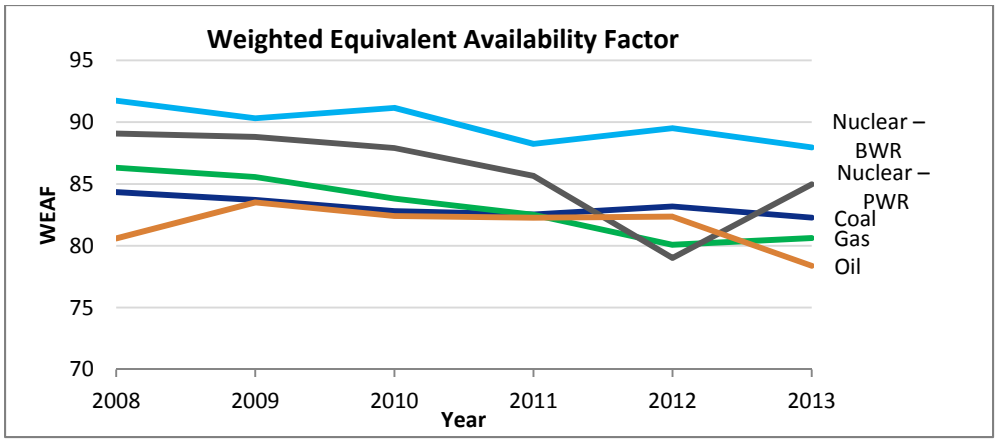


The following graph shows an illustrative example of a Days Away From Work (DAFWII) case rate over a period of six years for a hypothetical utility.

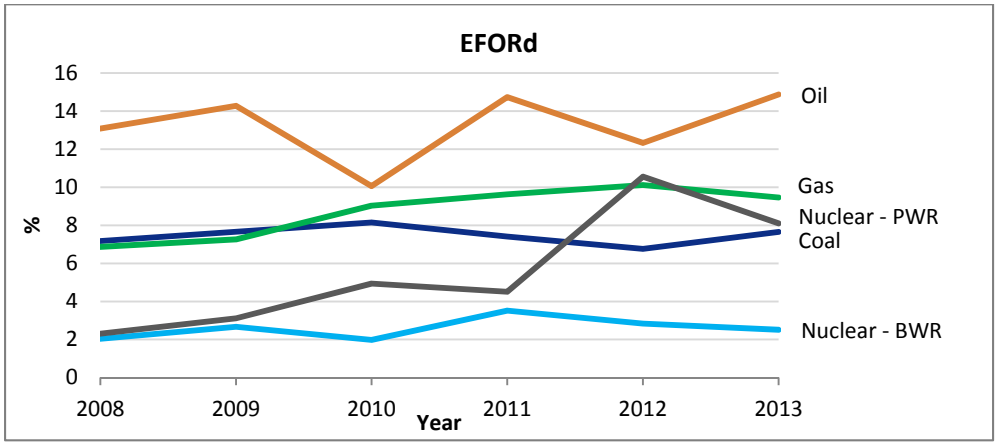


Power Plant Availability

Regulators often review the performance of individual power plants. However, regulators should consider the performance of the electric system as a whole, especially in the context of resource planning. The Weighted Equivalent Availability Factor (WEAF) is a metric indicating availability of supply side generation resources. Below is a graph showing the actual WEAF for the entire U.S. for six historical years, by fuel type.

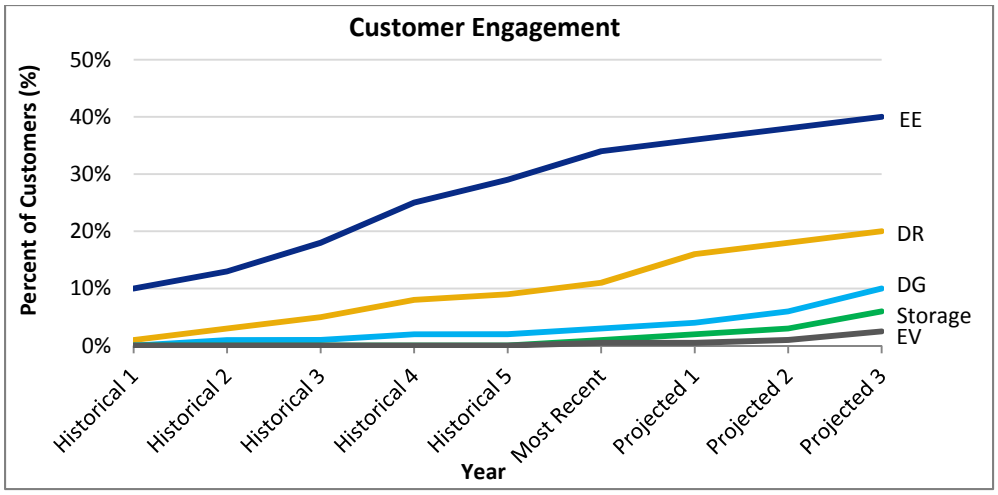


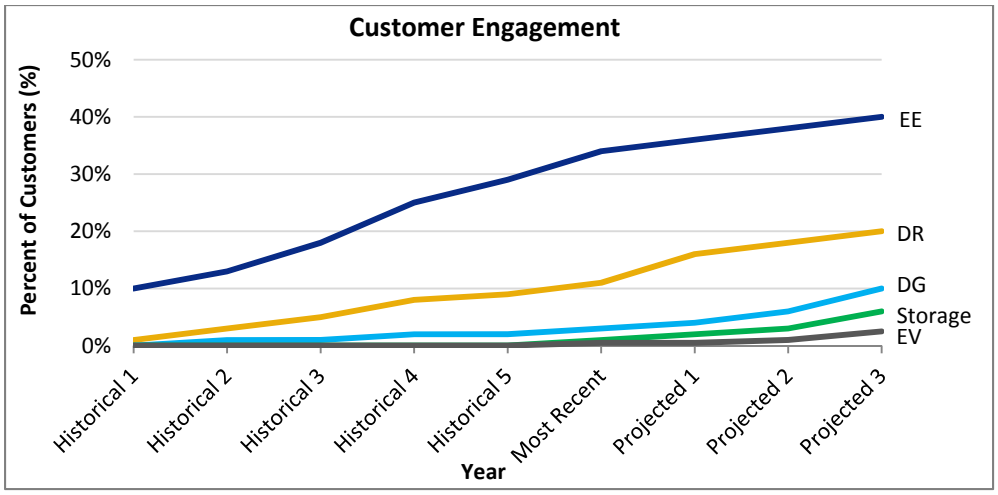
The Equivalent Forced Outage Rate Demand (EFORd) measures the probability that a unit (or group of units) will not meet demand periods for generating requirements because of forced outages or derates. Below, is a graph showing the actual EFORd by fuel type for the entire U.S. over six historical years.



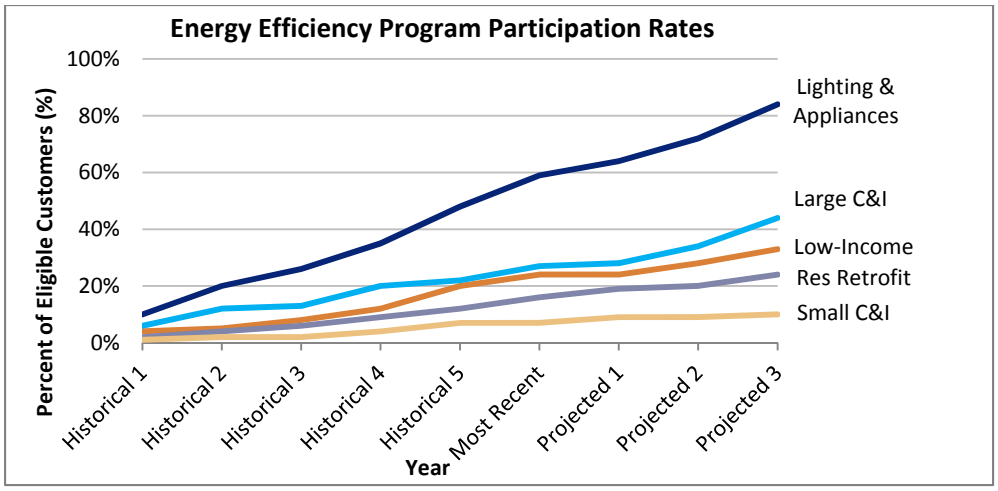
Customer Engagement

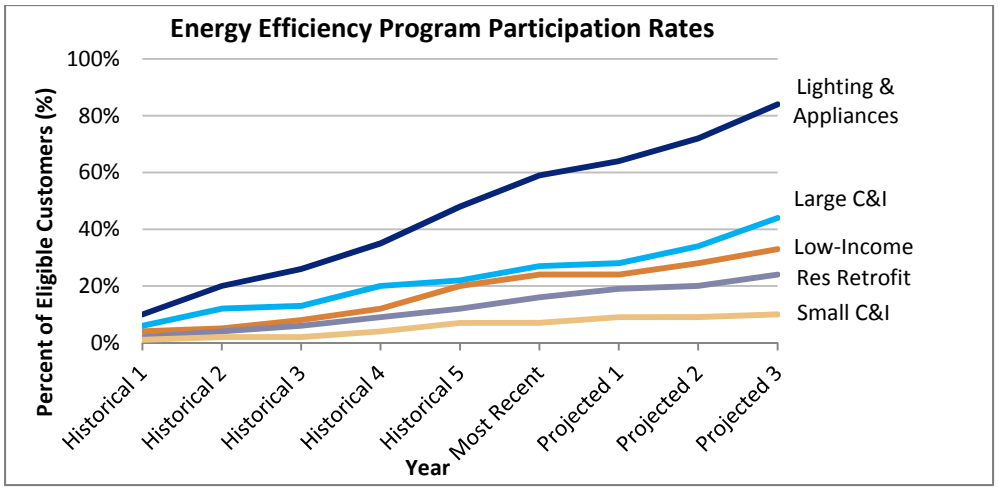
Customer engagement metrics indicate the extent to which customers are participating in demand-side programs or installing demand-side resources, which can reduce the need for new supply-side resources. The following graph shows historical and projected customer engagement for a hypothetical utility in five key areas: energy efficiency (EE), demand response (DR), distributed generation (DG), customer-sited energy storage, and electric vehicles (EV).





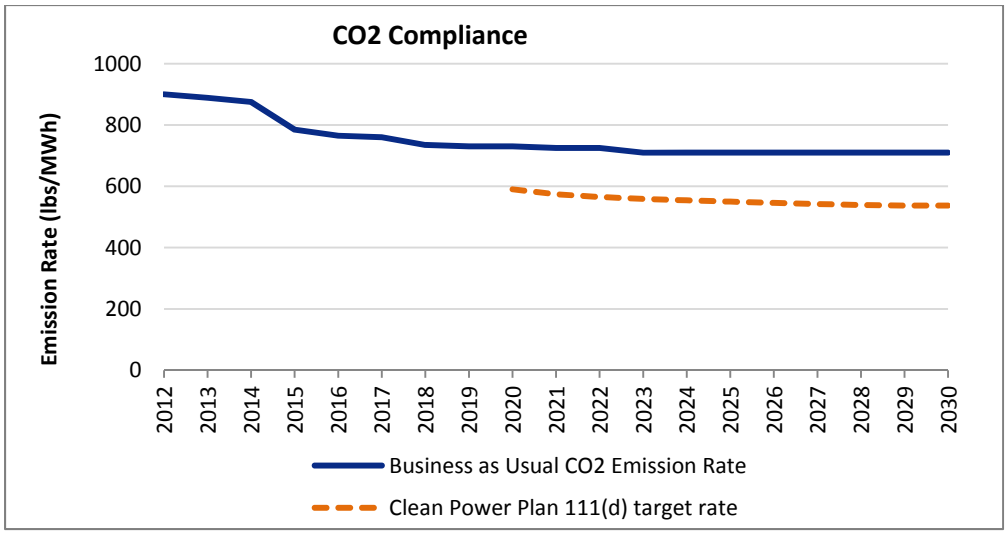
As an indication of which sectors are participating in energy efficiency programs, utilities and regulators may wish to examine participation in programs targeting specific customer segments, as a percentage of customers eligible for those programs. The following graph shows historical and projected participation rates for a hypothetical utility's lighting and appliances (for which data on participant customer types are rarely available), large commercial and industrial (C&I), low-income, residential (res) retrofit, and small C&I energy efficiency programs.





Environmental Goals

Environmental metrics indicate the extent to which the utility and its customers are reducing environmental impacts and can be particularly important with regard to ensuring that the state is on a path toward compliance with climate change regulations. Below is a graph showing the actual Clean Power Plan target CO2 rate for a western state, along with historical and hypothetical projected emissions rate under a business as usual scenario.



Below is an illustrative graph showing historical and projected fossil and renewable generation as a percent of total generation for a hypothetical utility.

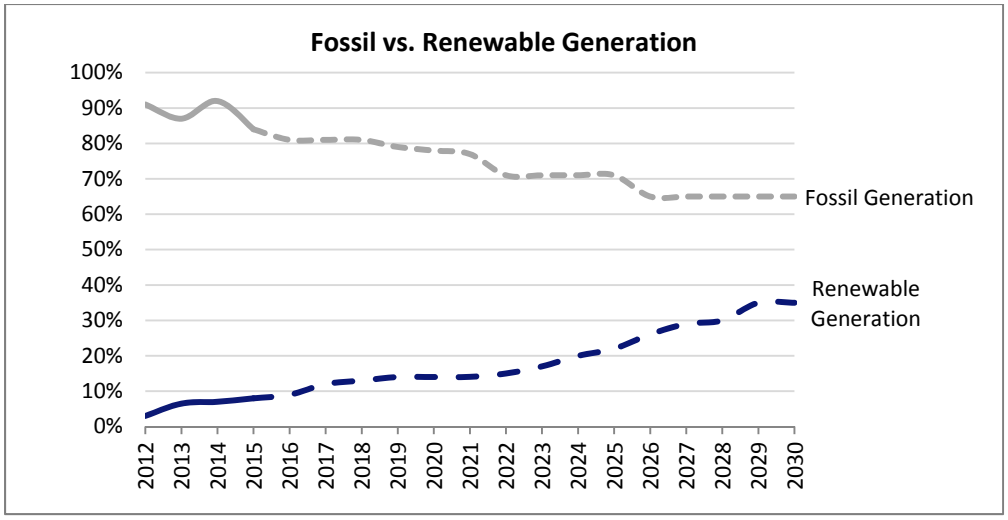


Exhibit 4

LUMA's Responses and Objections to
PREB's First Request of Information

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

IN RE: PERFORMANCE METRICS TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO. NEPR-AP-2020-0025** **SUBJECT: Response to First Requirement for Information by the Puerto Rico Energy Bureau ("PREB")**

LUMA'S RESPONSES AND OBJECTIONS TO
FIRST REQUIREMENT FOR INFORMATION BY PREB

TO: Puerto Rico Energy Bureau ("PREB")
Through counsels:

FROM: LUMA Energy, LLC, and **LUMA Energy ServCo, LLC** ("LUMA"),

Through counsels:

Margarita Mercado Echegaray, margarita.mercado@us.dlapiper.com and Yahaira De la Rosa, yahaira.delarosa@us.dlapiper.com.

LUMA Energy, LLC and LUMA Energy ServCo, LLC (jointly referred to as "LUMA"), by and through its attorneys, and pursuant to Regulation No. 8543 of the Puerto Rico Energy Bureau, responds and objects to the Puerto Rico Energy Bureau ("PREB") First Requirement for Information as follows:

PRELIMINARY STATEMENT

1. By making the accompanying responses and objections to PREB's requests, LUMA does not waive, and hereby expressly reserves, its right to assert any and all objections as to the admissibility of such responses into evidence in this proceeding, or in any other proceedings, on any and all grounds including, but not limited to, competency, relevancy, materiality, and privilege. Further, LUMA makes the responses and objections herein without in any way implying that it considers the requests, and responses to the requests, to be relevant or material to the subject matter of this proceeding and without acquiescing to their admissibility as evidence in this proceeding.

2. LUMA will produce responsive documents only to the extent that such documents are in its possession, custody, or control.

3. LUMA expressly reserves the right to supplement, clarify, revise, or correct any or all of the responses and objections herein, and to assert additional objections, in one or more subsequent supplemental response(s).

4. Publicly available documents including, but not limited to, documents matter of public record that are available electronically, will not be produced, but sufficient information will be provided to easily identify and access the electronic public records in which they are located.

GENERAL OBJECTIONS

LUMA makes the following general objections, which are incorporated into each of its responses below as if stated in full therein:

1. LUMA objects to PREB's requests which call for information and the production of documents not relevant to the subject matter of the proceeding.

2. LUMA expressly limits its responses to PREB's requests to the information that could be located by each of the responders after a reasonable search of its records believed most likely to contain the responsive information.

3. LUMA's decision to provide information notwithstanding the objectionable nature of some of PREB's discovery requests are not to be construed as an admission that the information is relevant, as a waiver of the general or specific objections, or as an agreement that future requests for similar discovery will be treated in a similar manner.

4. LUMA reserves its right to supplement, modify or amend these responses as discovery progresses in this proceeding.

LUMA'S OBJECTIONS AND RESPONSES TO PREB´S REQUESTS

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-001

REQUEST:

Please explain how the ability to earn a financial incentive will change LUMA's performance related to employee health and safety compared to what would have otherwise occurred.

RESPONDER:

Mario Hurtado

RESPONSE:

Please refer to LUMA's Reply Comments filed on February 19, 2021 in Case No. NEPR-MI-2019-0007. LUMA agrees with comments from stakeholders (RMI and SESA) that this is a toolset to align incentives and move the regulated utility towards public policy compliance and drive benefits for the people of Puerto Rico. The ability to earn financial incentive rewards the operator for metrics that are important to customers.

Establishment by the Puerto Rico Energy Bureau of performance-based incentive and penalty mechanisms, including financial incentives, is the public policy of the Government of Puerto Rico stated in Act 57-2014 and 17-2019. Following Section 1.17 (12) of Regulation 9137, Regulation for Performance Incentive Mechanisms ("Regulation 9137"), which states that Performance Incentive Mechanisms, including financial incentives, are designed to induce improvements in performance, LUMA's proposed financial incentives are designed to improve performance in a measurable manner in important areas of LUMA's operations under the Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement ("T&D OMA"). As stated in the Report by FTI Consulting *The Advantages of a Third-Party T&D Operator of the Puerto Rico T&D System* at page 3, "the T&D solicitation process included an incentive mechanism that tracks various management performance metrics and awards financial compensation based on predefined target metrics." *See Partnership Committee Report, Puerto Rico Public-Private Partnership for the Electric Power Transmission and Distribution System.* Incentives associated with the proposed LUMA Performance Metrics were a result of an extensive 18-month competitive negotiation process, which took into account an allocation of risk and reward and the incentives are a critical component of the overall compensation, as detailed in the Partnership Committee Report, Puerto Rico Public-

Private Partnership for the Electric Power Transmission and Distribution System, dated May 15, 2020.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-002

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for OSHA Recordable Incident Rate. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the OSHA Recordable Incident Rate Performance Metric.

Without waving this objection, witness Meléndez states that in his individual capacity, he is personally not aware of any other utility with externally driven performance incentives for OSHA Recordable Incident Rates.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-003

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for OSHA Severity Rate. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the OSHA Severity Rate Performance Metric.

Without waving this objection, witness Meléndez states that in his individual capacity, he is not aware of any other utility with externally driven performance incentives for OSHA Severity Rate.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-004

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for OSHA DART. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the OSHA DART Performance Metric.

Without waving this objection, witness Meléndez states that in his individual capacity, he is not aware of any other utility with externally driven performance incentives for OSHA DART.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-005

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for OSHA Fatalities. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the OSHA Facilities Performance Metric.

Without waving this objection, witness Meléndez states that in his individual capacity he is not aware of any other utility with externally driven performance incentives for OSHA Fatalities.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-006

REQUEST:

In the last five years, please indicate if PREPA has been cited for OSHA violations. If so, please identify the violation.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request because it seeks information that pertains to third parties and is not information necessarily within its possession, custody, control, or personal knowledge.

Without waiving the foregoing objection, witness Meléndez states that he is not aware of any citations or fines issued to PREPA for OSHA violations in the past 5 years.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-007

REQUEST:

In the last five years, please indicate if PREPA has been fined for OSHA violations. If so, please identify the circumstance and the amount of the fine.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to this request because it seeks information that pertains to third parties and is not information necessarily within its possession, custody, control, or personal knowledge.

Without waiving the foregoing objection, witness Meléndez states that he is not aware of any citations or fines issued to PREPA for OSHA violations in the past 5 years.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-008

REQUEST:

Please indicate if LUMA would consider performance incentive penalties for OSHA violation.

RESPONDER:

Jorge Meléndez

RESPONSE:

The T&D OMA does not contemplate incentive penalties, while we acknowledge that PREB has the ability to establish penalties, they are currently not outlined as part of the T&D OMA.

The OSHA Act provides for assessment of civil penalties for OSHA violations outlined in Chapter 6 of the Field Operations Manual. Adding performance incentive penalties in addition to civil penalties has the potential of imposition of double or successive penalties.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-009

REQUEST:

Please indicate if LUMA participates in the Edison Electric Institute eSafetyLine program. If so, please describe LUMA's involvement. If not, please explain why not.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to the relevance of this request that appears to be directed at operational matters not directly related to the proposed Performance Metrics Targets. Without waiving said objection and without acquiescing to the admissibility of this data as evidence in this proceeding, LUMA informs that it recently joined the Edison Electric Institute in early 2021, and as a member, has access to associated member programs and benchmarking, including the eSafetyLine program.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-010

REQUEST:

Please refer to lines 67-69 of the direct testimony. Please indicate the frequency that LUMA is required to report to OSHA for OSHA Recordable Incident Rate, OSHA Severity Rate, OSHA fatalities, and OSHA DART.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA is required to maintain accurate injury logs in accordance with OSHA standards at all times and is required to publish the summary of incidents annually as part of the OSHA 300 Log.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-011

REQUEST:

Please refer to lines 85-89 of the direct testimony. Please indicate if PREPA provided an explanation to LUMA regarding the initiation of the Casi Casi report.

RESPONDER:

Jorge Meléndez

RESPONSE:

I am not aware of PREPA providing an explanation to LUMA regarding the initiation of the Casi Casi report.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-012

REQUEST:

Please refer to lines 120-121 of the direct testimony and the Casi Casi 2019 2020 N worksheet in the Exhibit A- KPI Metrics- Safety- NEPR-AP-2020-0025.xlsx workbook. Please identify the calculation for LUMA's determination of 510 lost workdays.

RESPONDER:

Jorge Meléndez

RESPONSE:

The values in column E on tab 'CASI-CASI 2019 2021' were summed if there was evidence that the incident described was an OSHA recordable injury or illness.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-013

REQUEST:

Please refer to lines 163-167 of the direct testimony. Please describe what steps LUMA has taken to improve accuracy and transparency of health and safety reporting.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA has developed and deployed an electronic incident management software system (Intelex) to automate and streamline reporting, notification, investigation, and closure of Health, Safety and Environmental incidents within LUMA. Additionally, as part of its new employee onboarding, LUMA introduced a communication and training campaign with employees, including notifying employees of incident reporting processes and demonstrating how incidents are to be reported both verbally and electronically using the incident management system.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-014

REQUEST:

Please refer to lines 172-174 of the direct testimony. Please provide a copy of LUMA's feasibility assessment to improve PREPA's current state related to health and safety matters.

RESPONDER:

Jorge Meléndez

RESPONSE:

Without acquiescing to the admissibility of this data as evidence in this proceeding, please refer to the Health, Safety, Environment, and Quality portion of the Gap Assessment that was filed as part of the System Remediation Plan, Case Number NEPR-MI-2020-0019 & in Section 3 of the Revised Annex IX Performance Metrics Filing in this proceeding on August 18, 2021. Based on its Gap Assessment LUMA developed the HSEQ & Technical Training program that is a part of the System Remediation Plan.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-015

REQUEST:

Please refer to lines 174-175 of the direct testimony.

a. Please describe what strategies LUMA intends to implement to improve health and safety performance.
b. Please describe what is LUMA's timeline to implement to improve health and safety performance.
c. Please describe what actions has LUMA implemented to improve health and safety performance.

RESPONDER:

Jorge Meléndez

RESPONSE:

LUMA objects to the relevance of this request that appears to be directed at future operational matters and improvement programs that have been approved by the Puerto Rico Energy Bureau in other proceedings and without acquiescing to the admissibility of this data as evidence in this proceeding, LUMA states the following:

a. The main strategies, as shared in LUMA's System Remediation Plan, will use include increasing the communication of safety issues and of recent incidents, improving recognition and mitigation of hazards, through reinforcing individual and leadership accountability for safety performance, and through improved operational and technical training.

b. LUMA has immediately improved health and safety efforts, including expanding staff dedicated to field safety. As more measures are introduced and repeated through throughout the organization, safety performance will continue to improve.

c. LUMA is in the process of implementing the following measures with the intention of improving health and safety performance:

    - Integrating hazard identification and awareness as part of new employee onboarding and reinforced messaging through tailboards and safety observations,

- Providing critical safety training to new field-based employees, including working safely near electricity and substation safety awareness,
- Releasing a health and safety software platform, aimed at improving the accuracy and effectiveness of incident reporting, root cause analysis, and corrective action management,
- Procuring additional personal protective equipment, including safety glasses, gloves, fire-retardant clothing, hard hats, safety boots, and AEDs aimed at keeping workers safe.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-016

REQUEST:

What does LUMA consider its core functions as the utility transmission and distribution system service provider?

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA objects to this request as vague and overly broad and due to lack of relevance. Without waiving the foregoing objections and preserving objections on admissibility of this data in the proceeding, LUMA considers its core functions as the utility transmission and distribution system service provider are to deliver the O&M Services as outlined in the T&D OMA, in order to recover and transform the utility to deliver customer-centric, reliable, resilient, safe and sustainable electricity at reasonable prices.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-017

REQUEST:

Please refer to lines 267-268 of the direct testimony. What does LUMA consider to be "prudent utility practices"?

RESPONDER:

Don Cortez

RESPONSE:

Under the T&D OMA, a "Prudent Utility Practice" is defined as "at any particular time, the practices, methods, techniques, conduct and acts that, at the time they are employed, are generally recognized and accepted by companies operating in the United States electric transmission and distribution business as such practices, methods, techniques, conduct and acts appropriate to the operation, maintenance, repair and replacement of assets, facilities and properties of the type covered by the [T&D OMA]."

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-018

REQUEST:

Are any of the proposed five-performance metrics included in the direct testimony required by Act 17-2019? If the answer is yes, please explain how each performance metric relates to Act 17-2019.

RESPONDER:

Don Cortez

RESPONSE:

Act 17-2019 does not require any specific performance metric. However, it does declare that is the public policy of the Government of Puerto Rico is to: (1) promote the necessary changes in order to transform the Electric Power System into one that satisfies the energy needs of the 21st century Puerto Rico; (2) to oversee the implementation of strategies geared toward achieving efficiency in the generation, transmission, and distribution of electric power; (3) to ensure the security and reliability of the electric power infrastructure by using modern technologies that promote inexpensive and efficient operations; (4) to maintain the electric power infrastructure in optimal conditions to ensure the reliability, resilience, and safety of the electric power service; (5) to ensure continuous improvements for the electric power grid, in order to promote its resilience and diversification; (6) to guarantee every consumer's right to receive a reliable, stable, and excellent electric power service at a cost that is accessible, just, and reasonable; among other principles.

To accomplish the public policies enacted in Act 17-2019, the statute authorizes the Energy Bureau to establish performance-based incentives for electric power service companies.

The Technical Performance Metrics proposed by LUMA incentivize system reliability and system safety, among others. These objectives are aligned with the public policies included in Act 17-2019, as well as with the criteria to establish performance-based incentives. Even though Act 17-2019 does not require any specific performance metric, it does require the Energy Bureau to comply with the public policies therein. The establishment of performance metrics that observe the public policy of maintaining the electric power infrastructure to ensure the reliability, resilience, and safety of the electric power service, such as the ones proposed by LUMA, is one of the mechanisms available

this Energy Bureau has under its powers to observe compliance with Puerto Rico's public policies as enacted in Act 17-2019.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-019

REQUEST:

Please explain how the ability to earn a financial incentive will change LUMA's performance related to system safety and reliability compared to what would have otherwise occurred.

RESPONDER:

Mario Hurtado

RESPONSE:

Please refer to the response provided in RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-001.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-020

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for System Average Interruption Duration Index (SAIDI). If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the SAIDI Performance Metrics.

Without waving this objection, witness Cortez states that he is aware that PSEG Long Island, the operator of the Long Island Power Authority system, has a performance incentive for SAIDI. The PSEG LI SAIDI metric is a matter of public record.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-021

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for System Average Interruption Frequency Index (SAIFI). If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the SAIFI Performance Metrics.

Without waving this objection, witness Cortez states that he is aware that PSEG Long Island, the operator of the Long Island Power Authority system, has a performance incentive for SAIFI. The PSEG LI SAIFI metric is a matter of public record.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-022

REQUEST:

Did LUMA calculate the incremental net benefits that accrue to customers from meeting the proposed targets for SAIDI and SAIFI compared to the baseline? If yes, provide the value of the net incremental benefits to customers.

RESPONDER:

Don Cortez

RESPONSE:

In response TC-RFI-LUMA-MI-21-0004-210503-PREB-012 to a request in Initial Budgets – 2021-05-03 Technical Conference Docket ID: NEPR-MI-2021-0004 subject Lost Load – Qualification of Benefits, LUMA responded:

LUMA proposes to calculate the overall load reductions related to outages, or unserved energy, by using the two Value of Lost Load (VOLL) blended costs per MWh as presented in the IRP, namely those resulting from a similar calculation (with other jurisdictions) and from the Interruption Cost Estimate (ICE) calculator. These were provided in the IRP as $31,897[1] per MWh (Method 1) and $57,940[2] per MWh (Method 2), respectively.

The following parameters were used:

- Total energy consumed in 2020: 16,004,000 MWh
- Total number of customers: 1,468,223
- SAIDI reduction as per LUMA's proposed performance metrics

The energy not served (ENS) is estimated by calculating the ratio of the SAIDI to total minutes in one year (SAIDI:mpr) and multiplying this ratio by the energy consumed in each year. Finally, a total cost estimate for the VOLL using both methods can be calculated, as presented in Table 1 below.

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[1] CEPR-AP-2018-0001 - Final Resolution and Order on the Puerto Rico Electric Power Authority's Integrated Resource Plan, Paragraph 694.
[2] *Ibid*, Paragraph 695.

Table 1: VOLL Calculated Costs ($ in millions)

	1	2	3	4	5
	SAIDI	**Ratio SAIDI:mpr***	**ENS (MWh)**	**VOLL Cost (Method 1)**	**VOLL Cost (Method 2)**
Baseline	1,307	0.25%	39,797	$1,269.40	$2,305.84
After year 1	1,176	0.22%	35,808	$1,142.17	$2,074.72
After year 2	980	0.19%	29,840	$ 951.81	$1,728.93
After year 3	784	0.15%	23,872	$ 761.45	$1,383.14

**Rounded to 2 decimal points*

Savings in VOLL over Initial Budgets period are summarized in Table 2 below. The values are derived from Table 1 (Columns 4 and 5) in the following manner: Subtract Year 1 from Baseline, then subtract Year 2 from Year 1, and finally subtract Year 3 from Year 2.

Table 2: Projected Reduction in VOLL ($ in millions)

Savings	**Method 1**	**Method 2**
Year 1	$127.23	$231.11
Year 2	$190.36	$345.79
Year 3	$190.36	$345.79
Cumulative	**$507.95**	**$922.68**

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-023

REQUEST:

Please refer to lines 361-363 of the direct testimony. Is the annual percent improvement for SAIDI directly related to the investments included in LUMA's current and forecasted annual budgets?

RESPONDER:

Don Cortez

RESPONSE:

As stated in lines 358 – 360 of my direct testimony, "Since no reliable historical data exists that indicates what degree of T&D reliability improvement can generally be expected from a specific level of funds invested in Puerto Rico" the percent improvements are not directly related to the budgets, rather, as stated in lines 360 – 363 of my direct testimony, "…, *LUMA relied upon my many years of experience in T&D at various utilities and* [emphasis added] the LUMA current and forecasted annual budgets to estimate an aggressive but attainable annual percent improvement from the baselines to establish future annual targets for LUMA's first three years of operation."

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-024

REQUEST:

How will LUMA's achievement of the Distribution Line Inspections, Transmission Line Inspections, and T&D Substation Inspections Performance Metrics impact its achievement of the proposed SAIFI and SAIDI Performance Metrics?

RESPONDER:

Don Cortez

RESPONSE:

In achieving the inspections cited above, LUMA will identify issues around the health and condition of its critical assets, thereby enabling their repair and/or replacement prior to failure. The primary results of theses inspections are to prioritize and sequence repairs and other work to reduce the risk of failure and lower the safety risk to electrical workers and the public. Achieving the inspections will also enable targeted construction programs and allow for more effective deployment of capital funds, including federal funds. The implementation of the capital programs that target the equipment inspected and that equipment should have lower risk of failure and therefore cause less outages. An improvement of in SAIFI and SAIDI are indirectly related to successful inspections programs. The inspection programs are rather an important precursor to capital projects on the grid.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-025

REQUEST:

For each of the following proposed performance metrics: Distribution Line Inspections, Transmission Line Inspections, and T&D Substation Inspections performance metrics, please answer the following:

a. Are the proposed performance metrics dependent on LUMA completing the repair and/or replacement of lines and substations identified as Category 0 and Category 1?

b. If LUMA achieves its proposed targets related to number of inspections and the incorporation into a plan within the 60-day timeframe, would it still be able to earn a performance incentive if the remediation work does not occur?

c. Is there a required timeframe by when LUMA must complete remediation of the lines and substations identified as Category 0 and Category 1?

d. If the performance metrics are not approved, would LUMA still conduct these inspections within the same timeframe? If not, please explain why.

e. Please explain why it is appropriate to provide a financial incentive for achieving targets when no baseline has been established?

f. Please explain why the timeframe of 60 days was chosen.

g. Did LUMA calculate the incremental net benefits that accrue to customers from meeting the proposed targets? If yes, provide the value of the net incremental benefits to customers.

RESPONDER:

Don Cortez

RESPONSE:

a. The proposed performance metrics do not directly address the repair and/or replacement of lines and substations identified as Category 0 or 1. Though the activities themselves are a necessary precursor to identifying Category 0 and 1

condition assets for prioritization, they are independent from a performance measurement perspective.

b. All “0” and “1” deficiencies require remediation, independent of any performance incentives as LUMA follows Prudent Utility Practice. In addition, LUMA is committed to establishing and maintaining an industry leading Asset Management program. Such a program cannot allow high-risk items to go unaddressed.

c. The timeframe for complete remediation of lines and substations identified as Category “0” or Category “1” must remain undefined as the scope is unknown, as are myriad of other priority activities (e.g., service restoration, preventive and otherwise identified corrective maintenance requirements, new business connections, and modification relating to IRP). As the scope of these activities is better defined, detailed schedules will be developed, and overall timeframes will be specified.

d. Please refer to LUMA’s Reply Comments filed on February 19. 2021 in Case No. NEPR-MI-2019-0007. LUMA agrees with comments from stakeholders (RMI and SESA) that this is a toolset to align incentives and move the regulated utility towards public policy compliance and drive benefits for the people of Puerto Rico. The ability to earn financial incentive rewards the operator for metrics that are important to customers. As these activities are part of the approved Initial Budgets, these will be performed by LUMA. However, timing is dependent on multiple factors.

e. The baseline for assessments is zero because PREPA does not have a record of performing assessments to maintain a grid infrastructure in good condition and to keep good records of the health of the grid assets. However, having the grid infrastructure in good condition with good asset health records is fundamental for tracking the condition of company assets. Therefore, it is reasonable to have performance metrics to track the overall health of the grid assets and maintain them in good condition. There is no reasonable way to establish a true baseline as the data deemed foundational to such a process has been shown to be incomplete and inaccurate.

f. The 60-day timeframe to plan work required to address poor health condition assets reflects an ambitious timeframe and an appropriate level of urgency, given the anticipated flood of emergent work related to service restoration activities, and the number of supporting processes and procedures that will require development and integration.

g. Such a calculation was not performed. Without these activities, LUMA will remain in a reactive mode with little or no chance of improving the customer experience as it relates to receiving safe and reliable electric service.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-026

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive comparable to its proposed Distribution Line Inspections performance metric. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the Distribution Line Inspections Performance Metric.

Without waving this objection, witness Cortez states that prudent utility practice in North America requires periodic Distribution Line Inspections but the witness is not aware of a jurisdiction that has established a Distribution Line Inspection performance incentive. Having data on the condition of all assets is the best approach to optimize the cost to improve the condition of the T&D assets. PREPA does not have a record of the asset health condition and as such it is appropriate to incentivize this performance category.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-027

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive comparable to its proposed Transmission Line Inspections performance metric. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the Transmission Line Inspections Performance Metric.

Without waving this objection, witness Cortez states that prudent utility practice in North America requires periodic Transmission Line Inspections but the witness is not aware of a jurisdiction that has established a Transmission Line Inspection performance incentive. Having data on the condition of all assets is the best approach to optimize the cost to improve the condition of the T&D assets. PREPA does not have a record of the asset health condition and as such it is appropriate to incentivize this performance category.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-028

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive comparable to its T&D Substation Inspections performance metrics. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus, does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau, were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with the T&D Substation Inspections Performance Metric.

Without waving this objection, witness Cortez states that prudent utility practice in North America requires periodic T&D Substation Inspections but the witness is not aware of a jurisdiction that has established a T&D Substation Line Inspection performance incentive. Having data on the condition of all assets is the best approach to optimize the cost to improve the condition of the T&D assets. PREPA does not have a record of the asset health condition and as such it is appropriate to incentivize this performance category.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-029

REQUEST:

Please refer to lines 400-402 of the direct testimony. Would LUMA not prioritize inspecting the 1,057 three-phase, main line distribution feeders without the incentive mechanisms?

RESPONDER:

Don Cortez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-025 (d).

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-030

REQUEST:

Please refer to lines 420-421 of the direct testimony. Would the 260 transmission lines not be inspected without the performance metric?

RESPONDER:

Don Cortez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-025 (d).

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-031

REQUEST:

Please refer to lines 439-440 of the direct testimony. Would the 392 T&D substations not be inspected without the performance metric?

RESPONDER:

Don Cortez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-025 (d).

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-032

REQUEST:

Please refer to lines 490-491 of the direct testimony. If the inspections are an essential first step required to improve reliability, why are these actions not included as part of the SAIDI and SAIFI performance metrics?

RESPONDER:

Don Cortez

RESPONSE:

The assessments are an essential first step required to improve reliability, but they also support other requirements such as addressing public and employee safety, improving physical security, and creating a resilient grid.

Assessments are a leading indicator as the execution of inspections may not be immediately reflected in SAIDI and SAIFI Performance Metrics. This also allows the Bureau to measure and incentivize foundational activities required to support the systematic and efficient improvement to the T&D Infrastructure.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-033

REQUEST:

Please refer to lines 495-496 of the direct testimony. If the data collected as part of these inspections is necessary to formulate LUMA's long-term Operations and Maintenance and Capital Plan, wouldn't LUMA need to collect this data regardless of the performance metrics?

RESPONDER:

Don Cortez

RESPONSE:

Please refer to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-032. All activities within the proposed Performance Metrics are functions of a prudent utility. These inspections and associated collection of important asset health and condition data and are representative of an effective Asset Management process. Tying them to performance metrics reflects their importance to the overall mission of for the T&D System of Puerto Rico; and is not intended to be a precondition to performing these vital activities.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-034

REQUEST:

Referring to lines 175 to 178 of the direct testimony, please explain why a lack of baseline is a reason for deferring the $CEMI_N$ metric but is not a reason for deferring the Distribution Line Inspections, Transmission Line Inspections, and T&D Substation Inspections performance metrics.

RESPONDER:

Don Cortez

RESPONSE:

Every T&D system in operation is inherently operating at some non-zero level of $CEMI_N$, whether it can be accurately calculated or not. Setting future targets requires accurately knowing that non-zero level of $CEMI_N$.

In contrast, by stating in my testimony, starting on line 291 concerning the Distribution Line Inspections, Transmission Line Inspections, and T&D Substation Inspections performance metrics that:

> "Since PREPA does not have a documented health condition assessment of the grid assets and it is unknown when and if PREPA conducted programed inspections of its assets, there is no data currently available from which to determine a baseline."

The baseline is assumed to be zero and targets for inspection metrics cannot be determined based on existing data as there is no evidence that PREPA performed and documented inspections.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-035

REQUEST:

Please explain how the ability to earn a financial incentive will change LUMA's performance related to customer satisfaction compared to what would have otherwise occurred.

RESPONDER:

Mario Hurtado

RESPONSE:

Please refer to the response provided in RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-001.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-036

REQUEST:

Please explain how the ability to earn a financial incentive will change LUMA's performance related to Major Outage Events- Communications compared to what would have otherwise occurred.

RESPONDER:

Mario Hurtado

RESPONSE:

Please refer to the response provided in RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-001.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-037

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Residential Customer Satisfaction. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with Residential Customer Satisfaction.

Without waving this objection, witness Laird is aware of the following utilities: ATCO Electric, which performs under Performance Based Regulation where Customer Satisfaction (CSAT) is one of the targets and where CSAT is a performance incentive for PSEG Long Island, the utility operator, under the Operations Services Agreement with Long Island Lighting Company, ("LIPA Agreement").

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-038

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Commercial Customer Satisfaction. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with Commercial Customer Satisfaction.

Without waving this objection, witness Laird is aware of the following utilities: ATCO Electric, which performs under Performance Based Regulation where CSAT is one of the targets under their Rule 002 reporting. CSAT is also a performance incentive under the LIPA agreement.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-039

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Average Speed of Answer. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with Average Speed of Answer.

Without waving this objection, witness Laird states that ATCO Electric works under Performance Based Regulation and has a metric termed as service level which requires 70% of calls answered in 30 seconds or less). Average Speed of Answer is also a performance incentive under the LIPA agreement.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-040

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Abandonment Rate. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with Abandonment Rate.

Without waving this objection, witness Laird is aware that Abandonment Rate is a Tier 2 performance metric under the LIPA agreement.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-041

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Major Outage Events-Call Answer Rates. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to this request as drafted. It employs the vague and imprecise term of "aware" which does no provide sufficient context to ascertain the relevance of the request in connection with LUMA's Revised Proposed Performance Metrics Targets filing of August 18, 2021 and the Revised Annex IX to the T&D OMA, and thus does not allow the witness to answer. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public Private Partnerships Authority that led to execution of the T&D OMA. LUMA was not required to conduct an independent utility industry assessment in connection with Major Outage Events-Call Answer Rates.

Without waving this objection, witness Cortes states that this metric is specified in the NYPSC Order (Case 13-E-0140) related to a Scorecard for New York State utilities. P3A provided the NYPSC Performance Metrics Score Card as a basis for the development of the Major Outage Events metrics.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-042

REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Major Outage Events-Web Availability. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

Please see response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-041.

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Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-043
REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for a target similar to Major Outage Events- PREB and Administrator (P3A) Reporting. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

Please see response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-041.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-044
REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Major Outage Events- Customer Communications. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

Please see response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-041.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-045
REQUEST:

Please indicate if the witness or LUMA is aware of any other utility with a performance incentive for Major Outage Events- Outgoing message on a telephone line. If so, please identify the utility and the associated performance incentive.

RESPONDER:

Don Cortez

RESPONSE:

Please see response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-041.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-046
REQUEST:

Please refer to lines 74-77 of the direct testimony, where the factors and subfactors considered in the J.D. Power study are listed. Has LUMA conducted any analysis of the relative importance of each of these factors to PREPA's residential and commercial customers?

RESPONDER:

Jessica Laird

RESPONSE:

The J.D. Power Customer Satisfaction Survey methodology is based on standard methodology that has been accepted as industry standard. These factors have proven to be standard across jurisdictions and align with the customer satisfaction factors LUMA receives from quality assurance call listening and general feedback from customers. When J.D. Power provides survey results, they provide both customer verbatims and numerical survey values. After reviewing these customer verbatims, it is evident that they align with the numerical values associated with the factors for current customer concerns.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-047
REQUEST:

Please refer to lines 74-77 of the direct testimony, where the factors and subfactors considered in the J.D. Power study are listed. Please explain why it is appropriate to account for power quality & reliability and price in the customer service metric given that both reliability and costs are also treated as discrete performance outcomes and tracked separately.

RESPONDER:

Jessica Laird

RESPONSE:

It is important to measure technical aspects of power quality and reliability, but it is also essential to measure a customer's perception of those improvements. In order to determine how satisfied or dissatisfied a customer is with the overall service, all factors related to the utility should be measured. Customer Satisfaction measures how customers perceive the organization is delivering service as a whole. By breaking the Customer Satisfaction metric into these various factors, it enables the organization to clearly identify the largest areas of opportunity for improvement. Moreover, the selection of these factors is standard across industry and considered critical-to-customers by the J.D. Power survey and LUMA would be unable to alter the third-party company's methodology.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-048
REQUEST:

Please refer to Exhibit B of the direct testimony. Please explain how the overall residential and commercial scores are calculated from the components listed for each score.

RESPONDER:

Jessica Laird

RESPONSE:

This methodology is proprietary to J.D. Power.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-049
REQUEST:

Please refer to line 88 of the direct testimony. Please clarify what is meant by “face value” in reference to the use of J.D. Power data.

RESPONDER:

Jessica Laird

RESPONSE:

By “face value”, I intended to convey that the information from J.D. Power survey was submitted to PREB without adjustment but directly how it was received and reported by J.D. Power.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-050
REQUEST:

Please refer to lines 94-95 of the direct testimony where the witness states, “J.D. Power was able to complete 2 quarters of residential survey results and 1 half of business survey results…”. Please clarify the period for which business survey results were available.

RESPONDER:

Jessica Laird

RESPONSE:

The J.D. Power business survey results were available for the last half of calendar year 2020.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-051
REQUEST:

Please refer to lines 128-136 of the direct testimony. Were all calls in PREPA's queue rolled over to third-party contact centers after ten minutes, or only a portion of all calls?

RESPONDER:

Jessica Laird

RESPONSE:

LUMA's understanding is that a portion of the calls remained and were handled in the PREPA call center. The remaining calls rolled into the third-party call center queues.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-052
REQUEST:

Please refer to lines 135-136 of the direct testimony. Please explain specially how "subject matter experience" was applied in the determination of the baseline.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA's subject matter expert analyzed the limited data from the PREPA contact centers against knowledge from past industry standard experience to develop a baseline. Past industry standard experience includes managing ASA in utility contact centers and performance reporting to industry regulators.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-053
REQUEST:

Please refer to line 158 and line 191 of the direct testimony. Please explain how LUMA determined what constituted a "reasonable year over year improvement" in setting targets for the Average Speed of Answer and Abandonment Rate metrics.

RESPONDER:

Jessica Laird

RESPONSE:

The year over year improvements for Average Speed of Answer ("ASA") and Abandonment Rate are based on industry experience and planned improvements, as approved in the System Remediation Plan and Initial Budgets within NEPR-MI-2020-0019 and NEPR-MI-2021-0004 proceedings, respectively.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: PREB Requests

REFERENCE: RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-054
REQUEST:

Referring to line 158 and line 191 of the direct testimony, do the targets proposed for the Average Speed of Answer and Abandonment Rate metrics reflect the same or different rates of improvement relative to baseline? If they differ, please explain why in detail.

RESPONDER:

Jessica Laird

RESPONSE:

Average Speed of Answer and Abandon Rate together create a service level. Forecasting and staffing is based on the overall service level target set for a contact center, and not necessarily one or the other. While the metrics are related, setting the rate of improvement is not a direct product of one or the other, but rather of the two combined. The baselines were set to reflect the following service levels:

- Year 1 – 60% of calls answered in 9 minutes or less
- Year 2 – 68% of calls answered in 6.4 minutes or less
- Year 3 – 71% of calls answered in 5.8 minutes or less

Year over year improvements are not linear as there are steeper learning curves in the first year of operation and tapering of improvements as the organization matures.

CERTIFICATION

It is hereby certified that the answers provided to this First Discovery Request, by each responder are true to the best of his/her knowledge, information and belief.

Jorge Meléndez

Don Cortez

Don Cortez

Jessica Laird

Jessica Laird

Mario Hurtado

RESPECTFULLY SUBMITTED.

We hereby certify that, as required by the Energy Bureau in the April 8th Resolution and Order, Attachment A, and by Section 8.01 (K) of Energy Bureau Regulation 8543, we will send an electronic copy of this response and exhibits to same to the attorneys for PREPA, Joannely Marrero-Cruz, jmarrero@diazvaz.law; and Katiuska Bolaños-Lugo, kbolanos@diazvaz.law, the Office of the Independent Consumer Protection Office, Hannia Rivera Diaz, hrivera@jrsp.pr.gov, and counsel for the Puerto Rico Institute for Competitiveness and Sustainable Economy ("ICSE"), Fernando Agrait, agraitfe@agraitlawpr.com, counsel for the Colegio de Ingenieros y a de Puerto Rico ("CIAPR"), Rhonda Castillo, rhoncat@netscape.net, and counsels for Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc., Enlace Latino de Acción Climatica, Alianza Comunitaria Ambientalista del Sureste, Inc., Coalicion de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, Sierra Club and its Puerto Rico Chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (jointly, Puerto Rico Local and Environmental Organizations), larroyo@earthjustice.org, rstgo2@gmail.com, notificaciones@bufete-emmanuelli.com, pedrosaade5@gmail.com, jessica@bufete-emmanuelli.com; rolando@bufete-emmanuelli.com.

In San Juan, Puerto Rico, this 10th day of September 2021.

DLA Piper (Puerto Rico) LLC
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San Juan, PR 00901-1969
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Exhibit 5

LUMA's Responses and Objections to
LECO's First Request of Information

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

IN RE: PERFORMANCE METRICS TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO. NEPR-AP-2020-0025** **SUBJECT: Response to First Discovery Request by the Puerto Rico Local Environmental and Civil Organizations ("LECO")**

LUMA'S RESPONSES AND OBJECTIONS TO FIRST DISCOVERY REQUEST BY LECO

TO: Puerto Rico Local Environmental and Civil Organizations ("LECO")
Through counsels:
Ruth Santiago, rstgo2@gmail.com, Rolando Emmanuellii, notificaciones@bufete-emmanuelli.com, rolando@bufete-emmanuelli.com, Jessica Méndez, jessica@bufete-emmanuelli.com, Pedro Saadé pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com, and Laura Arroyo, larroyo@earthjustice.org.

FROM: LUMA Energy, LLC, and **LUMA Energy ServCo, LLC** ("LUMA"),

Through counsels:

Margarita Mercado Echegaray, margarita.mercado@us.dlapiper.com and Yahaira De la Rosa, yahaira.delarosa@us.dlapiper.com.

LUMA Energy, LLC and LUMA Energy ServCo, LLC (jointly referred to as "LUMA"), by and through its attorneys, and pursuant to Regulation No. 8543 of the Puerto Rico Energy Bureau, responds and objects to the Local Environmental and Civil Organizations ("LECO") First Discovery Request as follows:

PRELIMINARY STATEMENT

1. By making the accompanying responses and objections to LECO's requests, LUMA does not waive, and hereby expressly reserves, its right to assert any and all objections as to the admissibility of such responses into evidence in this proceeding, or in any other proceedings, on any and all grounds including, but not limited to, competency, relevancy, materiality, and privilege. Further, LUMA makes the responses and objections herein without in any way implying that it considers the requests, and responses to the requests, to be relevant or material to the subject matter of this proceeding.

2. LUMA will produce responsive documents only to the extent that such documents are in its possession, custody, or control.

3. LUMA expressly reserves the right to supplement, clarify, revise, or correct any or all of the responses and objections herein, and to assert additional objections, in one or more subsequent supplemental response(s).

4. Publicly available documents including, but not limited to, documents matter of public record that are available electronically, will not be produced, but sufficient information will be provided to easily identify and access the electronic public records in which they are located.

GENERAL OBJECTIONS

LUMA makes the following general objections, which are incorporated into each of its responses below as if stated in full therein:

1. LUMA objects to LECO's requests which call for information and the production of documents not relevant to the subject matter of the proceeding.

2. LUMA expressly limits its responses to LECO's requests to the information that could be located by each of the responders after a reasonable search of its records believed most likely to contain the responsive information.

3. LUMA's decision to provide information notwithstanding the objectionable nature of some of LECO's discovery requests are not to be construed as an admission that the information is relevant, as a waiver of the general or specific objections, or as an agreement that future requests for similar discovery will be treated in a similar manner.

4. LUMA reserves its right to supplement, modify or amend these responses as discovery progresses in this proceeding.

LUMA'S OBJECTIONS AND RESPONSES TO LECO´S REQUESTS

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-001

REQUEST:

Please produce all discovery responses to any other party in this proceeding. This is a continuing request.

RESPONDER:

All

RESPONSE:

This request does not warrant a response at this time. LUMA will comply with the directives issued by the Energy Bureau in the Resolution and Order of April 8, 2021 and Attachment A to the same, regarding requirements for answering discovery requests.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-002

REQUEST:

Please produce the information, data, studies, reports, evaluations, studies, workpapers and modeling files (including both input and output files) within your possession that support the proposed Annex IX submitted by LUMA, including all workpapers and modeling files created, used, or relied on in developing each of the figures, tables, and exhibits presented in the proposal. Please specifically include the information and documents supporting or justifying the proposed metrics contained in Tables 2-1 through 2-25 of the proposed Annex IX.

RESPONDER:

N/A

RESPONSE:

This request is vague, uncertain and overly broad and does not place LUMA in position to provide a fulsome answer. LUMA's proposed Revised Annex IX to the Puerto Rico Transmission and Distribution Operation and Maintenance Agreement ("T&D OMA") is found at Section 2.5 of LUMA's Revised Performance Metrics filing of August 18, 2021 and includes Tables 2-1 through 2-25. Thus, LUMA understands that the first and second sentences of this request, call for the same type of information. LUMA requests clarification on the scope of this request as LUMA cannot determine the nature of the information sought.

Without waving the aforementioned objections and requests for clarifications and to the extent that LECO has requested workpapers and documentation to support LUMA's proposed Revised Annex IX to the T&D OMA, please see the supporting workpapers that were submitted on August 18, 2021 as exhibits to the written testimonies, and as part of Appendix B:

- Exhibits A, B, C and D to written testimony of Mr. Kalen Kostyk.
- Exhibit A to written testimony of Mrs. Jorge Meléndez.[1]
- Exhibit A to written testimony of Mr. Abner Gómez.
- Exhibit A to written testimony of Mr. Juan Fonseca, filed on August 18, 2021 and Exhibit B to written testimony of Juan Fonseca, filed on August 27, 2021.
- Exhibits A and B to written testimony of Mr. Don Cortez.

[1] Replaces the testimony of Ms. Esther González.

- Exhibits A through D to written testimony of Mrs. Jessica Laird.
- Exhibits A and B to written testimony of Ms. Melanie Jeppesen.

Please refer to the following documents that are produced with this response RFI-LUMA-ap-2020-0025-LECO-10SEPT21-002-Attachment 1, RFI-LUMA—AP-2020-0025-LECO-10SEPT21-004 Attachments 1-4.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-003

REQUEST:

Refer to the PREB January 21, 2021 Order's requirement that incentives cannot be awarded for "easy-to-fix" problems. Please identify any such easy-to-fix problems in the following categories:

- electric rate volatility and affordability
- economic incentives and investment payback
- electric service reliability
- customer service and commitment - including options to manage costs
- customer access to electric power company information - specifically including information on electric power consumption
- public access to electric power company information - specifically including information on aggregated customer energy
- compliance with the RPS
- rapid integration of renewables, including the quality of interconnection of distributed renewables
- compliance with energy efficiency metrics of Law 17-2019
- infrastructure maintenance
- occupational safety and health incidents (specifically including fatalities and severity of incidents)

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA is not in position to answer this request that is grounded on a Resolution and Order of January 21, 2021. LUMA has not been able to locate an order by this Energy Bureau in this proceeding dated January 21, 2021. Thus, LUMA requests clarification on what order LECO is referencing in this request. LUMA also objects this request as it is vague and ambiguous, since it lacks a definition on what may be considered “easy to fix problems.” Without waving this objection, it is clarified that operating the Transmission and Distribution of an electric power utility is not easy. Operating and revitalizing the Transmission and Distribution System of the Puerto Rico Electric Power Authority, a bankrupt utility whose operations and infrastructure do not meet industry standards in several respects, cannot be considered as involving “easy to fix” problems. LUMA does

not consider any of the categories outlined in this request as involving “easy to fix” problems.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-004

REQUEST:

Refer to the following statement on p. 10 of the proposed Annex IX: "Based on analysis of data over the last 36 months and consideration of impact of external factors such as Hurricane Maria and the COVID cut-off moratorium, the timeframe of May 2019 - February 2020 represents the most current stable and unimpaired period of collections activity for general customers." Provide the basis for this statement, along with any supporting documents. Please specifically include the "analysis" and "consideration" referenced in this statement.

RESPONDER:

Juan Fonseca

RESPONSE:

The basis for the statement above was determined by governmental executive orders OE-2020-0020 and OE-2020-023, and Act No. 39-2020 enacted on April 9, 2020. Please refer to the following documents RFI-LUMA-AP-2020-0025-LECO-10SEPT21-004-Attachments 1-4.

The considerations made as a result of the executive orders are related to the inability to disconnect customers. When a utility does not have the ability to disconnect customers for non-payment, there is less incentive for a customer to pay their bill as there is no consequence for non-payment. PREPA ceased all disconnects for non-payment after Hurricane Maria and did not resume disconnections for non-payment until May 2019. In March 2020, the Puerto Rico Governor Hon. Wanda Vazquez Garced issued executive orders OE-2020-020 and OE-2020-023, declaring a state of emergency due to the COVID-19 pandemic and a total lockdown. Act No. 39-2020 prohibited PREPA from disconnecting customers for non-payment for the duration of the state of emergency. The declaration of state of emergency due to the COVID-19 pandemic is still ongoing, as per OE-2021-054 of July 1, 2021. In Case No. NEPR-MI-2019-0007, in a Resolution and Order dated May 21, 2021, PREB ordered LUMA use FY2020 data to calculate baseline performance. Due to the extraneous circumstances caused by the pandemic, LUMA attempted to use the period closest to the order from May of 2019 to March of 2020, demonstrates a period of time where the utility was able to perform normal collection processes as PREPA had the ability to disconnect for non-payment.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-005

REQUEST:

Refer to the definition of Major Outage Event on p. 37.

a. Does this definition differ in any way from the definition of Major Outage Event contained within LUMA's Emergency Response Plan?
b. Have any of the outages that occurred since LUMA took over the transmission and distribution system, in June 2021, met the listed criteria?

RESPONDER:

Terry Tonsi

RESPONSE:

a. The Emergency Response Plan ("ERP") does not define a Major Outage Event. The ERP references a Major Outage Event as defined in Annex IX (Performance Metrics) of the T&D OMA.
b. LUMA objects this request as it seeks information that falls beyond the scope of the subject matter of this proceeding inasmuch as it references performance on outages. As explained at page 8 of LUMA's Revised Performance Metrics Targets filing of August 18, 2021, LUMA's proposed Major Outage Event Performance Metrics only apply during Major Outage Events that are defined as:

> an event as a result of which (i) at least two hundred and five thousand (205,000) T&D Customers are interrupted for more than 15 minutes or (ii) at any point in time during the event, there are one thousand five hundred or more (≥1,500) active outage events for the T&D System, which are tracked in the Outage Management System (OMS). The major outage event is deemed ongoing so long as the interruptions/outages continue to remain above the stated cumulative amounts, in each case for a period of twenty-four hours or longer (≥24) and are caused by an act of God. If such an act of God is a storm, the storm must be designated as a named storm by the U.S. National Weather Service or a State of Emergency declared by the Government of Puerto Rico. The major outage event shall be deemed to have ended when the cumulative number of T&D customers remaining interrupted falls below ten thousand (10,000) for a continuous period of eight (8) hours.

LUMA objects to that portion of the request that seeks information related to outages that have occurred since LUMA took over the transmission and distribution system, in June 2021. This proceeding does not involve performance or data after the Energy Bureau set the applicable baselines in the Resolutions and Orders of May 21, 2021 and July 2, 2021, issued in Case No. NEPR-MI-2019-0007. Thus, the requested information on outages that have occurred after June 1, 2021, is not relevant to this proceeding.

Without waiving the foregoing objections, LUMA responds that there have been no Major Outage Events that meet the specified criteria since June 2021.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-006

REQUEST:

Refer to the Summary of Major Outage Event Performance Metrics in Table 24, p. 38. Please provide a detailed description of LUMA's performance, according to each of these metrics, for all outages that have occurred since LUMA took over the transmission and distribution system, in June 2021.

RESPONDER:

N/A

RESPONSE:

As explained at page 8 of LUMA's Revised Performance Metrics Targets filing of August 18, 2021, LUMA's proposed Major Outage Event Performance Metrics only apply during Major Outage Events that are defined as:

> an event as a result of which (i) at least two hundred and five thousand (205,000) T&D Customers are interrupted for more than 15 minutes or (ii) at any point in time during the event, there are one thousand five hundred or more (≥1,500) active outage events for the T&D System, which are tracked in the Outage Management System (OMS). The major outage event is deemed ongoing so long as the interruptions/outages continue to remain above the stated cumulative amounts, in each case for a period of twenty-four hours or longer (≥24) and are caused by an act of God. If such an act of God is a storm, the storm must be designated as a named storm by the U.S. National Weather Service or a State of Emergency declared by the Government of Puerto Rico. The major outage event shall be deemed to have ended when the cumulative number of T&D customers remaining interrupted falls below ten thousand (10,000) for a continuous period of eight (8) hours.

LUMA objects to that portion of the request that seeks information related to LUMA's performance for all outages that have occurred since LUMA took over the transmission and distribution system, in June 2021. This proceeding does not involve performance or data after the Energy Bureau set the applicable baselines in the Resolutions and Orders of May 21, 2021 and July 2, 2021, issued in Case No. NEPR-MI-2019-0007. Thus, the requested information on outages that have occurred after June 1, 2021, is not relevant to this proceeding.

Without waiving the foregoing objections, LUMA responds that the Major Outage Event Scorecard (MOE Scorecard) proposed by LUMA, will be used as a tool to specifically measure utility performance during each MOE. Since June 1, 2021, no MOE have taken place. Thus, currently there is no available data on performance during an MOE.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-007

REQUEST:

LUMA provided testimony from four witnesses. Please provide a detailed description of these witnesses' level of expertise in the following areas:

- customer access to electric power company information - specifically including information on electric power consumption
- public access to electric power company information - specifically including information on aggregated customer energy
- compliance with the RPS
- rapid integration of renewables, including the quality of interconnection of distributed renewables
- compliance with energy efficiency metrics of Law 17-2019

RESPONDER:

N/A

RESPONSE:

This request is vague, ambiguous, uncertain, confusing, and does not place LUMA in position to ascertain its relevance or provide a fulsome and correct answer. This request calls for pure conjecture and speculation. Thus, LUMA cannot determine the nature of the information sought. On August 18, 2021, LUMA submitted the written testimonies of nine witnesses. Each of the testimonies include background information on each of the witnesses. This request, however, references the testimonies of four witnesses, but fails to identify the names of those four witnesses. Also, the request does not identify how the list of "expertise areas" that are enumerated in the request are relevant to any of the pre-filed testimonies or what connection there may be between those "expertise areas" and the proposed Performance Metrics Targets included in the Revised Annex IX to the T&D OMA. Thus, LUMA cannot answer this request. Also, as drafted the request does not elicit information relevant to this proceeding. LUMA reserves the right to raise additional objections to this request if and when LECO clarifies the same.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-008

REQUEST:

Has LUMA made any changes to the form of the invoices and bills sent to electricity customers, or any changes to the information provided in those documents? If so, please provide a detailed description of all changes made by LUMA.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects this request as it seeks information that falls beyond the scope of the subject matter of this proceeding. The form of the electricity invoices and bills sent to customers is not at issue in the instant proceeding. Thus, this request is not relevant to the controversy at issue. Without waiving the foregoing objections, LUMA responds that no changes to invoices or bills have been made as of September 10th, 2021. The form of the electricity invoices and bills is currently pending approval by the Puerto Rico Energy Bureau in Case No. NEPR-MI-2021-0008 (Review of LUMA Model Bill). The docket of that case is a matter of public record readily available to the public.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-009

REQUEST:

Refer to the following statement on Table 2-2 Summary of Performance Metrics on p. 8 of the Revised Annex IX: "[Average speed of answers is] [b]ased on past PREPA performance and LUMA experience." Does LUMA intend to use its experience since it took over the transmission and distribution system in June 2021 as a baseline performance level for the average speed of answers? If so, please provide a detailed description of the information from LUMA's experience, specifically including the number of answers provided by LUMA, the average speed of answer, and the median speed of answers

RESPONDER:

Jessica Laird

RESPONSE:

The baseline was set based on a careful review of PREPA's performance data and the professional experience of the LUMA subject matter expert. Since the baseline represents the starting point from which LUMA needs make improvements, it would be inappropriate to include data from post June 1st, 2021.The current metrics are proposed for three years and over time LUMA's performance will become part of the data which will be used to set subsequent baselines and targets.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-010

REQUEST:

Refer to table 2-2 Summary of Performance Metrics on p.8 of the Revised Annex IX "Customer Complaint Rate" referring to LUMA's baseline performance level derivation which is "[b]ased on the total number of complaints received by the PREB (NEPR-QR) from May 2019 to February 2020, annualized, as the baseline as it is the most normal period of operations for PREPA in the last 4 years."

a. Why are current LUMA calls and LUMA experience not factored in, as they are for Average Speed of Answers?
b. What is the decisive factor when using LUMA's experience (since it took over the transmission and distribution system, in June 2021) in some of these baseline performance level derivations (see question above) and not in others?

RESPONDER:

Melanie Jeppesen

RESPONSE:

a. See response to RFI-LUMA-AP-2020-0025-LECO-10SEPT21-009.
b. The context of LUMA’s experience in the written testimony is that LUMA’s subject matter experts used their professional experience in standard utility metrics reporting to gauge the accuracy of data and set plausible baselines and targets based on PREPA’s historical data.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-011

REQUEST:

Refer to the following statement on p.17 and p.19 of the Revised Annex IX: "[t]here is a lack of visibility into three separate call routing systems and overflow which prevents LUMA from accurately calculating [Average Speed of Answer]." Please provide a detailed description of the "lack of visibility"

a. Has LUMA conducted any analysis on the causes of the lack of visibility?
b. Has LUMA identified any way to improve visibility?
c. How does the lack of visibility directly affect your ability to calculate the Average Speed of Answer?
d. Has LUMA considered any alternative method of calculating Average Speed of Answer?

RESPONDER:

Jessica Laird

RESPONSE:

a. The lack of visibility was caused by the utilization of three separate contact center platforms that did not enable a fulsome and integrated view of PREPA's call center performance. Further detail is included in Exhibit D of my testimony – *Performance Metric Workpapers – Contact Center Metric Baselines*.
b. Yes, LUMA identified that all contact centers should operate on a unified platform. A cloud-based contact center platform has been implemented that allows the calculation of an integrated Average Speed of Answer across all contact centers.
c. A lack of visibility exists due to the three separate platforms being used. Software tracking these platforms was not consolidated / made cohesive which consequently affects the ability to calculate a consolidated Average Speed of Answer. Further detail on the inability to consolidate data from three platforms is included in Exhibit D of my testimony – *Performance Metric Workpapers – Contact Center Metric Baselines*.
d. No, Average Speed of Answer is an industry standard calculation.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-012

REQUEST:

Refer to p.33 "Special Considerations". Please provide a comprehensive list of possible situations that merit special considerations, aside from the three included.

RESPONDER:

Juan Fonseca

RESPONSE:

It is impossible to develop a comprehensive list of situations that would merit special consideration for Days Sales Outstanding. However, special consideration should be given during events that LUMA is not able to perform normal collection processes for reasons outside their control (for example, Executive Order referenced in RFI-LUMA-AP-2020-0025-LECO-10SEPT21-004) or should new/different information come about due to previously unaudited financials.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 1: LECO Requests

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-10SEPT21-013

REQUEST:

Refer to the following statement provided in table 2-4 Summary of Major Outage Event Performance Metrics on p.39 "Crewing": "three (3) days prior to a forecasted event occurring (when the event allows that much warning time), LUMA will complete a "damage prediction" to determine crew requirements. Based on this damage prediction, the number of mutual assistance crew will be determined."

a. Please provide the guidelines that will be used to assess and create these "damage predictions."

b. Please explain whether LUMA plans to keep track of areas that are more susceptible to damage, to be used in case of lack of time to complete the aforementioned "damage prediction" or in the case of an unpredicted event (i.e., earthquake).

RESPONDER:

Terry Tonsi

RESPONSE:

a. Annex A to the LUMA Emergency Response Plan states that LUMA will draw upon its institutional knowledge and experience from past events to develop rudimentary preliminary damage estimates. Items that will factor into these estimates will include weather, its projected intensity, and the overall health and condition of the system.
b. LUMA plans to keep track of key areas if there are incidents occur for the reasons implied in the request. As addressed in the System Remediation Plan, Initial Budgets and Performance Metrics submittals, LUMA is currently carrying out inspection and evaluation of facilities which will allow us to identify any obvious safety and reliability-related issues, representing areas with a higher likelihood of damage.

CERTIFICATION

It is hereby certified that the answers provided to this First Discovery Request, by each responder are true to the best of his/her knowledge, information and belief.

Jessica Laird

Jessica Laird

Digitally signed by Terry Tonsi
Date: 2021.09.10 18:02:11 -04'00'

Terry Tonsi

Melanie Jeppesen

Juan Fonseca

Mario Hurtado

RESPECTFULLY SUBMITTED.

We hereby certify that, as required by the Energy Bureau in the April 8th Resolution and Order, Attachment A, and by Section 8.01(K) of Energy Bureau Regulation 8543, we will send an electronic copy of this response and exhibits to same to the attorneys for PREPA, Joannely Marrero-Cruz, jmarrero@diazvaz.law; and Katiuska Bolaños-Lugo, kbolanos@diazvaz.law, the Office of the Independent Consumer Protection Office,

Hannia Rivera Diaz, hrivera@jrsp.pr.gov, and counsel for the Puerto Rico Institute for Competitiveness and Sustainable Economy ("ICSE"), Fernando Agrait, agraitfe@agraitlawpr.com, counsel for the Colegio de Ingenieros y a de Puerto Rico ("CIAPR"), Rhonda Castillo, rhoncat@netscape.net, and counsels for Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc., Enlace Latino de Acción Climatica, Alianza Comunitaria Ambientalista del Sureste, Inc., Coalicion de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, Sierra Club and its Puerto Rico Chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (jointly, Puerto Rico Local and Environmental Organizations), larroyo@earthjustice.org, rstgo2@gmail.com, notificaciones@bufete-emmanuelli.com, pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com; rolando@bufete-emmanuelli.com.

An electronic copy of this response and exhibits will also be sent to: viacaron@jrsp.pr.gov; secretaria@jrsp.pr.gov; and legal@jrsp.pr.gov.

In San Juan, Puerto Rico, this 10th day of September 2021.

DLA Piper DLA PIPER **(Puerto Rico) LLC**
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San Juan, PR 00901-1969
Tel. 787-945-9107
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/s/ Margarita Mercado Echegaray
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Yahaira De la Rosa Algarín
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Exhibit 6

LUMA's Responses and Objections to
LECO's Fourth Request of Information

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

IN RE: PERFORMANCE METRICS TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO. NEPR-AP-2020-0025** **SUBJECT: Response to Fourth Discovery Request by the Puerto Rico Local Environmental and Civil Organizations ("LECO")**

LUMA'S RESPONSES AND OBJECTIONS TO FOURTH DISCOVERY REQUEST BY LECO

TO: Puerto Rico Local Environmental and Civil Organizations ("LECO")
Through counsels:
Ruth Santiago, rstgo2@gmail.com, Rolando Emmanuellii, notificaciones@bufete-emmanuelli.com, rolando@bufete-emmanuelli.com, Jessica Méndez, jessica@bufete-emmanuelli.com, Pedro Saadé pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com, and Laura Arroyo, larroyo@earthjustice.org.

FROM: LUMA Energy, LLC, and **LUMA Energy ServCo, LLC** ("LUMA"),

Through counsels:

Margarita Mercado Echegaray, margarita.mercado@us.dlapiper.com and Yahaira De la Rosa, yahaira.delarosa@us.dlapiper.com.

LUMA Energy, LLC and LUMA Energy ServCo, LLC (jointly referred to as "LUMA"), by and through its attorneys, and pursuant to Regulation No. 8543 of the Puerto Rico Energy Bureau, responds and objects to the Local Environmental and Civil Organizations ("LECO") Fourth Discovery Request as follows:

PRELIMINARY STATEMENT

1. By making the accompanying responses and objections to LECO's requests, LUMA does not waive, and hereby expressly reserves, its right to assert any and all objections as to the admissibility of such responses into evidence in this proceeding, or in any other proceedings, on any and all grounds including, but not limited to, competency, relevancy, materiality, and privilege. Further, LUMA makes the responses and objections herein without in any way implying that it considers the requests, and responses to the requests, to be relevant or material to the subject matter of this proceeding.

2. LUMA will produce responsive documents only to the extent that such documents are in its possession, custody, or control.

3. LUMA expressly reserves the right to supplement, clarify, revise, or correct any or all of the responses and objections herein, and to assert additional objections, in one or more subsequent supplemental response(s).

4. Publicly available documents including, but not limited to, documents matter of public record that are available electronically, will not be produced, but sufficient information will be provided to easily identify and access the electronic public records in which they are located.

GENERAL OBJECTIONS

LUMA makes the following general objections, which are incorporated into each of its responses below as if stated in full therein:

1. LUMA objects to LECO's requests which call for information and the production of documents not relevant to the subject matter of the proceeding.

2. LUMA expressly limits its responses to LECO's requests to the information that could be located by each of the responders after a reasonable search of its records believed most likely to contain the responsive information.

3. LUMA's decision to provide information notwithstanding the objectionable nature of some of LECO's discovery requests are not to be construed as an admission that the information is relevant, as a waiver of the general or specific objections, or as an agreement that future requests for similar discovery will be treated in a similar manner.

4. LUMA reserves its right to supplement, modify or amend these responses as discovery progresses in this proceeding.

LUMA'S OBJECTIONS AND RESPONSES TO LECO´S REQUESTS

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-001

REQUEST:

LUMA's proposed Annex IX includes a metric named "Operating Budget". PREB's May Order Attachment A includes a metric named "Operational Expenses v. Budget (excluding fuel)(system)".

a. Are there any differences between LUMA's proposed metric and the metric set forth by PREB?
b. PREB set the baseline for this metric at 80.4%. LUMA proposes a baseline of 100%. Please provide a detailed description of the reason LUMA is proposing a different baseline then the baseline set by PREB.
c. PREB's May Order, Attachment A that the benchmark for this metric is to remain "within budget". Please provide a detailed description of LUMA's understanding of that benchmark.

RESPONDER:

Kalen Kostyk

RESPONSE:

It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau ("PREB") were adopted within the competitive negotiated processes conducted by the Puerto Rico Public-Private Partnerships Authority ("P3 Authority") that led to the execution of the Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement of June 22, 2020 (T&D OMA). Without acquiescing to the relevance of this request:

a. Both metrics are calculated the same way by taking the actual operating expenses and dividing by the approved budget for the same period.

b. As described in Section 2.5.3 of the Revised Performance Metric filing,

> While the FY2020 data PREPA submitted shows an 80.4% baseline, LUMA remains at 100% of the budget. As this is funded by the rate order, it is in the customers' best interest

> that LUMA use the funds appropriately to build a stronger, more resilient utility.

To expand on LUMA's comments as noted above, PREPA's historical underspending of Operational Expenses reflect the failure of PREPA's management team and the overall utility to deliver on annual approved plans. PREPA's historical underspending was not consistent with prudent practice. The state of the Transmission and Distribution system (T&D System) is indicative of this failure. Therefore, in the absence of an accurate and reflective historical baseline, LUMA utilized the current state of PREPA to determine that a true baseline, had PREPA been able to prudently deliver on approved annual plans to the betterment of the T&D system, should have been 100%. Therefore, LUMA has filed a Baseline Performance Level of 100%.

c. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. Requests for interpretation or clarification of the Resolutions and Orders issued by the PREB in Case No. NEPR-MI-2019-0007, should be addressed as legal matters to the PREB and should not be directed at LUMA's witnesses which testimonies pertain to LUMA's Revised Performance Metrics Targets Submission and proposed Revised Annex IX to the Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement ("T&D OMA") filed on September 24, 2021 ("LUMA's Revised Performance Metrics Targets filing"). Without waiving the foregoing objections, pursuant to the T&D OMA, Annex IX, Section D:

> For the three approved budget-related metrics, Operating Budget, Capital Budget – Federally Funded and Capital Budget – Non-Federally Funded, exceeding 102% of the applicable Budget results in no points while spending less than or equal to 100% of the applicable Budget results in awarding full Base Points. The Operator can earn full Base Points by spending up to 102% of the budget, pending Administrator approval.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-002

REQUEST:

PREB's May Order includes a metric for “Capital expenses vs. Budget – Transmission & Distribution” and sets a baseline for a 9.9% ratio of T&D capital expenses to operating budget. Did LUMA consider including this metric in its proposed Annex IX? If so, why did LUMA choose not to include it? If not, why not?

RESPONDER:

Kalen Kostyk

RESPONSE:

LUMA objects to this request as it seeks information that falls beyond the scope of the subject matter of this proceeding and is not reasonably calculated to lead to the discovery of admissible evidence. Further, LUMA objects to this request as the information sought is irrelevant to the controversy at issue on LUMA's Revised Performance Metrics Targets. The proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA.

Without waiving the foregoing objections and without acquiescing to the relevance or admissibility of the information, LUMA is using this metric in the revised Annex IX of the T&D OMA. “Capital Expenses vs. Budget – Transmission & Distribution” is the equivalent of LUMA’s “Capital Budget: Non-Federally Funded”. PREPA previously did not have a metric to report on Federal Funds being spent and consistent with the T&D OMA, LUMA included separate budgets for federal and non-federal capital spending, and correspondingly a metric for performance to budget for Capital Budget: Federally Funded and a separate one for Capital Budget: Non-Federally Funded.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-003

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for System Average Interruption Frequency Index ("SAIFI"). PREB set a benchmark of 1, while LUMA's proposed benchmarks would allow for significantly more interruptions: 9.8; 8.5; 7.4 for Years 1, 2, and 3, respectively. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

RESPONDER:

Don Cortez

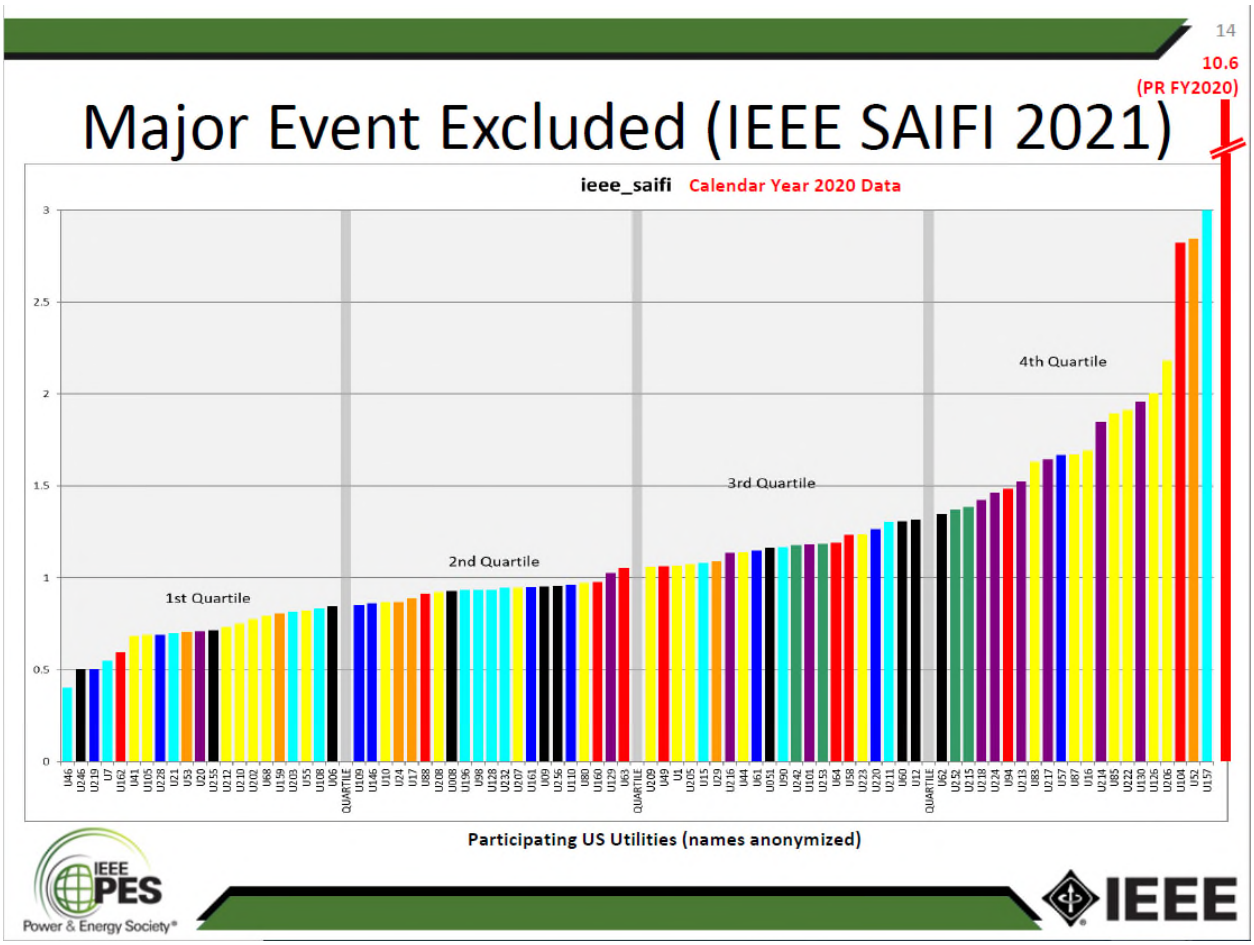
RESPONSE:

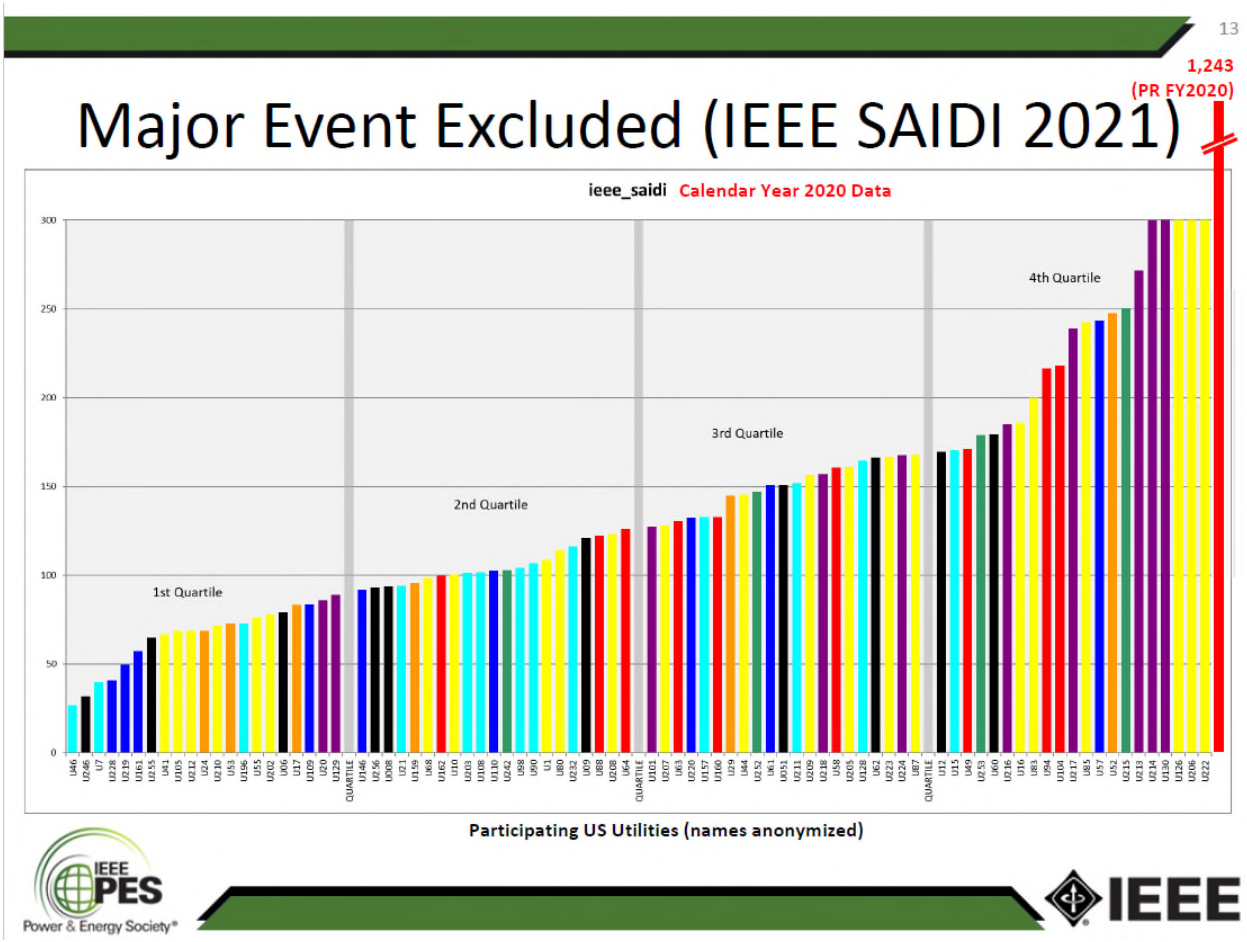
LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the unsupported premise that the benchmark is directly relevant to the baseline. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing of September 24, 2021, addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007. Without waiving the foregoing objections, PREB's proposed benchmark for SAIFI is not an annual target. As stated in Exhibit 3, page 1, of LUMA's Partial Request for Reconsideration, Submitting Information on Results of JD Power Survey and Requests for Clarification: "PREPA's current performance is well below industry benchmarks in almost all metrics measured …" *See* LUMA's Motion of April 28, 2021, entitled *Motion for Partial Reconsideration of Resolution and Order of April 8, 2021, Motion Submitting Information in Support Thereof, and Request for Clarifications,* Case No. NEPR-MI-2019-0007.

Also, in the Resolution and Order of May 21, 2021, in Case No. NEPR-MI-2019-0007, PREB explained at page 6, that benchmarks may need to evolve over time for two reasons: "First, if performance needs to be improved, it may not be possible for the utility to immediately achieve the desired level of performance, and second some problems may take years to fully remedy, despite the utility undertaking immediate actions to remediate the situation. In such cases, the performance measurement time interval can be lengthened, or benchmarks can be set to become more stringent over time, providing the utility with a glide path for achieving the ultimately desired level of performance." Additionally, the condition of the T&D system in Puerto Rico is so poor that it will require many years and a significant investment to perform in the vicinity of

PREB's proposed benchmark. The value set for the proposed benchmark (1) is a realistic benchmark for a mature utility that has functioned well for many years and maintained its infrastructure; this is not the scenario that LUMA faces in Puerto Rico.

Benchmarks are a point of comparison with a defined group of other utilities that are accepted as peers. The benchmarks issued by the PREB are based on a group of utilities selected by the PREB. Other appropriate peer groups could be defined to examine other points of comparison. The Distribution Reliability Working Group of the IEEE Power & Energy Society conducts an annual benchmarking exercise and publicly publishes the results. The following two graphs show the results of the 2021 exercise based on the calendar year 2020 data for SAIFI and SAIDI. PREPA's 2020 results for the same have been added for comparison. The graphs show that PREPA's performance is far worse than any other utility in the study.





In conclusion, the benchmark proposed by the PREB is not immediately relevant to the performance targets for the PREPA T&D system, given the level of degradation and neglect as well as the most recent, complete set of data for these metrics.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-004

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for System Average Interruption Duration Index ("SAIDI"). PREB set a benchmark of 102 minutes, while LUMA's proposed benchmarks would allow for significantly longer interruptions: 1,119; 932, and 749 minutes for Years 1, 2, and 3, respectively. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

RESPONDER:

Don Cortez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-003.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-005

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for Average Speed of Answer.

a. PREB set a baseline of 8.3 minutes, while LUMA proposes a higher baseline of 10.0 minutes. Provide a detailed description of LUMA's justification for not using PREB's assigned baseline.

b. PREB proposed a benchmark of 0.4 minutes; LUMA's proposed benchmarks are significantly higher. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

RESPONDER:

Jessica Laird

RESPONSE:

LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the unsupported premises of a PREB-assigned benchmark and a PREB-assigned baseline and that LUMA has proposed benchmarks. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing of September 24, 2021, addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007. LUMA has proposed performance targets as part of its Revised Performance Metrics Targets filing and in accordance with the T&D OMA. Without waiving the foregoing objections:

a. LUMA's justification for the proposed baseline can be found in lines 128-136 of my direct testimony and in Exhibit D submitted to the Energy Bureau on August 18, 2021. PREPA previously did not have one platform to consolidate their use of three contact centers. Consequently, customer wait times were not accurately reported causing a discrepancy in data as three different technologies were used and the Average Speed of Answer calculations that were provided could not be confirmed. Calculating a single Average Speed of Answer (ASA) based on PREPA's three different platforms is not possible because all calls came through the PREPA IVR where they sat for 10 minutes before rolling over to one of the 2

third party contact center platforms. The 3rd party contact centers calculated their ASA without including the 10 minutes spent in the PREPA IVR (i.e. their clock started when the call entered their call center platform). Therefore, a call having spent 2 minutes in a third-party contact center queue actually spent 12 minutes in a queue in total. The time spent in the PREPA queue also changed at some point during the Front End Transition Period from 10 minutes to 5 minutes after LUMA questioned the 10-minute wait, so calculating the ASA across the board is not even as simple as adding 10 minutes to the 3rd parties ASA.

b. It is impossible to benchmark a metric against a functioning utility. As described in Case No. NEPR-MI-2019-0007, benchmarks may evolve over time for two reasons: “First, if performance needs to be improved, it may not be possible for the utility to immediately achieve the desired level of performance, and second some problems may take years to fully remedy, despite the utility undertaking immediate actions to remediate the situation.” Furthermore, the North Carolina utilities on which PREB based their benchmarks have less outages, fully functioning meters that are capable of monthly reading, which in turn enable accurate monthly reading, and they do not have work orders outstanding for three or more years or a backlog of billing issues that go back three or more years. The issues identified by LUMA are major service quality problems that have impacted PREPA’s customer service performance since these problems result in an increase in the number of calls made to the contact center and, consequently, a longer wait time associated with these calls. These issues, in particular, are more complex in nature and require a greater length of time to resolve customer concerns. Once LUMA has improved on the deficient areas of utility operations, LUMA can be benchmarked against the utilities chosen by the PREB as comparable.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-006

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for Customer Complaint Rate.

a. PREB set a baseline of 841 complaints per 100,000 customers. LUMA's proposed baseline is 11.10. How does that relate to PREB's baseline? Is LUMA's baseline a percentage? Does it equate to 1,110 complaints per 100,000 customers?

b. PREB set a benchmark of 7 complaints per 100,000 customers. LUMA's proposed benchmarks appear to be significantly higher. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

c. LUMA specifies that only "justified" complaints would be counted. Who would decide whether complaints are "justified"? What criteria would be used to determine whether complaints are "justified"?

RESPONDER: Melanie Jeppesen

RESPONSE:

It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. LUMA also objects to this request because it is based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing of September 24, 2021, addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007. Without waiving the foregoing objections nor acquiescing to the relevance of this request:

a. PREB's baseline of 841 is calculated identically to the method employed by LUMA, with the exception of the number of complaints being considered. Historically, it appears that PREPA used all Act 57 claims to calculate complaints, and thus the PREB baseline appears to consider all Act 57 claims. LUMA proposes a baseline of 10.5 using the number of formal complaints. Please refer to Melanie Jeppesen's revised testimony and revised filing submitted in this case on September 24, 2021. As detailed in Exhibit B of Ms. Jeppesen's direct testimony, this 10.5 baseline was calculated as follows:

First, count the total formal complaints made against PREPA for May 2019-February 2020, then annualizing those complaints to consider 12-months of data. Second, that amount is divided by the total utility customer population. Lastly, that amount is multiplied by 100,000.

Please refer to rows 7-10 in Revised Exhibit B. LUMA's proposed baseline is not a percentage. This equates to 10.5 complaints per 100,000 customers.

b. LUMA is actively working toward improving the customer experience and, therefore, the improvement in the customer complaint rate. The annual targets LUMA set forth are not equivalent to the benchmarks PREB has stated in Case No. NEPR-MI-2019-007. The benchmark is an industry standard which as described in Case No. NEPR-MI-2019-0007 will evolve over time as the utility improves. PREPA is not immediately comparable to the utilities selected in PREB's benchmarking exercise as described in Part B of RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-005. LUMA will be working to achieve an industry standard but set its baseline and targets based on what is reasonably attainable given the current state of the utility. LUMA's calculated baseline is based on what LUMA proposes should be considered a formal complaint. The PREB benchmark appears to consider all Act 57 claims.

c. Please refer to my revised testimony submitted on September 24th, 2021, lines 129-133, which explains that Act 57 claims that become formal complaints with PREB are what are being considered for this complaint calculation.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-007

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for OSHA Recordable Incident Rate.

a. PREB sets a baseline of 6.9, while LUMA proposes a higher baseline of 8.75. Provide a detailed description of LUMA's justification for not using PREB's assigned baseline.

b. PREB sets a benchmark of 1.8, and 2.3 specifically for Transmission & Distribution only. Which of these benchmarks should apply to LUMA?

RESPONDER:

Jorge Melendez

RESPONSE:

a. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the unsupported premise that PREB "set" a benchmark whereas LUMA is proposing targets in accordance with the T&D OMA. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021 in case NEPR-MI-2019-0007.

   Without waiving the foregoing objections, please refer to Section 2.5.2, pages 21-22 of LUMA's Revised Performance Metrics Targets filing and Exhibit A – KPI Metrics – Safety to the Pre-Filed Testimonies and lines 89-150 of my pre-filed testimony for explanations of the different baselines and targets proposed for safety metrics.

b. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel.

Without waving the foregoing objection, neither benchmark should apply to LUMA. PREPA's historical safety performance is significantly higher than industry averages and as indicated in Section 2.5.2, pages 21-22 of LUMA's Revised Performance Metrics Targets filing, the historic data is unreliable. Significant investment and worker training is required to consistently improve safety performance.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-008

REQUEST:

LUMA proposes higher benchmarks of 6.56, 5.25, and 4.2 for Years 1, 2, 3. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

RESPONDER:

Jorge Melendez

RESPONSE:

It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the unsupported premise that PREB "set" a benchmark whereas LUMA is proposing targets in accordance with the T&D OMA. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007.

Without waiving the foregoing objections, please refer to Section 2.5.2, pages 21-22 of LUMA's Revised Performance Metrics Targets filing and Exhibit A – KPI Metrics – Safety to the Pre-Filed Testimonies and lines 89-150 of my pre-filed testimony for explanations of the different baselines and targets proposed for safety metrics.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-009

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for OSHA Severity Rate. PREB sets a baseline of 31.00, while LUMA proposes a higher baseline of 58.03. Provide a detailed description of LUMA's justification for not using PREB's assigned baseline.

RESPONDER:

Jorge Melendez

RESPONSE:

It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel.

Without waiving the foregoing objection, please refer to Section 2.5.2, pages 21-23 of LUMA's Revised Performance Metrics Targets filing and Exhibit A – KPI Metrics – Safety to the Pre-Filed Testimonies and lines 89-150 of my pre-filed testimony for explanations of the different baselines and targets proposed for safety metrics.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-010

REQUEST:

PREB's Attachment A and LUMA's proposed Annex IX both include a metric for OSHA DART Rate.

a. PREB proposes a baseline of 4.8, while LUMA proposes a higher baseline of 6.85. Provide a detailed description of LUMA's justification for not using PREB's assigned baseline.

b. PREB sets a benchmark of 0.9, and 1.1 specifically for Transmission & Distribution only. Which of these benchmarks should apply to LUMA?

RESPONDER:

Jorge Melendez

RESPONSE:

a. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel.

   Without waiving the foregoing objection, please refer to Section to Section 2.5.2, pages 21-24 of LUMA's Revised Performance Metrics Targets filing and Exhibit A – KPI Metrics – Safety to the Pre-Filed Testimonies and lines 89-150 of my pre-filed testimony for explanations of the different baselines proposed for safety metrics.

b. It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007.

   Without waiving the foregoing objections, neither benchmark should apply to LUMA. PREPA's historical safety performance is significantly higher than

industry averages and as indicated in Section 2.5.2, pages 21-22 of LUMA's Revised Performance Metrics Targets filing, the historic data is unreliable. Significant investment and worker training are required to consistently improve safety performance.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-011

REQUEST:

LUMA proposes higher benchmarks of 5.14, 4.11, 3.29 for Years 1, 2, 3. Provide a detailed description of LUMA's justification for not using PREB's assigned benchmark.

RESPONDER:

Jorge Melendez

RESPONSE:

It is clarified that the proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is also based on the incorrect premise that LUMA's Revised Performance Metrics Targets filing addresses or comments on the proposed benchmarks included in Attachment A to the PREB's Resolution and Order of May 21, 2021, in case NEPR-MI-2019-0007.

Without waiving the foregoing objections, please refer to Section 2.5.2, pages 21-24 of LUMA's Revised Performance Metrics Targets filing and Exhibit A – KPI Metrics – Safety to the Pre-Filed Testimonies and lines 89-150 of my pre-filed testimony for explanations of the different baselines and targets proposed for safety metrics.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-012

REQUEST:

The original Annex IX of Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement of June 22, 2020 includes metrics for Customers Experiencing Multiple Interruptions (CEMI), Momentary Average Interruption Frequency Index (MAIFI), First Call Resolution, and Reduction in Network Line Losses. These metrics are absent from LUMA's proposed Annex IX. For each metric, provide a detailed description of LUMA's reasoning for removing that metric from proposed Annex IX.

RESPONDER:

Don Cortez

RESPONSE:

Please see Table 1-1 Performance Metrics Summary in LUMA's Revised Performance Metrics Targets filing on page 7 for a description of LUMA's reasoning for removing the Customers Experiencing Multiple Interruptions (CEMI), Momentary Average Interruption Frequency Index (MAIFI), First Call Resolution (FCR) and Reduction in Network Line Losses metrics from proposed Annex IX.

Please refer to lines 156 to 232 of Witness Cortez's testimony for an additional description of LUMA's reasoning for removing the Customers Experiencing Multiple Interruptions (CEMI), Momentary Average Interruption Frequency Index (MAIFI), and Reduction in Network Line Losses metrics from proposed Annex IX.

Please see the response to RFI-LUMA-AP-2020-0025-PREB-R1-10SEPT21-034 for additional discussion of LUMA's reasoning for removing the Customers Experiencing Multiple Interruptions ($CEMI_m$) metric from proposed Annex IX.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-013

REQUEST:

PREB's May Order rejected LUMA's proposed J.D. Power Customer Satisfaction Survey metrics and stated that LUMA would have to provide "a more thorough analysis" to justify those metrics. Has LUMA provided that more thorough analysis in this proceeding? If so, please provide specific citations in LUMA's testimony and filings.

RESPONDER:

Jessica Laird

RESPONSE:

Please refer to my direct testimony filed on August 18, 2021. This information was provided in Lines 65-118 of my direct testimony, which provides answers to the following questions:

- Please describe the methodology for Residential and Commercial Customer Satisfaction
- How was the data used to calculate the baseline for JD Power Residential and Commercial Customer Satisfaction metrics?
- What considerations were made upon analyzing the baseline data to determine the target for the JD Power Customer Satisfaction metrics?
- What are your recommendations on the JD Power Residential and Commercial Customer Satisfaction metric?

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-014

REQUEST:

PREB's Attachment A includes Generation from RPS-eligible PPOAs as a metric, with a baseline of 3% and benchmark of 40% by 2025 (including distributed resources). Did LUMA consider including this metric in its proposed Annex IX? If so, why did LUMA choose not to include it? If not, why not?

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA objects to this request as the information sought is irrelevant to the controversy at issue on LUMA's Revised Performance Metrics Targets. The proposed Performance Metrics Targets submitted by LUMA for consideration by the PREB were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA.

LUMA also objects to this request as it calls for speculation or a hypothetical scenario and because it does not consider that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the Puerto Rico Public-Private Partnerships Authority that led to the execution of the T&D OMA. LUMA further objects to this request because it is argumentative and includes a legal interpretation by counsel.

Without waiving the foregoing objections, it is clarified that Section 5.1 and Annex 1 to the T&D OMA (Scope of Services) outline LUMA's duty to provide O&M Services. The O&M Services do not include generation-related procurement activities which are managed by the P3 Authority with oversight by the PREB. As stated in Section 5.13 (d) of the T&D OMA, LUMA's role regarding the procurement of generation projects and generation supply contracts includes:

(i) preparation of risk assessments and analysis in support of Resource Adequacy and Generation Project or Generation Supply Contract procurement prioritization and planning, which shall take into account the Integrated Resource Plan and Applicable Law (and which assessments and analyses PREB may request from time to time);

(ii) prepare long and short-range transmission and distribution planning analyses and forecasts to determine the need for Generation Project or Generation Supply Contract procurement, which shall take into account the Integrated Resource Plan to the extent applicable (and which analyses and forecasts PREB may request from time to time);

(iii) meet with PREB on an annual basis to review and assess the prepared analyses, demand projections (prepared in accordance with the Integrated Resource Plan), existing System Power Supply, Legacy Generation Assets and generation assets owned by IPPs related to the supply of Power and Electricity, and determine whether additional power supply sources are needed; and

(iv) (iv) coordinate any start-up-related services required from the Owner in connection with any such Generation Project or Generation Supply Contract.

To be clear, while the OMA goes into extensive detail to describe the O&M Services, including those related to Generation, LUMA is not tasked with managing any procurement process for new generation.

Accordingly, LUMA's Revised Performance Metrics Targets filing does not cover performance categories on generation from RPS PPOAs that are not part of LUMA's O&M Services and, thus, are not under LUMA's control.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-015

REQUEST:

PREB's Attachment A includes several other metrics not included in LUMA's proposed Annex IX:

a. Customer Average Interruption Duration Index (CAIDI) as a metric, with a baseline of 145 minutes and a benchmark of 101 minutes.

b. Absenteeism, with a Baseline of 13.1% and a Benchmark of 2.4%.

c. wait time in commercial offices

d. % of customer calls answered

e. average time to resolve billing disputes

f. percent of customers billed

g. percent of bills estimated vs. read

h. average time to respond to service and outage complaints

For each metric: Did LUMA consider including this metric in its proposed Annex IX? If so, why did LUMA choose not to include it? If not, why not?

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA objects to this request as the information sought is irrelevant to the controversy at issue on LUMA's Revised Performance Metrics Targets.

LUMA also objects to this request as it calls for speculation or a hypothetical scenario and because it does not consider that the proposed Performance Metrics Targets submitted by LUMA for consideration by the Puerto Rico Energy Bureau were adopted within the competitive negotiated processes conducted by the P3 Authority that led to the execution of the T&D OMA. LUMA further objects to this request because it is argumentative and includes a legal interpretation by counsel.

Without waiving the foregoing objections, the metrics selected for the revised Annex IX of the T&D OMA represent a broad list of activities across the utility that fairly represent a utility's performance. Furthermore, the metrics listed above are reported on a quarterly basis as part of Case No. NEPR-MI-2019-0007. As ordered by PREB, LUMA will continue to file reports on each quarter. Lastly, LUMA would like to clarify that while Annex IX contains only Performance Metrics as defined in the OMA, the list of items that will be reported on quarterly is not exclusive of the other key indicators that may be tracked, utilized throughout the utility's operations, and provided to the PREB.

As relates specifically to CAIDI, it was eliminated by LUMA as explained in table 1-1 of LUMA's Revised Performance Metrics Targets filing on page 7 and in the pre-filed testimony of Don Cortez at lines 212 -232, filed in this proceeding Case No. NEPR-AP-2020-0025.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-016

REQUEST:

When developing performance-based incentives and penalties, Law 17-2019 requires PREB to take into account "options to manage electric power costs available to customers;" Do any of LUMA's metrics address that criteria? If LUMA has not included any metrics that address this required criteria, please explain why not.

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the incorrect premise that Law 17-2019 “requires” the PREB to consider set criteria in developing performance-based incentives and penalties. Act 17-2019 declares that is the public policy of the Government of Puerto Rico is to: (1) promote the necessary changes in order to transform the Electric Power System into one that satisfies the energy needs of the 21st century Puerto Rico; (2) to oversee the implementation of strategies geared toward achieving efficiency in the generation, transmission, and distribution of electric power; (3) to ensure the security and reliability of the electric power infrastructure by using modern technologies that promote inexpensive and efficient operations; (4) to maintain the electric power infrastructure in optimal conditions to ensure the reliability, resilience, and safety of the electric power service; (5) to ensure continuous improvements for the electric power grid, in order to promote its resilience and diversification; (6) to guarantee every consumer’s right to receive a reliable, stable, and excellent electric power service at a cost that is accessible, just, and reasonable; among other principles.

To accomplish the public policies enacted in Act 17-2019, the statute authorizes the Energy Bureau to establish performance-based incentives for electric power service companies.

The Performance Metrics Targets proposed by LUMA incentivize system reliability and system safety and incentivize performance to ensure the provision of services at just and accessible costs, among others. The establishment of performance metrics that observe the public policy of maintaining the electric power infrastructure to ensure the

reliability, resilience, and safety of the electric power service and to provide services at just and accessible costs, such as the ones proposed by LUMA, is one of the mechanisms available this Energy Bureau has under its powers to observe compliance with Puerto Rico's public policies as enacted in Act 17-2019.

The JD Power Customer Survey has price as an indicator of customer satisfaction. LUMA is not directly in full control of total price to customers. Generation costs are not under LUMA's control. While a formal cost-related metric does not exist, the customer satisfaction metrics have a price component that addresses Law 17-2019 considerations.

There are metrics proposed which relate to budget management, which relate to the part of customer costs that LUMA can control. By effectively managing our budget, LUMA can help maintain reasonable costs. Over time, effective cost management can allow for better use of resources so that the utility's costs are more directly connected to the level of service.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-017

REQUEST:

Law 17-2019 requires that PREB consider metrics on the following:

a. revenue per kilowatt-hour (kWh),

b. operating and maintenance expenses per kilowatt-hour,

c. operating and maintenance expenses of the distribution system per customer,

d. customer service expenses per customer,

e. general and administrative expenses per customer

f. total energy cost per capita

g. total energy cost per capita in urban areas

h. total energy cost per capita in non-urban areas

For each metric: Did LUMA consider including this metric in its proposed Annex IX? If so, why did LUMA choose not to include it? If not, why not?

RESPONDER:

Mario Hurtado

RESPONSE:

LUMA objects to this request because it is argumentative and includes a legal interpretation by counsel. The request is based on the incorrect premise that Act 17-2019 “requires” the PREB to consider certain performance metrics in developing performance-based incentives and penalties. None of the criteria listed in the request were included in Act 17-2019 as metrics that the PREB should consider. Further, LUMA objects to this request as unintelligible.

Without waiving the foregoing objections, Act 17-2019 does not require any specific performance metric. However, it does declare that is the public policy of the Government of Puerto Rico is to: (1) promote the necessary changes in order to transform the Electric Power System into one that satisfies the energy needs of the 21st

century Puerto Rico; (2) to oversee the implementation of strategies geared toward achieving efficiency in the generation, transmission, and distribution of electric power; (3) to ensure the security and reliability of the electric power infrastructure by using modern technologies that promote inexpensive and efficient operations; (4) to maintain the electric power infrastructure in optimal conditions to ensure the reliability, resilience, and safety of the electric power service; (5) to ensure continuous improvements for the electric power grid, in order to promote its resilience and diversification; (6) to guarantee every consumer's right to receive a reliable, stable, and excellent electric power service at a cost that is accessible, just, and reasonable; among other principles.

To accomplish the public policies enacted in Act 17-2019, the statute authorizes the Energy Bureau to establish performance-based incentives for electric power service companies. Section 6.25B of Act 17-2019, on Performance-Based Incentive and Penalty Mechanisms, does not require the PREB to consider specified metrics, nor has PREB set fixed metrics to be considered in this proceeding.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-018

REQUEST:

Do the SAIDI and SAIFI calculations that LUMA presented for the months of June through August reflect the same methodology used to calculate the SAIDI and SAIFI values that LUMA presented for months prior to June 2021? If not, please specify all changes to methodology.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to that portion of the request that seeks information related to calculations since LUMA took over the transmission and distribution system, in June 2021. This proceeding does not involve performance or data after the Energy Bureau issued the Resolutions and Orders of May 21, 2021, and July 2, 2021, in Case No. NEPR-MI-2019-0007. Thus, the requested information on data after June 1st, 2021, is not relevant to this proceeding.

Without waiving the foregoing objections nor acquiescing to the relevance of the information requested, LUMA's commencement of T&D Operations began on June 1, 2021. LUMA did not present any SAIFI or SAIDI values for the months prior to the month of June 2021. PREPA presented the monthly metrics prior to June 1, 2021. In the Resolution and Order in Case No. NEPR-MI-2019-0007 dated May 21, 2021, the PREB ordered PREPA to resubmit recalculated values for the reliability metrics consistent with the IEEE Guide for Electric Power Distribution Reliability Indices IEEE Std 1366™-2012. For a discussion of LUMA's pre-commencement analysis and findings of PREPA's historical methodology, please refer to Exhibit 2 - LUMA's Comments on Performance Metrics Baselines dated February 5, 2021, in LUMA's filing in Case No. NEPR-MI-2019-0007 and based on data published by the Energy Bureau and presented during the technical conference held on January 19, 2021: Technical discussion beginning on page 12. PREPA recalculated reliability metrics for March 2021 going forward based on the Energy Bureau's order. While the current quarterly report to the PREB breaks the T&D SAIFI and SAIDI into T SAIFI and SAIDI and D SAIFI and SAIDI, LUMA's proposed SAIFI and SAIDI metrics are for the combined T&D system as is considered a common industry practice for T&D utilities. Requiring the inclusion of performance for generation operations—which are explicitly excluded from LUMA's O&M Services—in the reliability metrics would mean evaluating an item that LUMA does not control.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-019

REQUEST:

Please provide the raw outage data from May 1, 2018 through December 31, 2020 used by PREPA to calculate Tmed (according to p. 7 of https://energia.pr.gov/wp-content/uploads/sites/7/2021/05/Motion-to-Substitute-Exhibit-A-of-Motion-filed-on-April-29-2021-NEPR-MI-2019-0007.pdf). Is this the same data used by LUMA to calculate Tmed? If not, please specify the timeframe used by LUMA to calculate Tmed.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-020

REQUEST:

Please provide the raw outage data from January 1, 2021 through August 31, 2021. Data from the system after LUMA's June 1st takeover is relevant because PREB's orders in Docket # NEPR-MI-2019-0007 have made it clear that baselines and benchmarks must be informed by ongoing collection of data on LUMA's performance.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-021

REQUEST:

Do LUMA's SAIDI and SAIFI calculations include both transmission and distribution system outages, or only distribution?

RESPONDER:

Don Cortez

RESPONSE:

LUMA’s SAIDI and SAIFI calculations include both transmission and distribution system outages. Prior to the PREB’s Resolution & Order dated May 21, 2021, in Case No. NEPR-MI-2019-0007, in which PREPA and LUMA were ordered to submit recalculated values for the reliability metrics consistent with IEEE 1366 methodology, PREPA only included distribution system outages.

Performance Metrics

Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-022

REQUEST:

Provide monthly SAIDI and SAIFI values by region for June 2020 through August 2021 without excluding Major Event Days.

RESPONDER:

Don Cortez

RESPONSE:

LUMA objects to that portion of the request that seeks information related to data since LUMA took over the T& D System in June 2021. This proceeding does not involve performance or data after the Energy Bureau issued the Resolutions and Orders of May 21, 2021, and July 2, 2021, in Case No. NEPR-MI-2019-0007. Thus, the requested information on data after June 1st, 2021, is not relevant to this proceeding. LUMA is not required to perform these calculations for this proceeding.

CERTIFICATION

It is hereby certified that the answers provided to this Fourth Discovery Request, by each responder are true to the best of his/her knowledge, information and belief.

Kalen Kostek

Don Cortez

Jessica Laird

Melanie Jeppesen

Jorge Melendez

Mario Hurtado

RESPECTFULLY SUBMITTED.

We hereby certify that, as required by the Energy Bureau in the April 8th Resolution and Order, Attachment A, and by Section 8.01(K) of Energy Bureau Regulation 8543, we will send an electronic copy of this response and exhibits to same to the attorneys for

PREPA, Joannely Marrero-Cruz, jmarrero@diazvaz.law; and Katiuska Bolaños-Lugo, kbolanos@diazvaz.law, the Office of the Independent Consumer Protection Office, Hannia Rivera Diaz, hrivera@jrsp.pr.gov, and counsel for the Puerto Rico Institute for Competitiveness and Sustainable Economy ("ICSE"), Fernando Agrait, agraitfe@agraitlawpr.com, counsel for the Colegio de Ingenieros y a de Puerto Rico ("CIAPR"), Rhonda Castillo, rhoncat@netscape.net, and counsels for Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc., Enlace Latino de Acción Climatica, Alianza Comunitaria Ambientalista del Sureste, Inc., Coalicion de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, Sierra Club and its Puerto Rico Chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (jointly, Puerto Rico Local and Environmental Organizations), larroyo@earthjustice.org, rstgo2@gmail.com, notificaciones@bufete-emmanuelli.com, pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com; rolando@bufete-emmanuelli.com.

An electronic copy of this response and exhibits will also be sent to: viacaron@jrsp.pr.gov; secretaria@jrsp.pr.gov; and legal@jrsp.pr.gov.

In San Juan, Puerto Rico, this 7th day of October 2021.

DLA Piper (Puerto Rico) LLC
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Exhibit 7

LUMA's November 10th submission of additional responses in LECO's Fourth Request of Information

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

IN RE: PERFORMANCE METRICS TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO. NEPR-AP-2020-0025** **SUBJECT: Supplemental Responses to the Second and Fourth Discovery Requests by the Puerto Rico Local Environmental and Civil Organizations ("LECO") in Compliance with the November 4th Resolution and Order, and Reservation of Rights**

LUMA'S SUPPLEMENTAL RESPONSES AND OBJECTIONS TO THE SECOND AND FOURTH DISCOVERY REQUESTS BY LECO IN COMPLIANCE WITH NOVEMBER 4TH RESOLUTION AND ORDER AND RESERVATION OF RIGHTS

TO: Puerto Rico Local Environmental and Civil Organizations ("LECO")
Through counsels:
Ruth Santiago, rstgo2@gmail.com, Rolando Emmanuelli, notificaciones@bufete-emmanuelli.com, rolando@bufete-emmanuelli.com, Jessica Méndez, jessica@bufete-emmanuelli.com, Pedro Saadé pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com, and Laura Arroyo, larroyo@earthjustice.org.

FROM: LUMA Energy, LLC, and **LUMA Energy ServCo, LLC** ("LUMA"),

Through counsels:

Margarita Mercado Echegaray, margarita.mercado@us.dlapiper.com and Yahaira De la Rosa, yahaira.delarosa@us.dlapiper.com.

LUMA Energy, LLC and LUMA Energy ServCo, LLC (jointly referred to as "LUMA"), by and through its attorneys, and pursuant to Regulation No. 8543 of the Puerto Rico Energy Bureau, responds and objects to the Local Environmental and Civil Organizations ("LECO") Second and Fourth Discovery Requests as follows:

PRELIMINARY STATEMENT

1. By making the accompanying responses and objections to LECO's requests, LUMA does not waive, and hereby expressly reserves, its right to assert any and all objections as to the admissibility of such responses into evidence in this proceeding, or

in any other proceedings, on any and all grounds including, but not limited to, competency, relevancy, materiality, and privilege. Further, LUMA makes the responses and objections herein without in any way implying that it considers the requests, and responses to the requests, to be relevant or material to the subject matter of this proceeding.

2. LUMA will produce responsive documents only to the extent that such documents are in its possession, custody, or control.

3. LUMA expressly reserves the right to supplement, clarify, revise, or correct any or all of the responses and objections herein, and to assert additional objections, in one or more subsequent supplemental response(s).

4. Publicly available documents including, but not limited to, documents matter of public record that are available electronically, will not be produced, but sufficient information will be provided to easily identify and access the electronic public records in which they are located.

GENERAL OBJECTIONS

LUMA makes the following general objections, which are incorporated into each of its responses below as if stated in full therein:

1. LUMA objects to LECO's requests which call for information and the production of documents not relevant to the subject matter of the proceeding.

2. LUMA expressly limits its responses to LECO's requests to the information that could be located by each of the responders after a reasonable search of its records believed most likely to contain the responsive information.

3. LUMA's decision to provide information notwithstanding the objectionable nature of some of LECO's discovery requests are not to be construed as an admission that the information is relevant, as a waiver of the general or specific objections, or as an agreement that future requests for similar discovery will be treated in a similar manner.

4. LUMA reserves its right to supplement, modify or amend these responses as discovery progresses in this proceeding. LUMA is filing this Supplemental Response in Compliance with the Resolution and Order issued by the PREB on November 4, 2021 ("November 4th Resolution and Order"), which directed LUMA to answer requests regarding subject matters that are not covered by the pre-filed testimonies submitted on August 18, 2021.

5. By filing these responses, LUMA does not acquiesce to including the responders as witnesses on the subject matters of the responses submitted herein.

6. LUMA reserves the right to request further clarification on the relevance and use of the responses provided herein that involve requests outside the scope of LUMA's Revised Performance Metrics Targets filing of September 24, 2021. LUMA reserves the right to request an amendment of the procedural calendar to announce additional witnesses; the opportunity to conduct further discovery; or additional remedies if the PREB expands the scope of the subject matter of this proceeding to consider performance categories or metrics that are not included in LUMA's Revised Performance Metrics Targets filing of September 24, 2021.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001

REQUEST:

Please refer to LUMA's August 13, 2021 Motion to Show Cause in Docket NEPR-MI-2019-0016. Provide a detailed description of each of the "modifications to expedite [interconnection] procedures" described in that document:

a. LUMA has transitioned from a regionalized structure to a centralized structure with standardized procedures.

b. LUMA has also accelerated the studies stage of the interconnection procedure by eliminating sequential revisions in cases that do not require additional technical review.

c. The net metering procedures and necessary changes of meters are being handled outside of the Portal simultaneously with the validation and studies processes of the interconnection procedure.

d. These modifications are being accompanied by employee training and transparent communications with clients.

RESPONDER:

Don Cortez

RESPONSE:

LUMA reserves the right to object to the admissibility of data regarding the particulars of the procedures on interconnections of distributed energy resources which is the subject matter of Case No. NEPR-MI-2019-0016 (Informes de Progreso de Interconexión). LUMA does not agree with the PREB's determination in the November 4th Resolution and Order that the information on interconnection processes is subject to discovery in this proceeding. LUMA reserves the right to request remedies before the Energy Bureau or contest the PREB's determination on judicial review. As the record shows, LUMA's Revised Performance Metrics Targets filing of September 24, 2021, does not include a metric on interconnections procedures. As such, none of LUMA's witnesses' pre-filed direct testimonies encompass matters related to interconnections. At this juncture, LUMA has not been served with any petition or order stating that

interconnections may be considered as a performance category in this proceeding. Thus, the requested information on interconnections procedures is irrelevant and ultimately inadmissible in this proceeding where the PREB is called upon to consider LUMA's Revised Performance Metrics Targets filing.

Because at this juncture the PREB has not informed LUMA whether it plans to consider a performance metric to measure LUMA's performance in reducing the backlog, nor has the PREB filed for the record the hallmarks or calculation of such a metric, the information provided herein is not relevant to this procedure and cannot be used to set performance metrics targets involving LUMA's performance in reducing the backlog of interconnections requests.

Without waiving the foregoing reservation of rights, please see Section 3 of LUMA's "Action Plan to Improve the Net Metering Process" for a detailed description of these activities available in NEPR-MI-2019-0016.[1]

[1] https://energia.pr.gov/wp-content/uploads/sites/7/2021/09/Motion-in-Compliance-with-Order-DG-Interconnections-NEPR-MI-2019-0016.pdf

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-002

REQUEST:

Refer to this statement in LUMA's August 13th filing: "LUMA has also accelerated the studies stage of the interconnection procedure by eliminating sequential revisions in cases that do not require additional technical review." Please provide a detailed description of the "technical review" referred to here.

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, the technical review is made up of two primary activities: (1) a "Study" and if necessary, (2) "Supplemental Study." The Study Activity verifies that the Distributed Generation ("DG") complies with eligibility criteria set forth in Regulation 8915 (for Distribution level DGs) Section IV, Article D. The criteria include requirements about DG configuration (size), service transformer capacity and a verification of the aggregate amount of DGs interconnected to the feeder. The Study Activity also gathers the necessary information to digitalize the DG in the GIS database. If the evaluation fails any of these criteria, it will require a Supplementary Study.

If necessary, the Supplemental Study examines in detail the potential impacts of the DG on the system and identifies any necessary network improvements. As described in Article B of Regulation 8915, "[d]epending on the characteristics of the DG and the feeder to which it will be interconnected, the evaluation may include one or more of the following analyses:

a) Power flow - This study seeks to identify if the proposed DG interconnection affects the voltage regulation in the feeder, causes an overvoltage, or that some electrical equipment, such as a conductor, fuse or transformer, among others, exceeds its capacity. It will establish the necessary changes to correct the problems that are identified.
b) Short Circuit - This study determines whether the protective equipment, or the coordination of the protection thereof, is adversely affected by the short circuit

current contribution from the GD. In addition, it identifies possible solutions to the problems encountered.

c) Stability - This study determines whether the design or capacity of the proposed GD can cause stability problems in the feeder. Through this study, the dynamic behavior of the GD is evaluated and how it adversely affects the operation of the Authority's electrical distribution system. In addition, it identifies possible solutions to the problems encountered."

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-003

REQUEST:

Refer to this statement in LUMA's August 13th filing: "LUMA plans to methodically reduce the number of cases in sequential order, in order to be reasonable with those clients who have had [sic] waited the longest since they submitted their requests to PREPA." Please provide a detailed description of the plan referenced in this sentence.

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, please see Section 3.3 of LUMA's "Action Plan to Improve the Net Metering Process" for a detailed description of LUMA's process for "Accelerating NEM Service Activation."[2]

This Accelerated NEM Service Activation process is conducted for each application in sequential order of application filing (i.e. "first-in-first-out"). In other words, as new applications are filed, they are processed by LUMA in order of submittal. Once incoming applications are validated, they are added to a queue list used by the Billing team to track pending cases for NEM service activation on the customer's bill. The Billing team uses this queue spreadsheet daily, working down the list in order of application filing date. The cases that have been waiting the longest are at the top of this list and are processed first.

[2] https://energia.pr.gov/wp-content/uploads/sites/7/2021/09/Motion-in-Compliance-with-Order-DG-Interconnections-NEPR-MI-2019-0016.pdf

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-004

REQUEST:

According to LUMA's August 13th filings in PREB Docket NEPR-MI-2019-0016, as of May 1, 2021, PREPA had 7,208 pending requests for interconnection of distributed generation systems to the grid. As of July 31, 2021, LUMA had 6,978 pending requests.

a. Please specify the number of pending requests, as of May 1st, and as of July 31st, from each customer class (e.g. residential, commercial, industrial, etc.)

b. Please provide the number of requests that are over:

   i. 30 days old

   ii. 180 days old

   iii. 1 year old

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, the tables below present the number of pending requests by customer class for each date. Table 1 shows the breakdown of pending cases by customer class as of May 1.

Table 1. Pending Requests by Customer Class as of May 1

Customer Class	30 Days	180 Days	365 Days	TOTAL
Residential	921	4,324	1,357	**6,612**
Commercial	20	137	367	**527**
Industrial	2	44	23	**69**
TOTAL	**943**	**4,505**	**1,747**	**7,208**

Between May 1 and July 31, there were an additional 3,300 new applications. Roughly 3,500 applications were completed through the new Accelerated NEM Service

Activation process which LUMA implemented in mid-July. Table 2 below presents the breakdown of remaining pending cases by customer class as of July 31.

Table 2. Pending Requests by Customer Class as of July 31

Customer Class	30 Days	180 Days	365 Days	TOTAL
Residential	1,141	3,548	1,667	**6,356**
Commercial	17	129	396	**542**
Industrial	0	55	25	**80**
TOTAL	**1,158**	**3,732**	**2,088**	**6,978**

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-005

REQUEST:

Please list each day since June 1, 2021 where the Net Metering Portal has been non-functional for any part of the day.

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, aside from a period of less than 5 days in early June where the DG Portal was non-functional, the Portal has been functioning every day since then. LUMA has made several minor changes to the portal since June but made sure these changes would not cause service interruptions.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-006

REQUEST:

Please provide a detailed description of LUMA's plan to improve the performance of the Net Metering Portal.

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights,, please refer to Section 3.3, entitled “Web Portal Improvements,” in LUMA’s *Action Plan to Improve the Net Metering Process*.[3]

[3] https://energia.pr.gov/wp-content/uploads/sites/7/2021/09/Motion-in-Compliance-with-Order-DG-Interconnections-NEPR-MI-2019-0016.pdf

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-007

REQUEST:

For customers that submitted a Net Metering Request since June 1st: provide the number of customers who had Net Metering on their bill within thirty days of submission.

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, for customers who submitted a Net Metering request since June 1st, approximately 1,200 had Net Metering on their bill within thirty days of submission.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-008

REQUEST:

Please provide the number of net metering-capable meters available to LUMA to be dedicated to new Net Metering customers. Does LUMA anticipate any delay in processing applications, due to a meter shortage?

RESPONDER:

Don Cortez

RESPONSE:

Please see the reservation of rights included in the first two paragraphs of RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-001. Without waving said reservation rights, we do not currently anticipate delays in processing applications due to meter shortages. We have been monitoring the meter inventory because there is some risk, due to the situation that LUMA inherited.

As discussed in the September 13th Hearing on the *Action Plan to Improve the Net Metering Process*, LUMA submitted a purchase order for roughly 40,000 meters shortly after commencement, and after some contract and manufacturing delays, we received a shipment of over 6,000 meters. Our vendor is working to ship an additional 20,000 meters by the end of December.

As these shipments come in, we set aside bi-directional meters for the NEM program based on our current forecast. We forecast that roughly 1,000 meters will be needed each month to handle the backlog. Then at steady state, once the backlog is complete, we only expect to need roughly 350 new meters per month. We anticipate the need to set aside roughly 4,000 meters for the rest of this year for the NEM program, which is less than the 20,000 we expect to receive.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-016

REQUEST:

Please refer to p. 7 of the Emergency Response Plan. What is the status of LUMA's scenario specific plans? Produce copies of the scenario specific plans or any drafts of these plans.

RESPONDER:

Abner Gómez

RESPONSE:

Section IV. B. of the Emergency Response Plan (ERP). titled "Risk Analysis of Community Lifelines" starting on page 26 analyzes the impacts of various scenarios on community lifelines. Annexes A, B and C of the ERP describe scenario-specific plans for implementation of the ERP. Annex A: Major Outage Restoration Annex covers how the utility should implement restoration of service after a major incident affecting all or a significant portion of the electric service area. This annex applies to multiple scenarios, including a tropical storm or hurricane event. Annex B: Fire Restoration applies to a scenario involving a fire event that affects electric service facilities and infrastructure. Annex C: Earthquake Response applies to a scenario involving an earthquake or earthquake-related hazard that affects electric service facilities and infrastructure.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-017

REQUEST:

P. 7: Specify what parts of the ERP adopted guidance from the National Response Framework and/or the Comprehensive Preparedness Guide.

RESPONDER:

Abner Gómez

RESPONSE:

The Comprehensive Preparedness Guide (CPG) is based on the National Response Framework (CPG 101, Version 3.0, September 2021). Therefore, all components described below follow the National Response Framework.

The components specific to the format according to the CPG can be found in the following sections of LUMA's ERP:

1. Letter of Promulgation (Page 5)
2. Approval and Implementation (Page 9)
3. Record of Changes (Page11)
4. Record of Distribution (Page13)
5. Contents (Page15)
6. Purpose (Page19)
7. Scope (Page 19)
8. Situation and Assumptions (Page 20)
9. Concept of Operation (Page 34)
10. Organization and Assignment of Responsibilities (Page 44)
11. Direction, Control, and Coordination (Page 71)
12. Information Collection, Analysis, and Dissemination (Page 72)
13. Communication (Page 74)
14. Administration and Finance (Page 77)
15. Plan Development and Maintenance (Page 86)
16. Authorities and References (Page 88)

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-018

REQUEST:

Explain why the ERP does not discuss the Local Emergency Planning Committees.

RESPONDER:

Abner Gómez

RESPONSE:

Local Emergency Planning Committees ("LEPC") are specific to hazardous materials and are incorporated at the state level through PREMB. LUMA is open to engagement with the LEPC. The ERP does discuss regional emergency planning teams. LUMA's emergency response planning includes our regional managers and considers the risks and vulnerabilities of their geographic areas, as well as the need to maintain good communications at the local level.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-019

REQUEST:

P.8: Specify what risk assessments LUMA has performed. Produce copies of the risk assessments prepared by or at the behest of LUMA.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-019, Attachment 1.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-020

REQUEST:

P.8: Indicate what prevention or risk mitigation strategies LUMA has developed and/or adopted. Produce documentation on LUMA's prevention or risk mitigation strategies.

RESPONDER:

Terry Tonsi

RESPONSE:

LUMA has developed numerous best-in-class strategies to assist with prevention and risks to Transmission & Distribution ("T&D") system during a weather event or natural disaster. A number of these plans and strategies are included in the System Remediation Plan ("SRP").[4] Listed are a few key principles LUMA will follow:

- Regularly system inspections
- Preventative maintenance of vegetation
- Pole plant management program (test and treat, end of life replacement)
- Transformer and oil-filled equipment maintenance program
- Underground cable replacement and reunification program
- T&D Asset Management strategy
- Storm Hardening Plans
- Grid Hardening design/construction standard
- Grid Automation

As mentioned above, these are a selection of risk mitigation strategies that will enable LUMA to be more prepared for a major weather event or disaster.

[4] NEPR-MI-2020-0019 - LUMA System Remediation Plan

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-021

REQUEST:

P.19: List and describe the key elements of LUMA's Incident Command System.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to page 71 of the ERP. The ERP aligns with the principles of National Incident Management System ("NIMS") and employs the Incident Command System ("ICS") organizational structure, including the role of the Incident Command. This ICS construct is scalable and provides the flexibility to activate only those pieces of the organization required to successfully respond to the incident.

Within the Emergency Response Organization ("ERO"), there is an established chain of command that identifies a line of supervisory authority and formal reporting relationships within the structure of the organization.

This chain of command will be used to communicate direction and maintain a reasonable span of control within LUMA's response to an emergency. Additionally, Command and General Staff are responsible for implementing the strategic response based on strategic objectives during an emergency to include, but not be limited to:

1. Plan the response to the emergency and oversee its implementation
2. Implement emergency procedures
3. Communicate strategic objectives
4. Provide support to the tactical teams

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-022

REQUEST:

P.19: What emergency preparedness planning has LUMA performed?

RESPONDER:

Abner Gómez

RESPONSE:

LUMA's Crisis Management office has performed the following emergency preparedness planning:

1. Developed an improvement plan due to the After-Action Review ("AAR") of the storms that threatened Puerto Rico in the 2021 hurricane season; 149 tasks assigned
2. All personnel assigned roles in the LUMA Emergency Operations Center ("LEOC") and other training throughout the LUMA organization
3. Conducted Workshop Sections
4. Conducted Tabletop Exercises

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-023

REQUEST:

P.20: Specify what aspects of the National Incident Management System LUMA has adopted.

RESPONDER:

Abner Gómez

RESPONSE:

LUMA has adopted the following components of the NIMS:

1. Preparedness
2. Communications and Information Management
3. Resource Management
4. Command and Management
5. Ongoing Management and Maintenance

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-024

REQUEST:

P.21: Specify whether LUMA has conducted Damage Prediction Modeling. Produce all relevant documents.

RESPONDER:

Abner Gómez

RESPONSE:

LUMA is currently in the procurement process for Damage Prediction Modeling software.

Please refer to Section III: *Situation and Assumption* of the ERP for information on Damage Prediction Modeling.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-025

REQUEST:

P.21: What Field Labor Resource Predictions and Material Requirement Predictions has LUMA prepared?

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to ERP Attachment 4 - Major Interruption Metric (Page 63, Annex A: Major Interruption Restoration).

> "LUMA will stage materials, equipment, and personnel at the required location prior to the weather event striking the area. Within 24 hours of the damage prediction, 50% of indicated internal crews and qualified contract crews will be deployed. Within 48 hours of the damage prediction, 80% of the indicated internal crews and qualified contract crews will be mobilized on island".
>
> "Three (3) days prior to a forecasted event occurring (when the event allows that much warning time), LUMA will complete a damage prediction to determine the requirements for on and off island mutual aid/pre-negotiated contracts with other utility service providers. LUMA will activate the required resources and place them on standby until the damage assessment is completed. After the initial damage assessment is completed, the requests for mutual assistance or other utility service provider crews will be made as follows: • Within 70 hours, 40% of crews • After 120 hours, 80% of committed mutual aid and other utility service provider crews will be requested".

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-026

REQUEST:

P.21: Specify what training programs and exercises LUMA has conducted.

RESPONDER:

Abner Gómez

RESPONSE:

A. Training Programs:

   1. FEMA IS-100 Introduction to the Incident Command System
   2. FEMA IS-200 For Single Resources and Initial Action Incidents
   3. FEMA IS-300 Intermediate ICS for Expanding Incidents
   4. FEMA IS-400 Advanced ICS
   5. FEMA IS-700 National Incident Management System (NIMS)
   6. FEMA IS-800 National Response Framework (NRF)
   7. IS-2200: Basic Emergency Operations Center Functions

B. Training Exercises:

   1. LUMA Tabletop Exercises
   2. LUMA ERP Workshop Session

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-027

REQUEST:

P. 21: Explain the elements of an After-Action Report.

RESPONDER:

Abner Gómez

RESPONSE:

The elements of an After-Action Report include:

1. Incident Summary: What happened, when it happened, how it happened
2. Analysis: What was observed? What aspects of an event were expected vs. unexpected? Who was involved in the incident? What aspects of a response were successful? What are the areas of opportunity for improvement?
3. Recommendations: Detailed ways to improve performance for future incidents
4. Improvement Plan: Includes corrective actions for future incidents, additional training, and equipment needs; people responsible for completing these steps and expiration dates are listed
5. Conclusion: Summary of all sections of the report

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-028

REQUEST:

P. 22: Provide copies of the Mutual Aid Assistance Agreements that LUMA has entered into or is currently negotiating.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to TC-RFI-LUMA-MI-19-0006-210903-PREB-004 and TC-RFI-LUMA-MI-19-0006-210903-PREB-012 provided in NEPR-MI-2019-0006 and RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-028 Attachments 1 through 14.[5]

[5] Motion-Submitting-Responses-to-Attachment-A-ERP-SEPTEMBER-17-2021-NEPR-MI-2019-0006-1.pdf

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-029

REQUEST:

P.22: Explain the meaning of the following sentence: “In organizational, geographical and jurisdictional terms events are attended to at the lowest possible level.”

RESPONDER:

Abner Gómez

RESPONSE:

This sentence refers to the National Response Framework (“NRF”), where it is promulgated, that emergencies are handled from the lowest to the highest level, from the municipal, state, and federal levels. LUMA follows this enactment from the regional point of view to the highest level organizationally.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-030

REQUEST:

P.27: Explain the specific actions and resources required in mountainous terrain to provide workers access to lines and other infrastructure.

RESPONDER:

Terry Tonsi

RESPONSE:

LUMA added numerous pieces of specialized fleet that include 125-foot reach bucket trucks, remote access track machines with buckets and pole hole digging/setting capabilities. To add to LUMA's ground access abilities, we also have use of arial fleet consisting of four helicopters. LUMA uses these helicopters to patrol infrastructure, and to transport men, equipment, and materials to remote locations to make repairs or preform maintenance.

All LUMA Pilots are trained certified and competent in Human External Cargo (HEC) 1, 2 and 3 levels. LUMA has also training and certified more than 45 Lineman in HEC 1 & 2 levels so these teams can safety execute the work with LUMA's helicopters.

LUMA's newly created vegetation management team also specializes in site access for vegetation removal, building temporary access roads and site staging areas to access LUMA's lines and infrastructure. Concurrent with the acquisition of this specialized equipment, all the operators for this specialized equipment have received training and orientation on the units.

LUMA has multiple third-party contactors that can supply operators and equipment to aid in site access in the event additional assistance is needed.

During certain emergencies, LUMA can also request the assistance of the National Guard to aid in response and restoration.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-031

REQUEST:

P.39: Define “small outage.” Please quantify this outage, in terms of customers affected and the duration of the outage.

RESPONDER:

Terry Tonsi

RESPONSE:

“Small outages” are part of normal day to day operations where LUMA responds within their available resources and without aid or opening the LEOC. Please refer to Annex A: Major Interruption Restoration (Page 39). The characteristics of a Type 5 Event are:

1. System activity is normal
2. Incidents are contained within the first operational period and last for less than 12 hours after resources arrive on scene
3. Typically, <1 % (14,000) customer interruptions at peak
4. Typically, <2,500 Outage Events at peak
5. Normal daily internal crew assignments

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-032

REQUEST:

P. 39 Define “severe event.” Please quantify this outage, in terms of customers affected and the duration of the outage.

RESPONDER:

Terry Tonsi

RESPONSE:

A severe event is a qualitative descriptor. The important consideration is that a severe event is generally a Type 2 event and would typically be handled by a full implementation of ICS.

Please refer to Annex A: Major Interruption Restoration (Page 36). The characteristics of a Type 2 event are:

1. The damage severity within a specific region or spread across the system is such that restoration activities are generally accomplished within a 7-day period once it is safe to begin restoration activities
2. Typically, 25% to 50% (350,000 to 700,000) customer interruptions at peak
3. Typically, >25,000 Outage Events at Peak
4. This type of event is anticipated to occur between 2 and 4 times in a five-year period

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-033

REQUEST:

P. 42: Explain how outages are prioritized. How does the priority matrix system work?

RESPONDER:

Terri Tonsi

RESPONSE:

Outages are prioritized by LUMA Operations using the Restoration Priority Matrix Guidelines (Page 40, Annex A: Major Interruption Restoration). The priority matrix system uses a variety of factors, including, but not limited to, community lifelines, customer type, number of affected customers, and outages involving safety conditions in order to aid in prioritization. The matrix has specific considerations for key factors including downed wires, road closure priorities, critical facilities, emergency event conditions, and make safe protocols. The matrix is a tool to aid in determining priorities.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-034

REQUEST:

P. 49: Explain the reference to “limits on information releases”.

RESPONDER:

Abner Gómez

RESPONSE:

The Incident Commander (“IC”) determines the limits of the information that the Public Information Officer (“PIO”) can provide during the response to an incident and the activation of the LEOC.
Public information should be concentrated for citizen and community preparedness and recovery, while maintaining operational continuity of the government and private sector in order to facilitate efficient emergency response activities.
The incident commander must also ensure that confidential information is not provided to the public that could compromise critical infrastructure while ensuring that customers and public officials are properly informed during an emergency.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-035

REQUEST:

P. 71: Explain the following statement: “To some extent electric utility mutual aid will be limited to those partners who are present in Puerto Rico.”

RESPONDER:

Terry Tonsi

RESPONSE:

"To some extent" is the dividing line between LUMA's ability to respond to an emergency utilizing resources located in Puerto Rico and the need to request assistance from resources located outside of Puerto Rico for emergencies that exceed LUMA's capabilities and the additional resources available in Puerto Rico.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-036

REQUEST:

Provide copies of all mutual aid documents, including but not limited to agreements, memoranda of understanding, correspondence, and other relevant documentation.

RESPONDER:

Terry Tonsi

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-028, Attachments 1-14, and RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-36, Attachment 1.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-037

REQUEST:

P. 72: Provide a detailed explanation of how LUMA will "minimize the need for specialized training or work practices". Please provide a detailed description of the "specialized training."

RESPONDER:

Abner Gómez

RESPONSE:

As stated on page 72 of the ERP:

> "Whenever possible, emergency response procedures will parallel normal operational procedures to ***minimize the need for specialized training or work practices*** wherever possible. This ERP provides the framework for the systematic response of resources when emergencies arise".

LUMA conducts standardized training throughout the organization. At a minimum, LUMA will train employees on ICS 100 and 200 which aids workflow of personnel on control and coordination methodologies, following chain of command expectations. This training occurs under normal operations, therefore, LUMA is "minimi[zing] the need for specialized training or work practices" by setting guidelines to keep all personnel familiar with emergency procedures and training.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-038

REQUEST:

P.81: Explain the terms, limits, and conditions of the proposed noncompetitive emergency procurement. Specify any amount and time limits for noncompetitive procurement.

RESPONDER:

Abner Gómez

RESPONSE:

The terms, limits and conditions of emergency procurement are available in the LUMA's Procurement Manual filed in Case No. NEPR-MI-2021-0004, Section 2.2.4.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-039

REQUEST:

P. 111: How did LUMA calculate the number of customers at 2,956,102?

RESPONDER:

Abner Gómez

RESPONSE:

LUMA notes that the figure detailed in the Restoration Stage Report Type 1 on page 111 of the ERP that includes the total number of LUMA Customers (2,957,102) is an inadvertent calculation error in the table. The table on page 111 double counts the total number of customers in each region in the total number of customers.
The correct figure for total number of customers for FY2020 is 1,468,391 as detailed on page 21 of the ERP.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-040

REQUEST:

P.13: Provide the Employee Staffing Roster with a full list of all relevant positions.

RESPONDER:

Abner Gomez

RESPONSE:

Please refer to page 14 of Annex A of the ERP.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-041

REQUEST:

P. 27: Explain how LUMA determined the levels of critical facilities.

RESPONDER:

Abner Gómez

RESPONSE:

The levels of critical facilities are determined and based on the concept of community lifelines Energy (Power & Fuel); Food, Water, Shelter; Transportation; Communications; Health and Medical. Please, Section IV. A. Community Lifelines of the ERP, starting on page 22.

For further details, please refer to Base Plan, Critical Infrastructure and Facilities Restoration Prioritization, Pages 42 through 44 of the ERP.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-042

REQUEST:

P. 35: Provide the documentation that forms the basis for the statement that a Type 1, catastrophic event, historically results in significant damage to the electrical transmission and distribution system, typically involves >50% (700,000) customer interruptions, >50,000 outage events and is anticipated to occur between one and four times in ten years.

RESPONDER:

Abner Gómez

RESPONSE:

Event Categorization is an industry best practice that all private utility organizations use to establish criteria that is meant to serve as a guideline in the response to various emergency event types. Additional details on LUMA's Event Classification by Type can be found in Annex A, Section B.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-043

REQUEST:

P. 36: Provide the documentation that provides the basis for the statement that a Type 2, severe event, historically results in significant damage to the electrical transmission and distribution system in a region or moderate damage across the entire territory, typically 25-50% (350,000-700,000) customer interruptions, >25,000 outage events and is anticipated to occur between two and four times in five years.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-042.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-044

REQUEST:

P. 37: Provide the documentation that provides the basis for the statement that a Type 3 event (tropical depression/storm), historically results in significant damage to the electrical transmission and distribution system in districts or moderate damage to regions, typically involves 10-25% (70,000-350,000) customer interruptions, >25,000 outage events and is anticipated to occur between one and five times per year.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-042.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-045

REQUEST:

P. 37: Explain the meaning of decentralized dispatching in this context.

RESPONDER:

Terri Tonsi

RESPONSE:

In response to the need to scale up based on the severity and impact to areas across Puerto Rico, LUMA may open more than one Operating Center for dispatch of restoration crews. Within field operations LUMA may open a combination of Regional Operating Centers as stated in Annex A. Also, during certain emergency response situations, functions could be decentralized using Regional Operating Centers. A scenario that could force the decision to decentralize the office could be caused by a large event that severely disrupts communication from a central location.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-046

REQUEST:

Specify how the outside assistance from contractors and mutual assistance would work.

RESPONDER:

Terry Tonsi

RESPONSE:

LUMA will monitor the event closely as it approaches and will escalate or decrease resourcing needs as more information becomes available. When an event is forecasted and tracked to strike LUMA's infrastructure with a reasonable notice (3 days prior to the weather event arriving), LUMA will complete a predictive damage assessment. From the forecasted damage to the T&D System, LUMA will compare the resourcing needs against our internal resources.

If LUMA expects to surpass its own resources, we will begin to contact our contingent of local contractors and put them on standby or stage deployment. If the forecasted event is expected to be larger than LUMA and local, Puerto Rico resources can respond to, LUMA will begin to notify off island contingent contractors to be on standby. At this same time, LUMA will begin the process to activate Mutual Aid "standby" as well.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-047

REQUEST:

P. 37: Provide the documentation that provides the basis for the statement that a Type 4 event which includes thunderstorms, high winds, frequent and/or severe lightning, small to moderate winter storms or unanticipated events, historically results in significant damage to the electrical transmission and distribution system in districts or moderate damage to regions, typically 1-5% (14,000-70,000) customer interruptions, > outage events and is anticipated to occur between five and ten times per year.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-042.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-048

REQUEST:

P. 39: Provide the documentation that explains the basis for the statement that a Type 5 event constitutes normal operations, typically involves <1% (14,000) customer interruptions and <2500 outage events.

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to the response to RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-042.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-049

REQUEST:

P. 41: Explain the frequency, duration and causes of downed wires, including but not limited to incidents of burning, arcing, and sparking.

RESPONDER:

Terry Tonsi

RESPONSE:

Every event or situation will have different impacts to the T&D system that will cause the frequency of downed wires. The lower the event classification level, the higher volume of expected downed wires will occur. For example, a type 5 event classification will have less wire downs due to storm intensity and duration, and winds speed and we estimate to have approximately 20 wire down situations daily, while a type 1 event classification may see 300-500 wire down situation daily.

There are multiple causes to these situations from lack of maintenance, poor construction/design standards, location and age of the infrastructure. As mentioned, the T&D system is very fragile and the vegetation maintenance was almost nonexistent. As LUMA rebuilds the infrastructure with higher storm hardening standards, the system will perform better which will result in less down wires. The duration of these event will vary depending on the amount of damage to the T&D infrastructure, volume of downed wires, location/access of downed wires and resource availability.

The safety of the public is one of LUMA's top priorities and we will prioritize our response to these events as soon as possible to eliminate the hazards that may threaten public safety.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-050

REQUEST:

Explain the methodology LUMA used to determine critical facilities and produce the relevant documentation. State LUMA's definition of critical facilities. Explain whether water treatment plants include water purification/filtration plants.

RESPONDER:

Abner Gómez

RESPONSE:

Water plants include PRASA's water purification and filtration plants. These are listed based on information provided by PRASA and PREPA.

For more details, please refer to Base Plan, Critical Infrastructure and Facilities Restoration Prioritization, Pages 42 through 44 of the ERP.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-051

REQUEST:

P. 44: Specify what Level 2 critical facilities "support other critical government functions besides prisons.

RESPONDER:

Abner Gómez

RESPONSE:

1. Facilities of the Department of Health of Puerto Rico
2. Communications from public safety agencies such as the Department of Public Safety Bureau

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-052

REQUEST:

P. 44: Define “other large customers” in Level 3.

RESPONDER:

Abner Gómez

RESPONSE:

An example of “other large customers” is manufacturing industries that employ large numbers of employees and industries, for example, in the pharmaceutical sector.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-053

REQUEST:

P. 45: Define Minimum Restoration Time, Larger Area Outages, and Smaller Area Outages.

RESPONDER:

Terry Tonsi

RESPONSE:

After the preliminary damage assessment, LUMA will establish a Minimum Restoration Time, according to the crew, equipment, and materials available.

- Minimum Restoration Time: to complete restoration efforts as quickly as possible following a severe storm; applicable for any size of outage

- Larger Area Outages: prioritized first when considering restoration efforts; see request and response provided in RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-032

- Smaller Area Outages: prioritized second when considering restoration efforts; see request and response provided in RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-031

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-054

REQUEST:

P. 46: Explain the following allegation: “Estimated Time of Outages will establish the baseline of projections”.

RESPONDER:

Terry Tonsi

RESPONSE:

This allegation provides a starting point for establishing reset metrics on different outages depending on their complexity.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-055

REQUEST:

P.63: Explain the methodology and produce the documentation for the calculation of downed wires restoration times.

RESPONDER:

Terry Tonsi

RESPONSE:

P3A provided the NYPSC Performance Metrics Score Card as a basis for the development of the Major Outage Events metrics. NYPSC Order (Case 13-E-0140) related to a Score Card for New York State utilities. LUMA then utilized the NYPSC Score Card to compare their standard to the aged and frail infrastructure present in the Puerto Rico T&D System. Regarding the calculation, LUMA added a stretch target to ensure we see continual improvement, so these safety issues are prioritized to the highest level and public safety is quickly addressed.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-056

REQUEST:

How did LUMA determine area restoration prioritization?

RESPONDER:

Abner Gómez

RESPONSE:

Please refer to Figure 4: Community Lifelines 1-7, defined on page 24 of the ERP. The restoration prioritization areas are determined based on the Communities Lifeline and the levels of the Critical Facilities.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-057

REQUEST:

Are all critical facilities included?

RESPONDER:

Abner Gómez

RESPONSE:

LUMA has made a great effort to collect all the information about the critical facilities. It should be noted that the ERP is a living document. Over time, the Crisis Management Office and the Operations Area will constantly receive new information to update the list of critical facilities.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-058

REQUEST:

List the different types of fire hazards and LUMA's plan to respond to each.

RESPONDER:

Abner Gómez

RESPONSE:

Fire hazards that LUMA plans to respond to include but are not limited to; electrical or structural fires caused by storm damage, earthquake damage and other disasters. Fire hazards can also be caused by out of date or poorly maintained infrastructure. For more information on LUMA's plan to respond to fire events please refer to Annex B of the ERP.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-059

REQUEST:

P. 10 Explain how the major, medium, and minor geographical faults potentially impact and relate to the T&D infrastructure.

RESPONDER:

Abner Gómez

RESPONSE:

The island of Puerto Rico is surrounded by geographical faults that could cause earthquakes, such as the one that occurred in January 2020 to the south of the Island and in October 1918 to the northwest of the Island. These failures could seriously damage the T&D and Generation infrastructure, as happened with the Costa Azul Power Plant in January 2020.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-060

REQUEST:

P. 26 What are the potential impacts of tsunamis to T&D infrastructure?

RESPONDER:

Abner Gómez

RESPONSE:

Tsunami events can impact T&D infrastructure by causing floods and erosion as well as structural damage as a result of strong seawater currents. These strong currents can cause severe damage to transmission towers, substations, and local distribution infrastructure in areas that are impacted by such an event.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 2: LECO Requests 2

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R2-13SEPT21-061

REQUEST:

What are the potential impacts of flooding/sea level rise/fires in subtropical dry areas/climate change to T&D infrastructure?

RESPONDER:

Abner Gómez

RESPONSE:

Floods caused by rains, storm surge and tsunamis can cause significant erosion and damage to areas where the transmission towers and distribution poles are located.

Southern Puerto Rico is a dry area that is at risk of forest fires that increase in frequency in the first months of each year due to the low rainfall.

Performance Metrics
Docket ID: NEPR-AP-2020-0025

Information Response Round 4: LECO Request 4

REFERENCE: RFI-LUMA-AP-2020-0025-LECO-R4-07OCT21-020

REQUEST:

Please provide the raw outage data from January 1, 2021 through August 31, 2021. Data from the system after LUMA's June 1st takeover is relevant because PREB's orders in Docket # NEPR-MI-2019-0007 have made it clear that baselines and benchmarks must be informed by ongoing collection of data on LUMA's performance.

RESPONDER:

Don Cortez

RESPONSE:

Please refer to the attached– RFI-LUMA-AP-2020-0025-LECO04-07OCT21-020_Attachment 1.

CERTIFICATION

It is hereby certified that the supplemental answers provided to this Second and Fourth Discovery Request, by each responder are true to the best of his/her knowledge, information and belief.

Don Cortez

Don Cortez

Abner Gomez

Terry Tonsi

RESPECTFULLY SUBMITTED.

We hereby certify that, as required by the Energy Bureau in the April 8th Resolution and Order, Attachment A, and by Section 8.01(K) of Energy Bureau Regulation 8543, we will send an electronic copy of this response and exhibits to same to the attorneys for PREPA, Joannely Marrero-Cruz, jmarrero@diazvaz.law; and Katiuska Bolaños-Lugo, kbolanos@diazvaz.law, the Office of the Independent Consumer Protection Office, Hannia Rivera Diaz, hrivera@jrsp.pr.gov, and counsel for the Puerto Rico Institute for Competitiveness and Sustainable Economy ("ICSE"), Fernando Agrait, agraitfe@agraitlawpr.com, counsel for the Colegio de Ingenieros y a de Puerto Rico ("CIAPR"), Rhonda Castillo, rhoncat@netscape.net, and counsels for Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc., Enlace Latino de Acción Climatica, Alianza Comunitaria Ambientalista del Sureste, Inc., Coalicion de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, Sierra Club and its Puerto Rico Chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (jointly, Puerto Rico Local and Environmental Organizations), larroyo@earthjustice.org, rstgo2@gmail.com, notificaciones@bufete-emmanuelli.com, pedrosaade5@gmail.com., jessica@bufete-emmanuelli.com; rolando@bufete-emmanuelli.com.

An electronic copy of this response and exhibits will also be sent to: viacaron@jrsp.pr.gov; secretaria@jrsp.pr.gov; and legal@jrsp.pr.gov.

In San Juan, Puerto Rico, this 10th day of November 2021.

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

IN RE: PERFORMANCE TARGETS FOR LUMA ENERGY SERVCO, LLC	**CASE NO.: NEPR-AP-2020-0025**

EXPERT TESTIMONY OF JOSÉ ALAMEDA-LOZADA ON BEHALF OF LOCAL ENVIRONMENTAL AND CIVIL ORGANIZATIONS

Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, and Sierra Club and its Puerto Rico chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "LECO").

NOVEMBER 16, 2021

Q: Please state your name, position, and business address:

A: My name is José Alameda-Lozada. I am a Professor in Economics, in the Economics Department at the University of Puerto Rico, Mayagüez Campus (UPRM, for its Spanish acronyms). My business address is Bechara #441, Villa Sultanita, Mayaguez, Puerto Rico, 00680, Puerto Rico.

Q: On whose behalf are you testifying in this proceeding?

A: I am testifying on behalf of the following organizations: Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., CAMBIO, and Sierra Club and its Puerto Rico chapter, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "LECO").

Q: Please summarize your qualifications and work experience.

A: I am currently a Professor of Economics at the Economics Department at the University of Puerto Rico, Mayaguez Campus. I have also been a consultant to the Planning Board and the Headquarters Commission of the 2004 Olympics and the organization that sponsors the celebration of the Central American and Caribbean Games in 2010, in the west zone of Puerto Rico. Since 1989, I have been an economic advisor to numerous institutions, government agencies and private companies.

I hold a bachelor's degree in Business Administration with a concentration in Economics (1973) from the University of Puerto Rico, Mayaguez Campus, and a master's degree in Economic Planning (1976) from the University of Puerto Rico, Graduate School of Planning, Rio Piedras Campus, where I received an award for the most outstanding student within the specialization of Economics. In 1982 I obtained a master's degree in Economics with a concentration in Monetary and International Economics from Rutgers University in the state of New Jersey. I also hold a PhD in Economics from the University of Wales in the United Kingdom, where I wrote my thesis on the analysis of transmission from the cycle of the U.S. economy to that of Puerto Rico.

I have served as a professor at the Interamerican University in Puerto Rico (1976-79), visiting professor at the Faculty of Puerto Rican studies in Rutgers University (1980-81), associate investigator in the Center of Commercial Investigations of the Faculty of Business Administration of the University of Puerto Rico, Rio Piedras Campus (1984-85). I also worked as an economics on the Special Commission for the Development of the Puerto Rico Senate (1985) and as an economic advisor to the President of the Planification Board of Puerto Rico (1985-87).

I have published an extensive number of articles in Puerto Rico, the United States, and the United Kingdom about, among other topics,

economic development, energy, human resources, the financial sector and section 936 funds, the economic impact of HIV in Puerto Rico, the economic impact of criminality, the economic viability of the 2004 Olympic Games, and the 2010 Central American and Caribbean Games (see CV for more comprehensive list). I was also one of the pioneers in America in studying HIV from an economic perspective, presenting my work on the International HIV Convention in Montreal, Canada in 1989. I have also presented my work in Chile, Costa Rica, Dominican Republic, England, United States, among other countries. Additionally, I was selected to appear in Who's Who of Marquis in Finances and Industries, edition number 27, 1992-93.

I have published six books (see CV for full list) and was coordinator and founder of the Economic Cycles Committee of the Puerto Rico Association of Economists, institution in which I was a founding member and later secretary (1989-90) and treasurer (1991-92). I was also appointed to the Auditing Committee of Puerto Rico's Public Debt in 2016 for Puerto Rico's Senate and House of Representatives.

At present, I am a researcher and consultant in cases of Forensic Economics[1], Consultant in Economics and Planning for the Commonwealth Planning Board of Puerto Rico, and a full time professor at UPR Mayaguez where I have taught: Macroeconomics

[1] See list of forensic cases included as Exhibit 2.

and Microeconomics, Managerial Economics, Comparative Economics Systems, Mathematics for Economists, Economic Development of Puerto Rico, International Trade and Finances, and Business Cycles.

Q: Please summarize your testimony and key findings.

A: I have been asked to evaluate the possibilities of different scenarios or models of rewards and penalties to be established by the Puerto Rico Energy Bureau (PREB) based on LUMA's performance. There are, at least, two schemes to pursue better standards of performances: (1) Reward-Penalty Scheme and (2) Outage compensation to consumers. I propose that PREB develop and adopt a Reward-Penalty Scheme in order to enforce LUMA to fulfill performance metrics that benefit the people of Puerto Rico, and consider adding an Outage Compensation mechanism as well. My analysis considers a model for compensation to consumers as well. The model is followed by five states of the United States. I conclude and recommend that PREB develop a Reward-Penalty Scheme and an Outage Compensation Mechanism the damages that this company may cause. This will allow the performance of LUMA to improve in ways that benefit consumers.

Q: What is a Reward-Penalty Scheme (RPS)?

A: The Reward-Penalty Scheme (RPS) is a financial strategy developed and performed by a regulator to encourage electric service companies to achieve certain benchmarks, and to penalize those companies for failing to meet performance baselines. Using a mathematical distribution, the

RPS, depicts a Dead Band Zone within,[2] and reward and penalty points for each utility.[3]

A scheme that applies both rewards **and** penalties is appropriate to energy utility transmission and distribution systems because both rewards and penalties will encourage a better performance of these mechanisms.

Performance standards specify the level of quality that the company is expected to supply. In this case, those standards should set forth the standards for the grid transformation that LUMA is expected to achieve.

The RPS should provide defined standards of performance and penalizes the utility when it underperforms. An important consequence of restructuring in the power industry is the emergence of service quality regulation in the distribution network – which allow for more precise metrics[4], rewards, and penalties to be applied to distribution system

[2] PREB describes this concept as follows: "Deadbands create a neutral zone around a Benchmark level in which the utility does not receive a reward or penalty. Deadbands can help to account for uncertainty regarding the optimal performance level, and allow for some performance variance based on factors outside of the utility's control." *In Re: the Performance of the Puerto Rico Electric Power Authority*, Resolution and Order, NEPR-MI-2019-0007, at 5 (May 21, 2021), https://energia.pr.gov/wp-content/uploads/sites/7/2021/05/Resolution-and-Order-NEPR-MI-2019-0007.pdf.

[3] Aleksandar Janjic *et al.*, *Designing an electricity distribution reward-penalty scheme based on spatial reliability statistics*, 70 Utils. Pol'y (June 2021), https://www.sciencedirect.com/science/article/abs/pii/S095717872100045X#:~:text=The%20RewardPenalty%20Scheme%20%28RPS%29%2C%20a%20financial%20strategy%20developed,based%20on%20the%20spatial%20distribution%20of%20reliability%20performances.

[4] Karin Alvehag and Kehinde Awodele, Impact of Reward and Penalty Scheme on the Incentives for Distribution System Reliability July 2014 Power Systems, IEEE (January 2014) https://ieeexplore.ieee.org/document/6594877.

operators.[5]

Q: How could the RPS be balanced between rewards and penalties?

A: In a 2015 handbook study,[6] M. Whited, T. Woolf and A. Napoleon described how regulators can guide energy power utilities by using performance incentive mechanisms. Regulators have used these mechanisms for many years to address traditional performance areas: reliability, safety, and energy efficiency. Nowadays, these mechanisms have received attention due to regulatory concerns over resilience, technological change, and the expanding opportunities for distributed energy resources. The RPS formulas can take numerous forms, including linear, quadratic, and step functions.

Whited, Woolf and Napoleon, proposed incentive, and penalty formulas, including linear, quadratic, and step functions. It is important that the formula and the mathematical equations are consistent with the desired outcomes and support appropriate utility performance. The authors depict a few examples. First, Figure 5[7] of the Handbook, postulated a linear function with ***deadband*** zones. The formula with a ***deadband*** of 0.5 standard deviations, measures how much performance varies from

[5] K. Alvehag and K. Awodele, *Impact of Reward and Penalty Scheme on the Incentives for Distribution System Reliability*, 29(1) IEEE Transactions on Power Sys. 386, (July 2014), https://ieeexplore.ieee.org/document/6594877.
[6] Melissa Whited, Tim Woolf & Alice Napoleon, *Utility Performance Incentive Mechanisms: A Handbook for Regulators*, (Mar. 9, 2015), https://www.synapse-energy.com/sites/default/files/Utility%20Performance%20Incentive%20Mechanisms%2014-098_0.pdf.
[7] *Id.* at 43.

the side of the target. After 0.5 standard deviations, penalties and rewards increase in a linear fashion up to a maximum of $5 million.

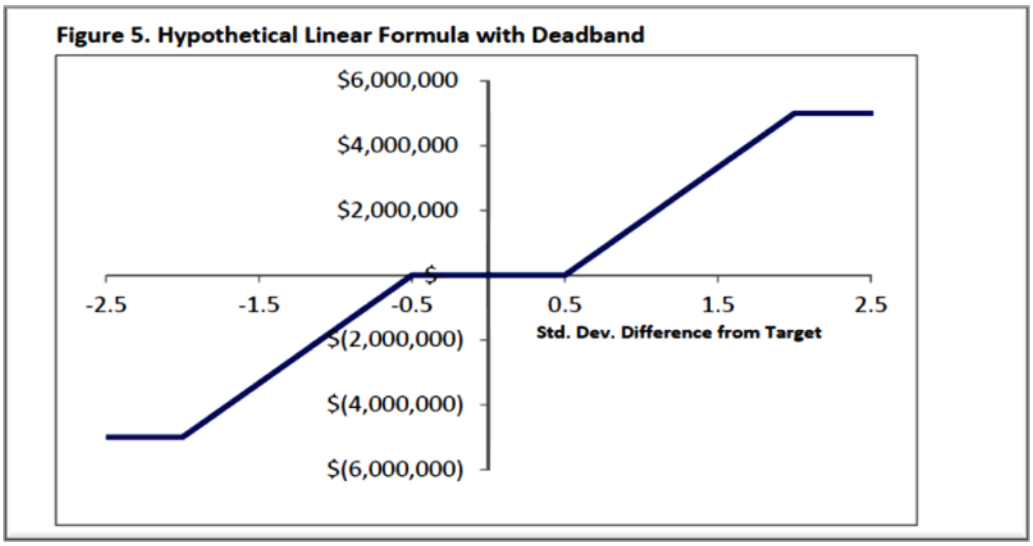
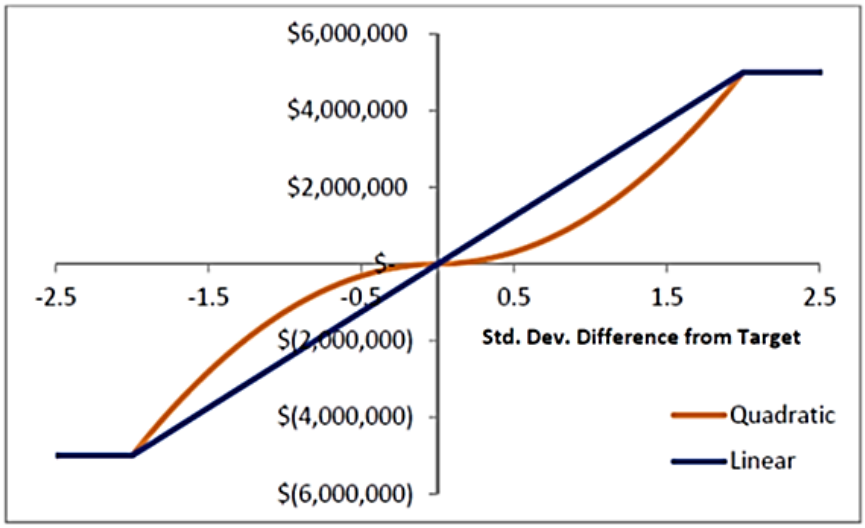


Figure 6[8] of the Handbook, depicts a quadratic function. Under such type of equation, rewards increasing as performance deviate from the target. Figure 6 presents a simple linear incentive function, as well as a quadratic incentive function with the same end points and central target. As indicated, a quadratic formula acts like a deadband by providing little incentive near the central target. A quadratic function also results in an increasing slope as the performance deviates from the performance target. As indicated, a quadratic formula acts like a deadband by providing little incentive near the central target.

[8] *Id.* at 44.

Figure 6. Quadratic Function Compared to a Linear Function



Q: Is an electric utility's performance relevant to the Social Wellbeing?

A: Yes. There are many definitions of Social Wellbeing, according to the social science field. However, in short, social wellbeing is the pursuit of happiness throughout a well-socially designed society, in which the economy must exist to serve society, not to be served by society. It must also benefit the whole society, instead of a few. As the World Economic Forum has asserted:

> Our era is confronted with many challenges, among them the imperative of reconciling the demands of three timescales – short, middle and long term, on which three types of interests are superimposed: ours, the interests of those close to us, and those of all sentient beings. In the short term, we must respond to the immediate demands of the present economy; in the middle term, the search for

happiness; and in the long term, the health of the environment and future generations.[9]

Q: Are energy utility performance metrics relevant for a society and Social Well-Being?

A: Yes. It is so far clear, that performance metrics would provide rewards when performances achieve any clear, dynamic, and hard-to-reach objectives but also impose penalties when utility failed to achieve at a given time, these objectives. RPS rewards the utility who is providing superior performance (in comparison to its peer utility group[10]), provides neither reward nor penalty for baseline performance, and penalizes the utility who is providing poor performance. Therefore, an RPS will encourage wellbeing to the society.

The employment of an RPS in transmission & distribution systems could provide incentives/penalties to improve operating efficiency and sustainability, empower consumers, and reduce relative electricity prices. However, if the RPS mechanisms were not properly designed, or failed to include adequate penalties, the enforcement of the RPS may have a negative effect on the system and then, to the wellbeing of the society.

[9] Matthieu Piccard, *5 Ways to Improve Health and Well-Being for All*, World Economic Forum (Sept. 17, 2015) https://www.weforum.org/agenda/2015/09/5-ways-to-improve-the-well-being-of-the-world/.

[10] PREB has identified Dominion Energy (South Carolina), Duke Energy Progress (North Carolina), Hawai'i Electric Light Company ("HELCO"), Hawaiian Electric Company ("HECO"), Los Angeles Department of Water and Power ("LADWP"), City of San Antonio ("CPS Energy"), San Diego Gas and Electric Company ("SDGE") as useful peer utilities to PREPA. PREB May 21, 2021 Order, *supra* note 2, at 8.

On the other hand, empirical studies clearly indicate that a strong RPS has led utility firms to invest in service quality:

> This paper focuses mainly on the experience of the Italian Regulatory Authority for electricity and gas in finding appropriate solutions for regulating continuity of supply in electricity distribution, during the years 2000 to 2008. We observe that the applied incentive mechanism has resulted in significant improvements of the continuity levels at an extremely low cost for consumers. The mechanism has also considerably evolved over time and 'learning along the way' has distinctively characterized the process.[11] (Emphasis added).

The authors explained that the Italian Regulatory Authority's experience demonstrated the need for an incentive scheme with rewards **and** penalties:

> […] the liberalization and privatization of utilities in the electricity sectors have created legitimate concerns on the effect that a generalized prevalence of the profit motivation could have on the quality of the services provided…. In other words, the introduction of specific incentives for quality

[11] Elena Fumagalli & Luca Lo Schiavo, *Regulating and Improving the Quality of Electricity Supply: the case of Italy*, 3(3) Eur. Rev. Energy Mkts. at 2 (Oct. 2009), https://www.eeinstitute.org/european-review-of-energy-market/EREM_9-_Article_E._Fumagalli_-amp_L._Lo_Schiavo.pdf.

> appears as a necessary measure to contrast the cost-reducing incentives implied in price-cap mechanisms and privatization.
>
> In theory, an optimal incentive scheme specifies (i) performance standards and (ii) rewards and penalties - for exceeding and failing to meet the standards - that reflect customer valuations of quality.[12]

Another relevant contribution in this field relies upon the paper written by De Fraja and A. Aiozzi:

> The authors demonstrate that a regulator, who is well informed about consumers' marginal valuations of quality, can modify regulatory mechanism to induce a regulated monopoly to set welfare-maximizing prices and quality levels.
>
> In the absence of sound theoretical guidance, regulators have typically taken an ad hoc approach towards quality. They have done so either by the imposing quality standards, enforced through legal sanctions, or by creating a link between the quality provided by the firm and its allowed revenues.[13]

[12] *Id* at p. 4.
[13] G. De Fraja & A. Aiozzi, *Bigger and Better: a Dynamic Regulatory Mechanism for Optimum Quality*, Cent. Econ. Pol'y Rsch. (Sept. 2004), https://ssrn.com/abstract=588245.

De Fraja and A. Aiozzi further explains author Weisman's findings as follows:

> The author finds that a regulated firm incentives to invest in service quality increase with the level of the price cap, the application of profit-share penalties, the regulated firm's participation in complementary competitive markets, and with information dissemination concerning compliance with service benchmarks.[14]

Q: Do you think energy is a human right?

A: Yes. A universal access to energy, as well as to a better quality of such input services to the society, cannot be seen as a mere "means to an end", but rather as a Human Right. The 1948 Universal Declaration of Human Rights (UDHR) did recognize multiple rights such as that of life, food, shelter, health, education, etc., all of these being deeply entwined with access to well-endowed energy services and quality. Under an improper electricity service and infrastructure, the poor, vulnerable, and isolated groups cannot be provided modern services in medical, education, and/or the hospitality industries. They will have fewer opportunities to transform or for that matter even sustain a decent livelihood or job.

[14] Fumagalli & Schiavo, *supra* n. 11 at 6.

The National Association for the Advancement of Colored People (NAACP) suggests five principles that will help utilities to make electricity available to anyone. These policies include:

1) INCLUSION: "Ensure INCLUSION of all customers in the development of utility policies and regulations."
2) ACCESS: "Secure ACCESS to utility services for all households."
3) PROTECTION: "Guarantee the PROTECTION of the human and civil rights of all customers."
4) TRANSPARENCY: "Create full TRANSPARENCY of the information and actions of utility companies, regulating bodies, legislatures, and utility affiliated organizations."
5) ELIMINATE POVERTY: "Advance programs that help ELIMINATE POVERTY, so that all customers can pay utility bills."[15]

Q: Can you please explain the concept of Consumers and Producers Surpluses?

A: A well-known concept in Microeconomics Theory is the Consumer's Surplus. It is also applied to Producers. The Surplus measures of well-being relies on the difference between what a person, household, or business is willing to pay for energy and what actually has to be paid. The theory holds that an optimal incentive scheme specifying performance standards, rewards and penalties is the proper means to

[15] Electric Choice, *Should Electricity Be Established as a Basic Human Right?*, https://www.electricchoice.com/blog/electricity-human-right/ (last visited Nov. 15, 2021).

measure the utility's performance and also reflect consumer valuations of the quality of energy inputs.

Consumer's surplus—a measure of well-being that relies on the difference between what a person, household, or group is willing to pay for energy and what actually has to be paid— has a long history in economics as a method for estimating the benefits of public projects.

Q: What is the social importance of the Reward - Penalty Scheme?

A: Rewards and penalties are financial tools that motivate better performance. Better performance means better quality of energy services. Better quality means a better off position for society and, finally, surpluses of wellbeing to consumers and producers. Rewards and penalties are market-driven mechanisms, but within a regulator's framework.

Q: Why is it important for the Reward-Penalty Scheme to include a strong penalty component?

If penalties to utility firms were absent in the RPS, the financial and operational risks would be shifted from private shareholders onto the consumers and producers' surpluses.

Many utility regulators exercised the authority to impose penalties on utilities, in order to ensure adequate performance. For example:

> In 2019 fines totaling around £9.5 million for contravention of license conditions were imposed by

> the economic regulators of utilities. In March 2019, the Office of Rail and Road (ORR) imposed a £5 million fine on Govia Thameslink Railway. In October 2019, the Water Services Regulation Authority (Ofwat) imposed a fine of £3 million on Southern Water Services. In July 2019, the Office of Communications (Ofcom) imposed a fine of £1.4 million on Giffgaff. The remaining major economic utility regulator, the Gas and Electricity Markets Authority (GEMA), did not impose any fines under domestic legislation in 2019, although it has previously done so.[16]

Q: Please describe the concept of outage compensation.

A: Outage compensation to consumers is another approach to motivate better performance. Outage compensation has become a topic of interest in the last decade. The well-known Coase Theorem from Nobel-Prize Ronald Coase (1991), postulated that liability should fall on those parties who can eliminate or mitigate the problem most cheaply. A desirable outcome is an efficient allocation of risk. The primary objective of these actions is to hold utilities more accountable, while accountability lies at the core of good regulations and effective Boards.

[16] Christopher McGee-Osborne & Zara Skelton, *The Utility Regulators' Powers to Impose Financial Penalties*, JD Supra, (Jan. 9, 2020), https://www.jdsupra.com/legalnews/the-utility-regulators-powers-to-impose-19502/.

Five states provide outage compensation to customers: Illinois, Michigan, New York, California, and Minnesota.[17] In the case of Michigan,

> electricity consumers are entitled to $25 in compensation if the utility:
> (a) fails to restore service within 120 hours of an outage during a catastrophic condition (i.e., when 10 percent or more consumers face service interruption, or a state of emergency occurs);
> (b) fails to restore service within 16 hours of an outage during normal conditions (e.g., less than catastrophic conditions, or when not more than 10 percent of consumers are without service); or;
> (c) has seven or more interruptions in a 12-month period. In each instance, a utility will lower a consumer's bill by the greater of $25 or the monthly consumer charge.[18]

The frequent and lengthy outages that Puerto Ricans have experienced since LUMA's takeover have often resulted in economic losses, such as work inactivity and interruption, house damage, permanent damage to consumers' appliances and deterioration of electric equipment. Many

[17] Ken Costello, *Should Public Utilities Compensate Customers for Service Interruptions?*, Nat'l Regul. Rsch. Inst. (July 2012), https://pubs.naruc.org/pub/FA86AD59-0662-E1F4-1213-3698BF336139.
[18] *Id.* at p.17.

Puerto Ricans have been forced to replace food or medicine that spoiled when refrigerators were unpowered. I recommend that PREB require LUMA to implement a system where consumers can obtain restitution from LUMA for financial losses caused by problems with the T&D system that LUMA operates.

Q: What is the Reliability Triangle?

A: T&D utilities' performances have been actively tracked by bench-marking distribution reliability statistics. Commonly, they are using the standard indices System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI) and Consumer Average Interruption Duration Index (CAIDI) for sustained outages. Utilities are continually looking for insight into what drives this *Reliability Triangle*. See Figure 1, below.

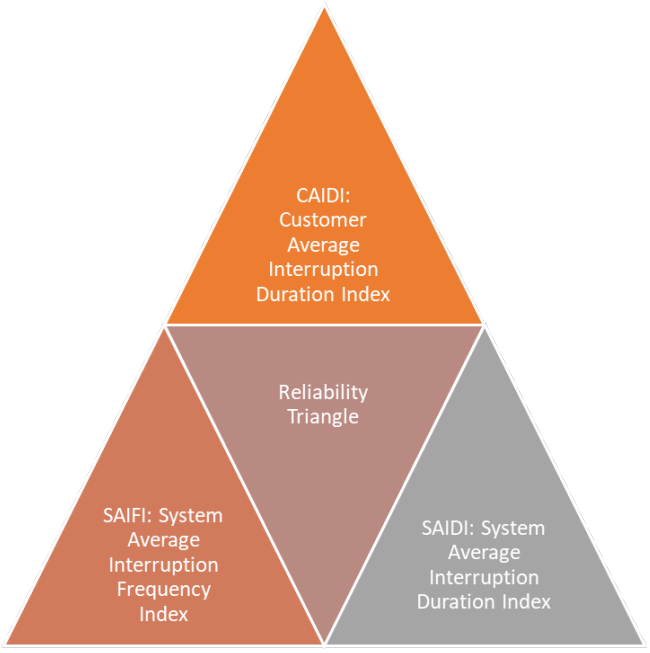


Figure 1. Reliability Triangle

On reliability issues, SAIFI, SAIDI, CAIDI, and MAIFI are some of the indices used to measure distribution system reliability. Reliability can be defined as the ability of the power system components to deliver electricity to all points of consumption, in the quantity and with the quality demanded by the consumer.

Q: Please describe an appropriate system of rewards and penalties related to reliability.

A: The following formulas and tables are RPS models, and constitute only examples to be assessed by PREB. This section outlines a reward and penalty structure for two widely utilized performance metrics for evaluating system reliability, SAIDI and SAIFI.

To establish rewards and penalties for SAIDI performance, I propose to multiply: 1) the difference between the utility's actual versus targeted performance, 2) a set reward/penalty value per kilowatt hour, and 3) the total number of PREPA customers. Reduced to formula form this is written as:

SAIDI Reward (Penalty) =

[(Target - Performance) * (Cost per KWh) * (Customers)]

Consider the following examples demonstrating how this formula to would apply to hypothetical SAIDI performance scenarios (Note: minutes are converted into hours for calculations).

Example 1—SAIDI Penalty: Target performance is 92 minutes (1.533 hours), but LUMA's actual performance is 101 minutes (1.687 hours). The resulting penalty for exceeding the SAIDI target would then be calculated as:

=[(1.533 hours - 1.687 hours) * ($0.20/kWh) * (1,466,159 customers)]

= [(-0.154) * ($0.20) * (1,466,159)]

= -$45,157

Therefore LUMA would owe an approximately $45,000 penalty, which it would be required to return to customers via bill credits.

Example 2—SAIDI Reward: Target performance is 92 minutes (1.533 hours), but LUMA's actual performance is only 75 minutes (1.242 hours). In this case, LUMA would earn the following reward:

= [(1.533 hours- 1.242 hours) * ($0.20/kWh) * (1,466,159 customers)]

= [(0.291) * ($0.20) * (1,466,159)]

= $85,330

For this better performance, LUMA would be able to recover as a reward an additional $85,000 from customers via an appropriate bill clause.

To establish rewards and penalties for SAIFI performance, PREB should consider a formula including 1) the difference between the utility's actual versus targeted performance, 2) the standard deviation across all customers, a 2) a reward/penalty multiplier, and 3) a reward/penalty value.

One example would be to multiply: 1) the standard deviation of the difference between the utility's actual versus targeted performance by 2) a set reward/penalty multiplier, and 3) a reward/penalty value. Reduced to formula form this is written as:

SAIFI Reward (Penalty) =

[(Target - Performance)/Standard deviation of performance across customer body]* (reward/penalty multiplier) * (Reward/penalty value)]

Here are two examples using a Target of 1.1 interruptions per year, and a standard deviation of 1.00, a reward/penalty multiplier of 0.25, and a reward/penalty value of $5 million.

Example 3—SAIFI Penalty for a given 1.50 interruptions per year:
[(1.10-1.50) /1.00] x 0.25 x $5 million = - $500,000

Example 4—SAIFI Reward for a given 0.85 interruptions per year:
For example: [(1.10-0.85) /1.00] x 0.25 x $5 million = $321,500

Q: What concerns do you have about LUMA, LUMA's contract, and LUMA's performance to date?

A: First: Many local non-profit organizations in Puerto Rico such as Colegio de Ingenieros y Agrimensores, Colegio de Abogados y Abogadas, Centro para la Nueva Economía, among others, agreed that the public-private partnership (PPP) between LUMA and the Commonwealth

Government is not only full of pitfalls but also bound by a one-sided contract, that only provides advantages to one of the parties.[19]

Second: a PPP should include main principles such as transparency, accountability, and sustained partnerships. LUMA has consistently disagreed to a full public disclosure of documents, information, and process, even though it has been financed by public appropriations.[20] The partnership must include a Reward – Penalty Scheme in order to ensure that the private entity is accountable to the public, and practices financial and technical responsibility.

Third: The PPP between LUMA and PREPA-Commonwealth Government allows Pass-Through Expenditures, which do not provide adequate limits on many of LUMA's operational expenditures.

[19] Union de Trabajadores de la Industria Eléctrica y Riego de Puerto Rico (UTIER), *Colegio de Abogados y Abogadas de Puerto Rico rechaza contrato de LUMA Energy* (Feb. 26, 2021), https://www.utier.net/post/colegio-de-abogados-y-abogadas-de-puerto-rico-rechaza-contrato-de-luma-energy; *see also*, Colegio de Abogados y Abogadas de Puerto Rico, Junta de Gobierno, Resolución Numero 9, Reunión ordinaria 7, at 7 (Feb. 20, 2021) https://download-files.wixmp.com/ugd/c08f1e_0b2585ce17bf43908cbb5f8f4edde930.pdf?token=eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJpc3MiOiJ1cm46YXBwOmU2NjYzMGU3MTRmMDQ5MGFhZWExZjE0OWIzYjY5ZTMyIiwic3ViIjoidXJuOmFwcDplNjY2MzBlNzE0ZjA0OTBhYWVhMWYxNDliM2I2OWUzMiIsImF1ZCI6WyJ1cm46c2VydmljZTpmaWxlLmRvd25sb2FkIl0sImlhdCI6MTYzNzE2NjM2OSwiZXhwIjoxNjM3MjAyMzc5LCJqdGkiOiI3OTFlMGMxZjkzYWYiLCJvYmoiOltbeyJwYXRoIjoiL3VnZC9jMDhmMWVfMGIyNTg1Y2UxN2JmNDM5MDhjYmI1ZjhmNGVkZGU5MzAucGRmIn1dXSwiYXR0YWNobWVudCI6eyJmaWxlbmFtZSI6IlJFU09MVUNJXHUwMGQzTiBMVU1BIEVORVJHWSBMTEMuIFsyMC1GRUItMjAyMV0ucGRmIn19.hq2F9wcfvWPBLI9hhL6jInvMCNEXeNB_q2r7MAIx4Hk.

[20] See PREB's October 7th Order to Compel Responses to Requirements of Information, and November 4th Resolution and Order regarding LECO's Motions to Compel and PREB's.

Fourth: Puerto Rico's Laws are currently based on a solid unionized workforce to help rebuild the energy grid. The PPP contract called for eliminating many labor protections, including existing labor unions, that protect wages and benefits and pensions. This is an unsound management decision. LUMA's new agreements exclude established unions, and LUMA's new agreements do not provide the same worker protections or compensation.[21]

Finally: In accordance with the Agreement, the Operator LUMA is entitled to receive a Service Fee consisting of (1) an annual Fixed Fee and (2) an Incentive Fee. The Fixed Fee starts at $70 million on year 1 and increases to $105 million for each of years for 4 through 15. There should be a corresponding level of penalties if LUMA fails to provide adequate performance. The Incentive Fee, which is payable upon LUMA achieving certain performance benchmarks set forth in Annex IX to the O&M Agreement and is calculated in accordance with the methodology set forth in Annex X to the O&M Agreement, starts at $13 million on year 1 and increases up to $20 million for each of years 4 through 15. Again, there should be a corresponding level of penalties if LUMA fails to provide adequate performance.

[21] Tom Sanzillo, *Contrato entre Puerto Rico y LUMA Energy establece una privatización completa y tarifas mas altas para la red de la isla*, Institute for Energy Economics & Financial Analysis (IEEFA), at 2, (Oct. 2020), https://ieefa.org/wp-content/uploads/2020/10/Luma-AEE-Contract-Report-IEEFA-ESP-October_2020.pdf.

Q: What are your conclusions and recommendations?

A: PREB should develop and adopt a Reward-Penalty Scheme to improve LUMA's performance. I also recommend that PREB evaluate an Outage Compensation Mechanism to be available to consumers impacted by outages.

Q: Does this conclude your testimony?

A: Yes, it does. However, I retain the right to modify or clarify my views based on new information made available to me.

Q: Are exhibits attached to your testimony?

A: Yes. Expert Witness CV (Exhibit 1); and Forensic Expertise (Exhibit 2).

CERTIFICATION

I José Alameda-Lozada, of legal age, married, economist and economic planner, resident of Mayagüez, Puerto Rico, CERTIFY that the contents of my testimony are known to me and are the truth according to the best of my abilities and reasonable knowledge. The technical and operational aspects included in the testimony are based on information that has been gathered in good faith; but I cannot guarantee the truthfulness of information gathered from third parties.

José Alameda-Lozada, Ph.D.

Before me, the undersigned Notary Public, personally appeared José Israel Alameda Lozada, who acknowledges that the above is true this day of November 17, 2021 in Mayagüez Puerto Rico.

[X] Personally known OR [ ] Identification Document provided _____.

Affidavit# 4996

Notary Public Name, Signature, Seal
Daniel Rosa Hernández

Exhibit 1

Expert Witness CV of José Alameda-Lozada

JOSE ISRAEL ALAMEDA LOZADA; Ph.D.; **Economist and economic planner**

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Up-dated July 2020. E Mail: joseialameda@gmail.com

PERSONAL INFORMATION

EDUCATION: Ph.D. Economics,1996, The University of Wales,
Aberystwyth, Wales, United Kingdom.

Master in Arts, Economics, 1983.
Rutgers University, New Brunswick
New Jersey, United States

Master in Planning, 1976.
University of Puerto Rico
Graduate School of Planning
Río Piedras, Puerto Rico

Business Administration, B.B.A., 1972.
University of Puerto Rico
Mayagüez, Puerto Rico

FIELD OF INTEREST: International Trade, Economics of Finance, Econometrics, Energy Economics, Economic Development, Money and Banking, Health Economics, Managerial Economics, Comparative Economics, Business Cycles and Forecasting, Torts and Injury damages.

CLASSES TAUGHT: Macroeconomics and Microeconomics, Managerial Economics, Comparative Economics Systems, Mathematics for Economists, Economic Development of Puerto Rico, International Trade and Finances, Business Cycles.

LANGUAGE: Spanish and English

PROFESSIONAL EXPERIENCE

Professional Planner Certified (Lic. #256), inactive.

1998 up to now- Full Professor in Economics, Department of Economics, UPR at Mayagüez.

1992--1997--Associate Professor, Department of Economics, University of Puerto Rico, Mayagüez.

1993-1994 -- Economic Advisor of the Chamber of Commerce of Puerto Rico-Western

2014—FULL PROFESSOR UPR MAYAGUEZ

2014---Planning Board economic consultant—Strategic Plan of Development for Puerto Rico—Retail Trade, Wholesale Trade and Transportation and Warehousing Sectors.

1992- present—Researcher and consultant in cases of Forensic Economics.

1986-at present, Consultant in Economics and Planning, the Commonwealth Planning Board of Puerto Rico.

1986-87, Consultant in Economics, Economic Development Administration,
U.S. Department of Commerce

1984-85, Instructor, Department of Finance, University of Puerto Rico, Río Piedras Campus.

1984-86, Associate Research, Center for Business Research
Department of Business Administration, U.P.R. Rio Piedras, Puerto Rico.

1983-84, Special Commission for the Development of Puerto Rico
Senate of Puerto Rico.

1983, Consultant for the Master Plan for the Development of Aguadilla,
CEMI, Inc;.

1982-83, Instructor, Department of Economics, Mayagüez campus.

1981-82, Visiting Lecturer, Puerto Rican Studies,
Livington College, Rutgers University, Piscataway, New Jersey

1980-81, Teaching Assistant, Livington College.

1980, Teaching Assistant, Rutgers University.

1976-79, Instructor, Department of Economics and Business Administration Interamerican University of Puerto Rico

1974-75, Research Assistant, Logic Research Inc., Santurce, Puerto Rico.

RESEARCH EXPERIENCE AND PUBLICATIONS
(Many papers and research excluded)

Books:

1. **La Economía del Diario Vivir: análisis económico de los asuntos públicos cotidianos desde el deporte, la organización política y el status de Puerto Rico**. Editorial Búsqueda. July, 2005.

2. **Ensayos en Economía Aplicada: análisis y medición del impacto social, político y económico de las instituciones sobre la economía de Puerto Rico**: octubre del 2005

3. **La Vivienda de Interés Social en Puerto Rico**, libro realizado para el Departamento de la Vivienda, co-autor Profesor Carlos Rivera Galindo. 2005. Printed by *Advance Graphic Printing, Chicago, IL*.

4. **Index of Sustainable and Economic Welfare (ISEW) for Puerto Rico**, Publisher at Instituto Tropical de Economía, Ambiente y Sociedad. (ITEAS). with Dr. Ivonne Díaz Rodríguez. 2009.

5. **La Politica Neoliberal en Puerto Rico y la Ley Numero 7: Impacto y consecuencias socioeconómicas: Años fiscales 2009 al 2011--** *with* Lic. Daniel Garavito- Medina. Editial Situm.

6. **Propuesta para una Nueva Estrategia de Desarrollo para Puerto Rico: Sustentabilidad, Equidad y Seguridad Social:** with Colectivo de Economistas Universitarios (with A. Gonzalez, Jeffrey Valentin Mari, Jose Toral, José Garcia y Myrna Comas Pagán, Editorial Situm, 2013.

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An Analysis of the Transmission of Real and Monetary Shocks on the Economy of Puerto Rico from United States. Ph. D. Thesis. University of Wales, United Kingdom.1996.

Energy Substitutability in the Manufacturing Sector of Puerto Rico. M.A. Thesis at Rutgers University, 1983.

.

"La fuga de capital humano de la economía de Puerto Rico: reto a la década actual", paper delivered at the annual meeting of South Eastern Council of Latin American Studies (SECOLAS) in San Juan, Puerto Rico. 1984.(with W. Ruiz Oliveras).Published in: Revista de Ciencias Sociales, Enero-Junio 1985, Núm. 1-2, Vol. XXIV, págs. 3-34.

"Análisis exploratorio de la emigración de profesionales en Puerto Rico: el caso de los ingenieros". (with W. Ruiz Oliveras). Revista de Administración Pública. Vol XVII, núm. 1, October 1984.

"***Technology Dependency and Energy Substitutability in Small, Open, and Petroleum-Importing Developing Economy: The Case of Puerto Rico"*** (with Arthur Mann). Journal of Economic Development, Vol 9, Núm. 1. July 1984.

"The Effects of Banking Deregulation on Savings and Loans Industry of Puerto Rico". Paper delivered at the Third Annual Meeting of Economists Association of Puerto Rico. (with C. Rivera Galindo). **Puerto Rico Business Review**. November 1985, Vol. 10, No.11, pp. 6-11.

"The International Indebtedness Position of the United States and its Effect on the Economy of Puerto Rico". **Puerto Rico Business Review.** December 1985, Vol 10, No. 12 pp. 9-12.

"A New Phase of Banking Deregulation: Who's Afraid of Deposit Rates Ceiling Removal?" 1986. Center of Business Research, Business Administration Department, University of Puerto Rico at Rio Piedras.

"***Energy Price Shocks, Input Prices Changes and Development Implications: A Translog Model Applied to Puerto Rico***" Journal of Development Studies, 25(3), April 1989. Institute of Economic Development. University of Sussex, Brighton, United Kingdom.

"Impacto Económico de los Juegos Olímpicos del 2004 en Puerto Rico: un análisis preliminar": 20 de septiembre de 1992, para la Comisión Por Sede Juegos Olímpicos del 2004. Hato Rey.

"Análisis Económico del SIDA en Puerto Rico" (Economic Impact of AIDS in Puerto Rico"). paper delivered in Second American Congress of Public Health. San Juan, August 3-5, 1989, (with Alfredo González).

"Análisis Económico del SIDA en Puerto Rico"(Economic Impact of AIDS in Puerto Rico" Delivered also at the Eighth Congress of Econometrics, Royal Society of Econometrics, San José, Costa Rica, August 3-5, 1988. Published in: FACTUM, 2(3) pp. 8-19 Journal of Bar of Lawyers in Puerto Rico (Colegio de Abogados de P.R.)

"Market Concentration in Services of Puerto Rico Depository Institutions: Is it getting better?". Puerto Rico Business Review, 12(12). December 1987. 5-10.

"Análisis del Impacto Económico del SIDA en Puerto Rico"(with .González).107-122. El SIDA en Puerto Rico: Acercamientos Multidisciplinarios (editors I. Cunnigham, Ramos Belido and Ortiz Colón). Institute of Caribbean Studies. University of Puerto Rico, Río Piedras. 1992.

"Las fluctuaciones económicas y la incidencia criminal en Puerto Rico: Un análisis espectral". Ceteris Paribus. Revista de Investigaciones Socio-Económicas,. Vol. I, Núm. 1, abril 1991. with Alfredo González. Department of Economics, U.P.R. at Mayagüez.

"***Is Puerto Rico's Economy becoming a Leading Indicator of U.S. recessions ?".*** Ceteris Paribus. Vol. I, Núm. 1, abril 1991.

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ESTUDIO DE RETRIBUCIÓN SALARIAL, BENEFICIOS MARGINALES, EVALUACIÓN DE DESEMPEÑO Y ESCALAS SALARIALES DEL PERSONAL: 2020 A 2022. 4 de noviembre de 2019.

Sustainable Fiscal Plan for the UPR / Plan Fiscal Sostenible para la UPR. PROTESTAmos (*Profesores Transformándonos en Solidaridad Tornada en Acción*). Co-author. May-June 2017.

Análisis de la Propuesta sobre Salarios y Beneficios Marginales a Empleados de la UTIER José I. Alameda Lozada y Alfredo González Martínez. 22 de Agosto de 2017

Estimación del Daño Económico a la Corporación del Fondo de Seguro del Estado y el Menoscabo de los Beneficios para Tres Organizaciones Laborales: Unión de Empleados; Asociación de Gerenciales y Unión de Médicos.20 de mayo de 2018 Versión Final

The Plan of Adjustment of Debt of COFINA: Sustainability and Financial Capacity of Puerto Rico's Economy-December 31, 2018. Study prepared for expert witness for PROMESA. Occasional Papers No. 11 – February 2019.
http://www.estudiostecnicos.com/pdf/occasionalpapers/2019/OP-No-11-2019.pdf

Aplicación del Análisis Económico en la Determinación de una Metodología Idónea para estimar las Indemnizaciones, con Alfredo González-Martínez. **El Valor de los Daños en la Responsabilidad Civil. Tercera Edicion. Antonio Amadeo- Murga.**

La construcción del mega-hotel *Rincón Blue Water* dentro del entorno socio-económico y ambiental del municipio de Rincón. 20 de agosto de 2019. For Salva Rincón !!.

ESTUDIO PERICIAL SOBRE EL INFORME DE LA FIRMA CARIBBEAN ANALYSIS UNIT, 29 de agosto de 2019. Caso de Laboratorio High Profile VI, Ponce

ESTUDIO DE VIABILIDAD PARA LABORATORIO CLINICO EN PONCE ADVANCE MEDICAL GROUP (PAMG). Economista y asesor financiero, 4 de agosto de 2019

EVALUACION PRELIMINAR DE LAS LEYES DE INCENTIVOS AGRICOLAS Y LA LEY DE INCENTIVOS ECONOMICOS PARA EL DESARROLLO: Ley 225 de 1995 y Ley 73 de 2008.

Estudio para el desarrollo de espacios comerciales en Mayagüez, Calle Comercio. Hecho para FALTO CRUZ REAL ESTATE HOLDINGS, MAYAGUEZ, PR 00680. 10 de octubre de 2019

Estudio de Viabilidad Económica para Centro de Inspección de Vehículos de Motor en la Estación Gulf, Barrio Leguisamo. k.m. 4.5 Carr. 352, Mayagüez. 19 de noviembre de 2019 revisado.

***The Impairment of UTIER's Collective Bargaining Agreement and the Calculation of Damages*. June 15, 2020. Study for UTIER union from Puerto Rico Electric Power Authority.**

ESTUDIO DE RETRIBUCIÓN SALARIAL, BENEFICIOS MARGINALES, EVALUACIÓN DE DESEMPEÑO Y ESCALAS SALARIALES DEL PERSONAL: 2020 A 2022. 4 de noviembre de 2019. To Cooperativa de Ahorro y Crédito de Isabela.

La pandemia Covid-19, el sistema sanitario en EE.UU. y el nuevo orden económico internacional. ***Estudios Técnicos.*** Perspectiva abril 2020.

El costo económico del discrimen racial. ***Estudios Técnicos.*** Perspectiva junio 2020.

SERVICES REALIZED AS ECONOMIC ADVISOR OR CONSULTANT

1. *Universidad de Puerto Rico, Recinto de Mayagüez* (oficina del Rector-estudio sobre de costo-beneficio sobre el R/V Chapman (con Dr. Leandro Colón);

2. *Universidad de Puerto Rico, Recinto de Mayagüez* (oficina del Rector-estudio sobre el impacto económico del RUM (con Dr. Edwin Irizarry Mora), utilizado por el RUM en una presentación hacia la Asamblea Legislativa)

3. *Centro de Desarrollo Económico de la UPR* (*Estudio sobre el Impacto Económico de Porta del Sol); realizado para la Compañía de Turismo de Puerto Rico*;

4. *Junta de Planificación –Planning Board* (estudio de fondo para el Informe Económico al Gobernador 2006 sobre las Trayectoria de los Ciclos Económicos de Puerto Rico y el Informe Económico 2008, Economía de Estados Unidos);

5. *Oficina de Gerencia y Presupuesto* (Office of Budget and Management, Commonwealth of Puerto Rico 2008.

6. *Autoridad para el Financiamiento de la Infraestructura* (studies about XXI Central American Games, 2010, and solid wastes-transshipment station at Trujillo Alto).

7. *Administración de Compensaciones por Accidentes de Automóviles* (ACAA), **Estudio del Impacto Económico de los Accidentes de Tránsito en Puerto Rico;** http://economia.uprrp.edu/Ensayo%20138joseialamedayjuanlara.pdf.

8. *Gobierno Municipal de Mayagüez,* Impacto Económico de los Juegos Centroamericanos y del Caribe 2010.

9. *Departamento de Agricultura de Puerto Rico: tres estudio de viabilidad:*

10. *Asociación de Dueños de Talleres de Reparación Colisión de Autos* (*estudio sobre el costo de los servicios y la fijación de tarifas por parte de las aseguradora*s-study about insurance payment and charges) ;

11. Frente Unido de Camioneros de Puerto Rico (*estudio sobre las tarifas de los camioneros presentados a la Comisión de Servicio Público—study about cargo freight and charges*). 2002

12. *Colegio de Médicos y Cirujanos de Puerto Rico*, (*estudio el impacto económico de la reforma de salud para presentarse en la Comisión Evaluadora de la Reforma de Salud de Puerto Rico; Epilepsy Study*);

13. *Asociación de Detallistas de Gasolina de Puerto Rico* (*caso sobre el impacto del salario mínimo, proyecto de Ley—study about mininum wages*),

14. *Centro Unido de Detallistas* (sobre reforma fiscal y contributiva y sobre los Tratados de Libre Comercio);

15. Department of Health; Demand and Supply of Physicians and Health Costs.

16. *Asociación Puertorriqueña de Dueños de Laboratorio Clínico Privado* (caso sobre demanda a aseguradoras, estudio para el *Federal Trade Commission* (FTC));

17. *Asociación de Farmacias de la Comunidad* (estudio comprensivo sobre la situación económica de las farmacias de la comunidad-- 4 de febrero del 2005);

18. *Sociedad de Radiología de Puerto Rico, Inc;* (estudio sobre el efecto de la fijación de tarifas por parte de las aseguradoras en los laboratorios de radiología en Puerto Rico, abril de 2004, estudio para el FTC).

19. *Cooperativa de Ahorro y Crédito de Aguada;* Estudio sobre la viabilidad de una sucursal en Mayagüez; septiembre 2005.

20. *Cooperativa Cash-Coop (Estudio de viabilidad para el establecimiento de una cooperativa de establecimientos dedicados al cambio de cheques y otros servicios financieros, Cooperativa CashCoop, July 2004).*

21. *Movimiento para el Desarrollo de Oeste* (*estudio sobre la inversión privada y pública en Carreteras en el Oeste*).

22. *Educadores Puertorriqueños en Acción Ciudadana,* (*Estudio para determinar la diferencia salarial entre los supervisores, superintendentes de escuelas y los directores de escuela en Puerto Rico: 22 de abril de 2004*).

23. *Asociación Puertorriqueña de Dueños de Laboratorios Clínicos Privados.*

24. *XXI Central American Games Organization:* (economic and financial advisor).

25. *Alianza Ciudadana para la Energia Renovable, University of Puerto Rico at Mayagüez campus (studies about energy conservation, renewable resources, public authorities, etc)*

26. *Instituto Tropical de Economía, Ambiente y Sociedad, sponsored by the University of Puerto Rico at Mayagüez.*

27. UTIER. The Unión de Trabajadores de la Industria Eléctrica y Riego.

28. PROSOL-UTIER, Programa de Solidaridad UTIER. Unión Obrera creada por la Unión de Trabajadores de la Industria Eléctrica y Riego.

29. Consultant Department of Treasury (Hacienda)—2015-16. Co-author study Sales and Used Tax index of Complaint: Merchandises and Services.

30. Administrador Judicial para el gobierno municipal de Añasco. Caso de propiedades *Municipio de Añasco v. Community Action for Social Affairs and Housing Development Organization of Puerto Rico, Inc.* et.al. Caso Civil Núm: ISCI2009-00654.

31. Consultor para el Colegio de Productores de Espectáculos Públicos (COPEP),

32. Economic Consultant, Cámara de Mercadeo, Industria y Distribución de Alimentos (MIDA); 2016

CONFERENCES (Details are excluded).

More than 200 conferences and/or participation in seminars or forums either locally or internationally related with the following topics;

- : NAFTA and its Economic Impact
- : Section 936 and its Impact in Puerto Rico
- : Economy of Crime Incidence
- : Energy, Externalities and Development
- : Economics of AIDS, and Health Reform;
- : Population Structure and Changes and Economy of Puerto Rico

- : Regional economics and development
- : Business Cycles, Forecasting and Econometrics
- : Government deficit and degradation
- : Human Costs of Vietnam War
- : Energy, Renewable Resources, Environment and Development
- : Economic Impact of 2004 Olympic Games in Puerto Rico and CentralAmerican Games.
- : The Virus Y2K and the global recession
- : Market Concentration and Competition
- : INVESTMENT SECURITY. Sponsored by Kidder Peabody and the
- : Center for Business Research, May 1983.
- : Computer - Word Perfect 5.1, University of Puerto Rico, Mayagüez June 1988.

- Mastering in Econometrics Software Package such as TSP, E-Views, *STATGRAFHIC, E Views (various versions) and MICROFIT*.

MEMBERSHIP AND PROFESSIONAL ASSOCIATIONS:

: Member of National Association of Forensic Economics, Kansas City, Missouri. (Inactive)

: Founder member of Association of Economists of Puerto Rico, Secretary (1989-90), and Treasurer (1991-92).

: Sociedad Puertorriqueña de Planificación. San Juan P.R. (inactive)

HONORS and PROFESSIONAL PARTICIPATIONS:

- : ***Comité de los 24:*** Participation at an active member, sponsored by Office of the Governor of Puerto Rico April 2014.
- : Outstanding Researcher of the Faculty of Arts and Science, 2013 (***See letter attached***).
- : Most Outstanding Student in the Concentration of Economic Planning June 1973. Graduate School of Planning from the University of Puerto Rico.
- : Presidential Fellowship for Graduate Studies Abroad, University of Puerto Rico. June 1980.
- : Participant in the 2008 Fed in the 21th Century Symposium for College Professors at the New York Federal Reserve Bank. :Participant in the 2011 to ***Fed in the for College Professors*** at the New York Federal Reserve Bank
- : Who's Who Marquis. Finance and Industry. 27th Edition, 1992-93.
- Member **Comité de Auditoria de la Deuda Pública de Puerto Rico: 2016. Senate and House of Representative of Puerto Rico.**

Universidad de Puerto Rico – Mayagüez
Decanato de Asuntos Académicos
Centro de Enriquecimiento Profesional (CEP)
Academia de Investigación para Facultad y Postdoctorales
Research Academy for Faculty and Postdoctoral Fellows

29 de abril de 2013

Dr. José Alameda
Profesor, Facultad Artes y Ciencias
Universidad de Puerto Rico, RUM

Estimado Dr. Alameda:

La Academia de Investigación para Facultad y Postdoctorales tiene el honor de informarle que usted ha sido seleccionado para recibir un homenaje especial como investigador destacado del Decanato de Artes y Ciencias en la actividad de reconocimiento dentro del Simposio titulado **"La investigación y labor creativa en el RUM como promotor de cambios socioeconómicos en Puerto Rico"** que se llevará a cabo el día 10 de mayo de 2013, a las 8:30 am en el Edificio de Administración de Empresas.

En muestra del agradecimiento a la ardua labor a los investigadores destacados de nuestro recinto la Academia de Investigación para Facultad y Postdoctorales le solicitó a su Decanato de Artes y Ciencias que estableciera criterios para seleccionar y otorgarle a profesores un merecido reconocimiento especial. Su decanato utilizó los criterios de número de publicaciones/patentes entre 2011-presente, número de propuestas sometidas/aprobadas en los últimos dos años, desempeño general en la enseñanza y atendiendo estudiantes en investigación en su campo. Es nuestro honor informarle que siguiendo dichos criterios, usted fue seleccionado por su decanato para recibir el homenaje de reconocimiento como investigador destacado.

Desde el pasado año el Centro de Enriquecimiento Profesional (CEP) y el Centro de Investigación y Desarrollo (CID) junto a los decanos asociados de investigación de las cuatro facultades académicas han estado colaborando en el desarrollo de la *Academia de Investigación para Facultad y Postdoctorales* con miras de ayudar a articular un plan concertado que fomente la competitividad y la excelencia en la investigación en el RUM. Como parte de nuestro esfuerzo por motivar y reconocer la importante labor investigativa que se realiza en nuestra institución, llevaremos a cabo este simposio multidisciplinario con la participación de investigadores de las cuatro facultades. Esta será una oportunidad única para compartir hallazgos, quehaceres, estrategias y entablar colaboraciones más allá de nuestras paredes disciplinarias.

El Simposio culminará con la actividad de reconocimiento a la labor de excelencia de los investigadores homenajeados en el Anfiteatro de ADEM a las 4:30 pm. Puede encontrar la agenda de las actividades del Simposio en la siguiente dirección: http://academia-de-investigacion.uprm.edu. Será un honor contar con su presencia.

Cordialmente;

Ubaldo M. Córdova, Ph. D.
Coordinador Academia de Investigación
CEP – Asuntos Académicos

Academia de Investigación para Facultad y Postdoctorales
Centro de Enriquecimiento Profesional (CEP)
Decanato de Asuntos Académicos
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Extensiones:3829, 3674, 5996
Fax:(787) 831-2085
Correo-e: cep@uprm.edu

JOSE ISRAEL ALAMEDA LOZADA

El doctor José I. Alameda Lozada es actualmente Catedrático del Departamento de Economía del Recinto Universitario de Mayagüez. Ha sido, además consultor de la Junta de Planificación y de la Comisión Pro Sede de las Olimpiadas del 2004 y de la organización que patrocina la celebración de los Juegos Centroamericanos y del Caribe en el 2010, en la zona oeste. Durante el 1989 al presente ha sido asesor económico de numerosas instituciones, agencias del gobierno y empresas privadas.

Posee un bachillerato en Administración de Empresas con concentración en Economía (1973) del Recinto Universitario de Mayagüez y obtuvo una maestría en Planificación Económica (1976) de la Escuela Graduada de Planificación de la Universidad de Puerto Rico, donde recibió el premio del estudiante más destacado dentro de la especialización de Economía. En el 1982, obtuvo el grado de maestría en Economía con concentración en economía monetaria y economía internacional de la Universidad de *Rutgers* del estado de Nueva Jersey. Posee un doctorado en Economía de la Universidad de Gales en el Reino Unido (1996), concentrando su tesis en el análisis de la transmisión del ciclo de la economía de Estados Unidos a la de Puerto Rico.

Ha sido profesor de la Universidad Interamericana (1976-79), profesor visitante en la Facultad de Estudios Puertorriqueños de la Universidad de *Rutgers* (1980-81), Investigador Asociado en el Centro de Investigaciones Comerciales de la Facultad de Administración de Empresas del Recinto de Río Piedras (1983-85), Profesor de Finanzas del Departamento de Finanzas del Recinto de Río Piedras (1984-85). Realizó labores como economista en la Comisión Especial para el Desarrollo del Senado de Puerto Rico (1985) y Asesor Económico de la Presidenta de la Junta de Planificación (1985-87).

Ha publicado extensamente en Puerto Rico, en Estados Unidos y en el Reino Unido artículos sobre el desarrollo económico, energía, recursos humanos, el sector financiero y los fondos 936, el impacto económico del SIDA en Puerto Rico, impacto económico de la criminalidad, viabilidad de los Juegos Olímpicos del 2004, y Centroamericanos y del Caribe 2010, entre otros. Fue uno de los pioneros en toda la América de estudiar el SIDA desde la perspectiva económica, presentado su trabajo en la Convención Internacional sobre el SIDA en la cuidad de Montreal, Canadá en el 1989. Ha realizado presentaciones de sus investigaciones en Chile, Costa Rica, República Dominicana, Inglaterra, Estados Unidos, entre otros países. Fue seleccionado para aparecer en *Who's Who de Marquis* en Finanzas e Industria, edición número 27, 1992-93.

Tiene publicados seis libros: (**1) La Economía del Diario Vivir: análisis de los asuntos cotidianos desde la organización social y deportiva hasta el status político (2004) ; (2) Ensayos en Economía Aplicada: Análisis y medición del impacto social, político y económico de las instituciones sobre la economía de Puerto Rico (2004); (3) La Vivienda de Interés social en Puerto Rico (2002),** este último con el Profesor Rivera Galindo y hecho para el Departamento de la Vivienda de Puerto Rico; (4) **Índice para la Medición del Bienestar Económico en Puerto Rico (2009)--** con la doctora Ivonne Díaz Rodríguez, catedrática del RUM y experta en economía ambiental; **(5) La Política Neoliberal en Puerto Rico y la Ley Número 7: Impacto y Consecuencias Socio-Económicas: Años Fiscales 2009 al 2011 (2012)** (Editorial Situm); y **Una nueva estrategia de desarrollo: sustentabilidad, equidad y seguridad social (2013) con Colectivo de Economistas Universitarios** (Editorial Situm)**.**

Fue coordinador y fundador del Comité de Ciclos Económicos de la Asociación de Economistas de Puerto Rico, institución en la cual es socio fundador. En la misma ha ocupado puestos en la Junta de Directores tales como Secretario (1989-90) y Tesorero (1991-92). Nombrado al **Comité de Auditoria de la Deuda Pública de Puerto Rico: 2016. Senado and Cámara de Representantes of Puerto Rico.**

Exhibit 2

Forensic Expertise

PERITAJE FORENSE JOSE ISRAEL ALAMEDA LOZADA, PH.D.

José I. Alameda Lozada, Ph.D.

Economista y planificador profesional 787-309-9046

E Mail: joseialameda@gmail.com

Update July 2020

Peritaje Forense (Forensic Cases)

Lista de Casos (List of Cases)

1. **ESTUDIO DE LUCRO CESANTE PARA JOSE A. SANABRIA: Fecha: 1985: Demanda civil por daños y perjuicios al municipio de Sabana Grande: Lucro Cesante / Daños y Perjuicios: Muerte del Sr. Sanabria debido a accidente fatal**

2. ESTUDIO DE LUCRO CESANTE PARA MUCHACHA GUITARRISTA: Fecha: 1986: Demanda civil por daños y perjuicios al negocio Chicken & Pizza Palace: Lucro Cesante / Daños e Incapacidad parcial

3. ESTUDIO DE LUCRO CESANTE ANGEL AYALA: Fecha: 1989: Demanda civil por daños y perjuicios: Lucro Cesante / Daños e Incapacidad parcial

4. ESTUDIO DE LUCRO CESANTE PARA LA SEÑORA ADA I DEL VALLE: 14 de julio de 1993: Demanda civil por daños y perjuicios: Lucro Cesante / Daños Incapacidad parcial.

5. ESTUDIO DE LUCRO CESANTE PARA MILAGROS MASSANET SIERRA: 5 de junio de 2000: Demanda Civil ID P99-0117, contra L&M Car and Truck Rental, Inc; Royal and Sun Alliance Insurance Company, et al. Lucro Cesante / Daños e Incapacidad parcial

6. ESTUDIO DE LUCRO CESANTE PARA ROBERTO SANTANA: Demanda Civil contra Supermercado XTRA: Lucro Cesante / Daños e Incapacidad parcial. 1996.

7. ESTUDIO PARA NELSON GRABIEL SOTO: Demanda por daños al Hospital San Carlos Borromeo: Daños al niño Nelson Gabriel Por impericia médica: 6 de mayo de 1997.

8. ESTUDIO DE LUCRO CESANTE PARA MARIA DEL SOCORRO BACO RODRIGUEZ Y DAVMARIE MERCADO BACO: (16 de julio de 1998): Demanda por daños y perjuicios al señor Luís González Franco: Lucro Cesante / Daños y Muerte en accidente de tránsito del esposo de María de S. Bacó (Sr. David Mercado).

9. ESTIMADO DE PERDIDA DE INGRESO PARA EL SEÑOR PORFIRIO ESCABI PADILLA: 16 de junio de 1998: IDP 93-0215, despido injustificado Contra el ELA por daños y perjuicios: Despido injustificado.

10. ESTUDIO PARA ESTIMAR LA PERDIDA DE INGRESOS DE LA SOCIEDAD DE BIENES GANACIALES COMPUESTA POR EL SEÑOR ADRIAN RUIZ VELEZ Y SU ESPOSA PATRIA RUPERTO RODRIGUEZ: 15 de octubre de 1999: Demanda por daños y perjurios a las aseguradoras: Lucro Cesante / Daños Incapacidad total por amputación de pierna perdida en un accidente en la construcción.

11. COMENTARIOS EN TORNO AL ESTUDIO DE LUCRO CESANTE REALIZADO POR EL DR. FRANCISCO FLORES PARA EL DR. SIGFREDO ACARON ORTIZ; 28 de diciembre de 1998.

12. ESTIMADO DE PERDIDA DE INGRESOS PARA LA SEÑORA BETSY SANTIAGO GONZALEZ: 25 marzo 1999: IDP98-0277, despido injustificado y daños contra Oriental Bank: Daños y perjuicios Despido injustificado

13. ESTUDIO DE PERDIDA DE INGRESO PARA LA SOCIEDAD DE BIENES GANANCIALES COMPUESTA POR CARMEN NILSA TRABAL HERNANDEZ Y GERMAN CEBALLOS:10 de marzo de 2000: Demanda Civil por daños y perjuicios contra el Dr. Felipe García Morales: Daños y perjuicios Despido injustificado.

14. ESTUDIO DE LUCRO CESANTE PARA EL SEÑOR WILFREDO CRUZ BURGOS: 9 de septiembre de 2000: Demanda civil por daños y prejuicios RDP 96-0505 contra Hospital Pavía, aseguradoras y médicos: Lucro Cesante/ Daños y perjuicios.

15. ESTUDIO ECONOMICO SOBRE LAS UNIDADES DE AUTO RETENIDAS POR LA GENERAL MOTORS OVERSEAS DISTRIBUTORS A LA FIRMA CONCESIONARIA; LUGO AUTO SALES; INC. Vs General Motors: Daños y perjuicios: Interrupción del negocio.

16. ESTUDIO DE EVALUACION DEL LUCRO CESANTE PARA EL SEÑOR CARLOS CARABALLO AGOSTINI: Evaluación del informe del economista Dr. Jaime Santiago Meléndez: 5 de diciembre de 2001.

17. ESTIMADO DE DAÑOS ECONOMICOS PARA LA SOCIEDAD DE BIENES GANANCIALES COMPUESTA POR CARLOS RUIZ LUCIANO Y MILAGROS ASENCIO ORTIZ: CARLOS RUIZ CASH & CARRY. (10 de octubre de 1998): Versus Concretera del Oeste, Inc, Carlos Binet y esposa y Aseguradora desconocida: Daños y perjuicios: Interrupción del negocio.

18. ESTUDIO PARA ESTIMAR EL LUCRO CESANTE PARA EL SEÑOR MANUEL VAZQUEZ CASIANO; 10 de abril de 2001; Demanda por daños y perjuicios al Hospital la Concepción por impericia médica: Lucro Cesante/Daños Muerte del señor Manuel Vázquez Casiano.

19. CASO DE COBRO DE DINERO POR INCUMPLIMIENTO DE CONTRATO: ESTUDIO DE DAÑOS ECONOMICOS PARA LA SEÑORA ELIZABETH GARCIA PERDOMO: Fecha: 10 de abril de 2001: Demanda Civil IDP97-0444: Reclamaciones de daños y perjuicios a Reinaldo García y Compañía: Daños y perjuicios: Despido injustificado

20. ESTUDIO PARA ESTIMAR EL LUCRO CESANTE PARA EL SEÑOR CARLOS RODRIQUEZ PADILLA: 10 de abril de 2001: Demanda civil por daños y perjuicios a Hospital la Concepción, San Germán: Lucro Cesante/ Daños por Muerte del sr. Carlos Rodríguez Padilla

21. ESTUDIO DE PERDIDA DE INGRESOS PARA LA SOCIEDAD DE BIENES GANANCIALES ABRAHAM RODRÍGUEZ RODRIGUEZ Y AUREA GARCIA COLON: (31 de marzo de 1997); Demanda civil por daños y perjuicios contra PanAmerican Grain: Daños y Perjuicios Despido injustificado y discrimen por Edad.

22. ESTUDIO DE DAÑOS ECONOMICOS PARA LA SEÑORITA ZULMA IRAIDA OTERO RODRIGUEZ: 27 de octubre de 2000: Demanda Civil #IDP99-0258 contra El Mayagüez Town Center Inc., Reading Cinemas of P.R., Inc et al.; Daños y perjuicios e Incapacidad parcial.

23. ESTUDIO DE PERDIDA DE INGRESO PARA ARIOSTO SOTOMAYOR: 25 de junio de 1999: Demanda Civil contra el Departamento de Recursos Naturales Daños y perjuicios: Discrimen Político.

24. ESTUDIO DE LUCRO CESANTE YELITSA SANTIAGO, ET AL VS HOSPITAL LA CONCEPCION: 10 de octubre de 2002: Demanda Civil contra HOSPITAL LA CONCEPCION: Civil Núm. IDP 1999-0449: Lucro cesante por impericia y negligencia médica.

25. ESTUDIO PARA ESTIMAR EN LUCRO CESANTE PARA SEÑORA ANA C. PUIG: 15 de octubre de 2001: Daños y Perjuicios: Sala Superior de Mayagüez

26. ESTUDIO DE EVALUACION DEL LUCRO CESANTE PARA CARLOS CARABALLO AGOSTINI: 5 de diciembre de 2001: Daños y Perjuicios: Sala Superior de Mayagüez.

27. ESTUDIO DE PERDIDA DE INGRESO POR CONCEPTO DE INTERRUPCION DE LAS OPERACIONES DEL NEGOCIO "PARADA LOS FLAMBOYANES" en Joyuda, Cabo Rojo, #102, Km. 15.9: 12 de abril de 2002: Daños y Perjuicios, Sala de Cabo Rojo.

28. ESTUDIO PARA ESTIMAR EL LUCRO CESANTE DEL JOVEN HECTOR RAFAEL PEREZ ZAYAS (Q.E.P.D.); 7 de marzo de 2002: Lucro cesante, muerte en accidente de tránsito.

29. ESTUDIO ECONOMICO DE LUCRO CESANTE PARA MARIA V. RODRIGUEZ MARRERO (Q.E.P.D.): (30 de mayo de 2002). DDP-2000-0698-504: Lucro cesante, muere en accidente.

30. ANALISIS DE LA CLAUSURA DEL CONTRATO ENTRE HECTOR SANCHEZ Y ESPOSA,Y UNA CORPORACION DE MICHIGAN: 18 de junio de 2002.

31. ESTUDIO SOBRE EL USO DE UN PREDIO DE TERRENO EN AGUADA, P.R.: ESTUDIO SOBRE EL INDICE DE PRECIOS AL CONSUMIDOR: Análisis del ajuste en la renta vía el Índice de Precios al Consumidor. Junio de 2002.

32. ESTUDIO PARA ESTIMAR EL DAÑO ECONOMICO DE LUGO AUTO SALES COMO CONCESIONARIO DE NISSAN EN PUERTO RICO: 9 de julio de 2002: Estudio para estimar daños y perjuicios.

33. ESTUDIO PARA ESTIMAR EL LUCRO CESANTE PARA LA SEÑORA DAMARIS IVETTE SANCHEZ BORGES; 17 de agosto de 2002: Estudio de lucro cesante por muerte e impericia y negligencia al Hospital de Damas, et al.

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