SOUTHERN STATES ENERGY BOARD

Transcending Boundaries

Blue Ribbon Task Force Report

STRATEGIZING AN ELECTRIC ENERGY POLICY & REGULATORY FRAMEWORK IN PUERTO RICO

November 2018

This report summarizes recommendations and options for the Government of Puerto Rico to consider when evaluating future energy policy and utility regulatory frameworks. Content is derived from the Southern States Energy Board, its project partners, and Blue Ribbon Task Force members. Considerable care has been taken to present a factual assessment of the legal and regulatory frameworks and finance, insurance, and economic risks that Puerto Rico's policy-makers may encounter while establishing related governing laws and regulations. However, the narrative herein is the result of a collaborative effort and is not the opinion of any one person or entity. As such, its contents should not be attributed to an individual or entity associated with the project.

This report is based upon work supported by the Department of Energy and was prepared as an account of work sponsored by an agency of the United States Government.

Preliminary Draft Report

Strategizing an Electric Energy Policy and Regulatory Framework in Puerto Rico and Blue Ribbon Task Force Recommendations

November 2018

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I. ABSTRACT

During 2017, hurricanes Harvey, Irma, Maria, and Nathan devastated and decimated parts of our Southern region. Most affected by these ravaging storms was Puerto Rico, which was blasted by hurricane Maria just six days before the Southern States Energy Board's 2017 Annual Meeting. In his role as Chairman, Governor Asa Hutchinson of Arkansas spoke for all members when he authored a Board resolution to provide assistance from the Board to Governor Rosselló and our member jurisdiction, Puerto Rico. That assistance now has taken the form of developing a long-term energy strategy and regulatory reform for the Island. A Blue Ribbon Task Force, led by SSEB and knowledgeable stakeholders from Puerto Rico, is exploring options for energy policies, regulatory regimes, financial and economic measures, insurance, and utility privatization.

The Southern States Energy Board announced the "Strategizing an Electric Energy Policy and Regulatory Framework in Puerto Rico" project through a public press release on February 27, 2018, that included statements of support from Governor Ricardo Rosselló Nevares of Puerto Rico, Governor Phil Bryant of Mississippi (SSEB Chairman 2017-2018), Governor Asa Hutchinson of Arkansas (SSEB Chairman 2015-2017), and Eddie Joe Williams, who serves as President Donald Trump's Federal Representative to the Board. On April 1, 2018, the project was officially awarded through a cooperative agreement between the Southern States Energy Board and the National Energy Technology Laboratory with funds provided by the U.S. Department of Energy's Office of Electricity.

This preliminary draft report, entitled "Strategizing an Electric Energy Policy and Regulatory Framework in Puerto Rico and Blue Ribbon Task Force Recommendations," presents an account of work performed to date by the Southern States Energy Board, its partners, and members of the Blue Ribbon Task Force. The goals of the project are: 1) to work with the Governor and Legislature of Puerto Rico to establish a reliable, affordable, and sustainable electric grid system for the Commonwealth, and for other purposes; and 2) to develop a policy and legal framework to provide a regulatory regime for a privatized electric energy grid system in Puerto Rico. A final report will be issued prior to the end of the project, which currently is anticipated in June 2019.

II. EXECUTIVE SUMMARY

On April 1, 2018, the Southern States Energy Board (SSEB) initiated a project entitled "Strategizing an Electric Energy Policy and Regulatory Framework in Puerto Rico." The goals of the project are to:

1. Work with the Governor and Legislature of Puerto Rico to establish a reliable, affordable, and sustainable electric grid system for the Commonwealth, and for other purposes; and
2. Develop a policy and legal framework to provide a regulatory regime for a possibly privatized electric energy grid system in Puerto Rico.

The project has four objectives that the SSEB must complete to achieve the two primary goals, including:

1. Build a stakeholder participation network;
2. Create potential legislative options for an electric energy grid system;
3. Define the long-term goals and objectives of policies and a regulatory framework; and
4. Review risks associated with privatization of the Puerto Rico Electric Power Authority (PREPA).

The project is focused on developing well-informed, unbiased, and innovative regulatory framework models for the Government of Puerto Rico. SSEB is responsible for the overall project oversight for all tasks and all partners. Project partners include: NORAVA Consulting; Rafael Llompart, Crescent Resource Innovation, JS Held, Smith Information Services, and Urban Connective Solutions.

This report supports the project objectives by providing an account of work completed as of November 19, 2018. It will be presented to a variety of stakeholders during an Energy Summit to be held in San Juan, Puerto Rico, on November 28, 2018. Background information is presented that offers historical details pertaining to PREPA. Further, the report outlines previous and recent legislative actions taken by the Government of Puerto Rico that is specifically related to the future energy policy and regulatory framework being developed in preparation for a privatized utility. This includes requirements of SSEB established in Act 120-2018 that was signed into law by Puerto Rico's Governor Ricardo Rosselló Nevares on June 20, 2018.

SSEB is actively engaging stakeholders across multiple sectors for the project. This is clearly represented by the individuals participating in its recently established Blue Ribbon Task Force (BRTF). With appointees from a diverse group of organizations, the BRTF convened on October 16-17, 2018, in San Juan to consider and formalize recommendations on policy and regulations.

During this event, the BRTF members divided into three subgroups focused on the topics of markets, permitting, and regulatory frameworks. Each subgroup was assigned co-chairs to facilitate the discussion. The markets subgroup was co-chaired by Mr. Sergio Marxuach, Center for a New Economy, and Dr. Carl Pechman, National Regulatory Research Institute. The permitting subgroup was co-chaired by Ms. Malu Blázquez, Resilient Puerto Rico Advisory Commission, and Ms. Janet Sena, North American Electric Reliability Corporation. The regulatory frameworks subgroup was co-chaired by Mr. Tomás Torres, Institute of

Competitiveness & Economic Sustainability, and Dr. Mark Jamison, University of Florida. The consensus-based recommendations enumerated below resulted from the subgroups' discussions and were presented to the full BRTF by the co-chairs.

The following recommendations were reported by the co-chairs of the markets subgroup:

- The regulator should evaluate rate allocation of legacy costs which could affect customer choices.
- The regulator is encouraged to evaluate the price of energy injected into the grid from distributed generation. Three options to be considered include:
    - Real-time prices based on system dispatch;
    - Administratively determined price; and
    - Buy back purchase agreements.
- The regulator is encouraged to review interconnection requirements to determine whether they are reasonable and consistent with industry norms.
- The regulator is encouraged to consider requiring PREPA and its successor(s) to provide statistics on reliability and system operation. These categories are:
    - System Average Interruption Duration Index (SAIDI);
    - System Average Interruption Frequency Index (SAIFI); and
    - North American Electric Reliability Corporation system operating statistics.
- The regulator is encouraged to work with North American Electric Reliability Corporation and other appropriate authorities to develop Puerto Rico-specific reliability standards and procedures.
- The regulator is encouraged to monitor and report on the efficiency and fairness of the dispatch of generating units on a regular basis.
- The regulator is encouraged to monitor and report on a regular basis the curtailment, and the reason for curtailment, of renewable generation.
- The regulator should be cognizant of different storage ownership and dispatch approaches.
- To inform potential market participants, the regulator is encouraged to require that a locational, real-time market price (cost) be developed and communicated based upon the power control dispatch algorithm.
- The regulator is encouraged to evaluate the benefits of demand response and, if appropriate, develop rules for its incorporation into system operation.

The following recommendations were reported by the co-chairs of the permitting subgroup:

- The permitting process should be independent from PREPA with suggested organizational placement of Puerto Rico Energy Bureau (PREB), or another independent body.
- Any statutory permit conditions, including expedited permitting processes, should be enforced to ensure the permitting agency is following legal requirements.
- The permitting agency should ensure that all new sources of generation comply with a uniform permitting and approval process, regardless of the project size.
- A review of the current net metering recertification process, currently required every five years, is needed to not only standardize requirements but also determine overall need of the recertification process.

- The permitting agency should establish a mandatory certification or licensing process for solar installers, including for maintenance, and ensure it is widely available to all interested.
- The permitting agency should work with all branches of government and other relevant agencies, including the PREB, to establish an incentive program that provides clear and expedited permitting requirements for future development.
- The permitting agency should review processes currently in place, specifically relating to environmental permits and land rights, for current and future major transmission lines and base load generation.

The following recommendations were reported by the co-chairs of the regulatory frameworks subgroup:

- The regulatory framework should be performance-based and designed to strengthen utility performance through incentives.
- The regulatory framework should be designed to provide the PREB complete authority without political intervention.
- Electric cooperatives should be an integral part of the Puerto Rico energy system.
- The regulatory framework structure should be based on the most applicable aspects of the Florida and Texas Public Service Commission models.
- Legislation should authorize the PREB to designate the service territories of the energy providers.
- The Puerto Rico Energy Bureau should develop regulations and standards for utility scale and residential solar systems, including Community Solar applications.
- The PREB should develop regulations that addresses Cost Recovery for energy providers through the use of cost-based rates.
- The regulatory framework structure and operation should be totally transparent and decision-making authority should be exercised in a collaborative manner. There should be a balance between how quickly decisions are made and what is being decided.
- The PREB should be provided the resources and authority to recruit and hire competent, professional staff.
- The PREB should have the authority to access relevant documentation from regulated energy providers and possess the necessary enforcement authority with associated penalties.
- The PREB should consist of three to five Commissioners appointed by the Governor with the consent of the Senate and with staggered appointments. Appointed Commissioners should be qualified, competent candidates and fully vetted by the cognizant Legislative committees.
- The PREB Executive Director should be bipartisan and independently appointed by the Commissioners.
- The regulatory framework should allow for Consumer Advocates and related organizations to provide relevant information.
- The regulatory framework should properly consider the role of energy efficiency, demand side management, energy storage, distributed energy resources, and electric vehicles (EV).

- With energy being provided from a variety of resources, a regulatory framework needs stakeholder buy-in which considers reliability and economic impact to all customers.
- The regulatory framework needs an appeal mechanism when regulated organizations disagree with the PREB decisions. The frameworks need to distinguish between legal and policy requirements.

The impacts of PREPA's privatization are also examined within this report, with an emphasis on the issues to be addressed to provide positive assurances to potential investors. These issues include the current financial situation, the anticipated regulatory environment, restoration funding, condition of existing infrastructure, fuel sources, existing power purchase agreements, labor relations, pension funding, and other topics. Act 120-2018 established a timeline to privatize the utility, to sell power plants, and to make a concession of its electricity transmission and distribution (T&D). On August 24, 2018, José Ortiz, Executive Director of PREPA, said that the private company that will run the operations of the utility will be selected in May 2019. On October 31, 2018, the Puerto Rico Public-Private Partnership Authority in conjunction with PREPA published a request for qualifications (RFQ) seeking to identify companies that are interested in the operation of the utility´s transmission, distribution, and customer service. That proposal should be adjudicated by May 2019. "The idea is to have the new operator of the Authority already working by July (2019). In parallel, we will be working on the sale of generation assets," said Mr. Ortiz[1].

The Puerto Rico Energy Public Policy Act, Senate Bill 1121, was introduced on October 17, 2018, it passed the Senate on November 6, and the House will take up the bill in the next legislative session that begins in January 2019. With regard to fuel diversity and operability of the electric grid, Puerto Rico is considering a requirement to meet its electricity demand with 100% renewable energy by 2050, in addition to streamlining grid interconnection of distributed energy and microgrids. Senate Bill 1121 also would eliminate coal-fired generation by 2028 while continuing to support investments in fossil fuels by mandating oil-fired power plants be converted to dual-fuel capability (Burger, 2018). Interim goals are for renewables to comprise 20% of the system by 2025; 50% by 2040; and includes a goal of 30% energy efficiency by 2040. Within the framework of the Integrated Resource Plan (IRP), which is updated every three years, the planning horizon of the IRP is 20 years (i.e., nearing 2040).

While Puerto Rico considers the decision to mandate a 100% renewable energy portfolio by 2050, there are a number of issues to explore and, from a high-level vantage point, a few obstacles that will need to be overcome from a technological and engineering perspective in order to achieve this goal. Some issues typically raised when discussing an electrical system comprised of all renewable resources include: operability of a system comprised of intermittent, distributed resources; ability of the electrical grid to provide reliable, affordable power; the lack of fuel diversity; and the ability to transform the entire electrical system to remove all carbon-emitting fuel sources.

While working to achieve this goal, new options currently unforeseen could evolve over this long timespan that could possibly justify re-evaluation of this goal. As a consequence, the PREB has an important role to play, not only as the administrator of change but also as the eyes and

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ears of the Legislature on new options and potential changes in policy that will enhance the electric system and the welfare of the people of Puerto Rico.

This report concludes with a forward-looking discussion of knowledge gaps identified to date throughout this project and future activities or studies needed to further the goals of the Government of Puerto Rico.

SSEB is honored to present this preliminary draft report of project activities, findings, and recommendations to the Government and citizens of Puerto Rico. SSEB and its partners offer continued support of Puerto Rico's effort to restore an electric grid and generation that is more resilient and maintains affordability for residential, commercial, and industrial customers.

III. INTRODUCTION

The Southern States Energy Board (SSEB) is a non-profit interstate compact organization created by southern governors and state legislatures in 1960 and established under Public Laws 87-563 and 92-440. The Board's mission is to enhance economic development and the quality of life in the South through innovations in energy and environmental policies, programs, and technologies. Sixteen southern states and two territories comprise SSEB's membership, with each jurisdiction represented by the governor and a state legislator from the House and Senate. Participation by all member jurisdictions in the Southern States Energy Board Compact is critical not only to the states but also to the region. All of the activities of the Board benefit the southern region in the development of a sound economy, proper utilization and diversity of energy sources and increased industrialization, while providing for protection of the environment to ensure public health, safety, and welfare.

SSEB's programs assist the region's stakeholders in addressing energy and environmental issues that transcend state boundaries and provide direct benefit to individual states. Long-term goals include:

- Perform essential services that provide direct scientific and technical assistance to state governments;
- Develop, promote, and recommend policies and programs on energy, environment, and economic development that encourage sustainable development;
- Provide technical assistance to executive and legislative policy-makers and the private sector in order to achieve synthesis of energy, environment, and economic issues that ensure energy security and supply;
- Facilitate the implementation of energy and environmental policies between federal, state, and local governments and the private sector;
- Sustain business development throughout the region by eliminating barriers to the use of efficient energy and environmental technologies; and
- Support improved energy efficient technologies that pollute less and contribute to a clean global environment while protecting indigenous natural resources for future generations.

Since Governor Luis Ferré initially joined SSEB on behalf of Puerto Rico in 1970, the Board has continued an active presence and involvement in the energy resource and technology issues that affect the Island. That presence continues to this day with the Administration of Governor Ricardo Rosselló Nevares. SSEB members and staff are attuned to the long-term goals that are

necessary to transform the Island's energy grid to an affordable, reliable, resilient, and sustainable energy system. Over the years, the Board has worked to benefit the economy of the Island through its involvement in energy resources development.

In September 2017, Puerto Rico was devastated by Hurricane Maria with impacts that will last for years to come. In the wake of this catastrophic event, the strength and perseverance of the Puerto Rican people has consistently presented itself. With much of the electricity system and transportation network system severely damaged, repairs and restoration have only recently been completed to provide all citizens with restored power service.

During the SSEB's 57th Annual Meeting in Charleston, South Carolina, SSEB Chairman Governor Asa Hutchinson introduced resolution number 13.2017 entitled, "Providing Support to Southern States Energy Board Member Jurisdictions in the Aftermath of Hurricane Disasters." SSEB members, including southern governors, legislators, and other state officials, unanimously passed the resolution on September 26, 2017.

The resolution calls for SSEB to offer support to the Governors of Puerto Rico and the U. S. Virgin Islands and the utilities to restore and rebuild their critical electric energy infrastructure and coordinate cooperative assistance with its Associate Members, the nation's energy sector, and the federal government to provide necessary technical support and resources. SSEB is requested to coordinate the technical capabilities of the Board, Associate Members, and others to assist with the ongoing energy crisis in Puerto Rico and the U.S. Virgin Islands.

That assistance now has taken the form of developing a long-term energy strategy and regulatory reform for the Island. The Southern States Energy Board announced the "Strategizing an Electric Energy Policy and Regulatory Framework in Puerto Rico" project through a public press release on February 27, 2018, that included statements of support from Governor Ricardo Rosselló Nevares of Puerto Rico, Governor Phil Bryant of Mississippi (SSEB Chairman 2017-2018), Governor Asa Hutchinson of Arkansas (SSEB Chairman 2015-2017), and Eddie Joe Williams, who serves as President Donald Trump's Federal Representative to the Board.

On April 1, 2018, the project was officially awarded through a cooperative agreement between the Southern States Energy Board and the National Energy Technology Laboratory with funds originating from the U.S. Department of Energy's (DOE) Office of Electricity (OE). The goals are to:

1. Work with the Governor and Legislature of Puerto Rico to establish a reliable, affordable, and sustainable electric grid system for the Commonwealth, and for other purposes; and
2. Develop a policy and legal framework to provide a regulatory regime for a possibly privatized electric energy grid system in Puerto Rico.

Achievement of the goals will rely on the completion of four key objectives, including:

1. Build a stakeholder participation network;
2. Create potential legislative options for an electric energy grid system;
3. Define the long-term goals and objectives of policies and a regulatory framework; and
4. Review risks associated with privatization of the PREPA.

The project focuses on developing well-informed, unbiased, and innovative regulatory framework models for the Government of Puerto Rico. SSEB is responsible for the overall project oversight for all tasks and all partners. Project partners include: NORAVA Consulting; Rafael Llompart, Crescent Resource Innovation, JS Held, Smith Information Services, and Urban Connective Solutions.

IV. STAKEHOLDER ENGAGEMENT

Stakeholder engagement is an essential and mutually beneficial strategic function that results in better informed participants and more effective development of an appropriate regulatory framework for Puerto Rico. For stakeholders, the benefits of engagement include the opportunity to contribute to the regulatory framework policy and program development, to provide input into issues affecting the overall framework, and to participate in the decision-making process. For the Government of Puerto Rico, the benefits of stakeholder engagement include: 1) improved communication between the Government and other individuals, groups, and organizations that work with the Government; 2) access to critical information related to the past experiences of individuals and organizations; and 3) the ability to consider the implications of policy initiatives or proposals to inform strategy development. Together, these benefits are intended to lead to a robust regulatory framework, positive outcomes, including a more reliable, resilient and affordable electric system, strengthened relationships and trust, and transparency. Experience has also shown that the earlier stakeholders are engaged, the more likely benefits will be realized.

The SSEB continues to develop a robust stakeholder network. All identified stakeholders will be invited to participate in an Energy Summit that is planned for November 28, 2018. We also have a dedicated webpage with information related to the project. The webpage address is www.sseb.org/strategizing-pr/.

V. EXISTING POLICY AND REGULATORY FRAMEWORK IN PUERTO RICO

PREPA was originally established as the Puerto Rico Water Resources Authority through Act 83-1941, due to an early reliance on hydrogeneration.[2] As fuels for electricity generation shifted toward petroleum, the name was changed in 1979 through Act 57-1979 to reflect the new status of PREPA on the Island. Countless Legislative measures have been enacted since that time enabling PREPA, whether through its own generation or power purchase agreements, to become the sole provider of electricity in Puerto Rico.

In May of 2014, Act 57-2014 established the Puerto Rico Energy Transformation and RELIEF Act. While this act seeks to reshape PREPA, as other measures have done previously, one of the major milestones resulting from Act 57's passage is the establishment of the Energy Commission (now the Energy Bureau), the Energy Administration, and the Independent Consumer Protection Office.

On January 22, 2018, Governor Ricardo Rosselló Nevares announced the transformation of the energy system by initiating the privatization of PREPA.[3] Since his proclamation earlier this year, the Legislature has been actively working to pursue this goal within the 18-month time frame that Governor Rosselló Nevares stated in his announcement.

[2] PREPA, *History of PREPA*, https://www2.aeepr.com/INVESTORS/History.aspx.
[3] Governor of Puerto Rico, Governor Ricardo Rosselló, *Message of the Governor of Puerto Rico*, January 22, 2018.

Introduced in both bodies of the Legislature in March 2018, Governor Ricardo Rosselló Nevares approved Act 120-2018, the "Puerto Rico Electric System Transformation Act" on June 20, 2018, which began the process of privatizing PREPA. This legislation implemented the specific legal requirements, to be carried out by the Public-Private Partnerships Authority, for an eventual privatization of PREPA through the selling of generation assets.

The "Blue-Ribbon Task Force on the Formulation of Energy Public Policy and the Regulatory Framework", also known as the Advisory Committee, was created through Act 120-2018. As stated in the legislation, "a Task Force shall be created to be in charge of working and making recommendations on the energy public policy and the regulatory framework." In this capacity, SSEB offers advice and recommendations, along with other agencies and partners, for approval by the Governor and Legislature.

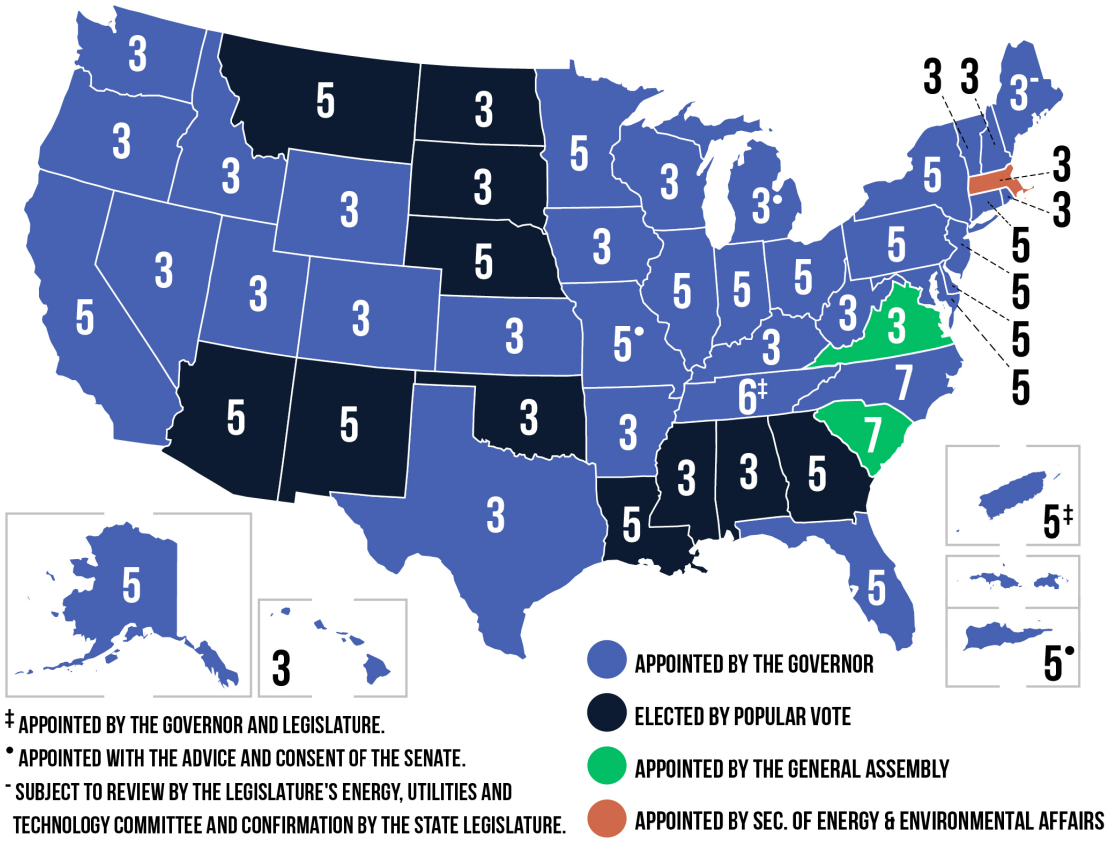
Another crucial piece of Act 120-2018, related to SSEB and the Advisory Committee, is the Legislatively established deadline for approval of the Puerto Rico Energy Policy and Regulatory Framework. Act 120-2018 states that the Legislature must approve any recommendations within 180 days of approval, or no later than December 17, 2018.

Act 122-2017, the "New Government of Puerto Rico Act," first laid the foundation for the reorganization of the Public Service Regulatory Board (PSRB). The reorganization and consolidation of multiple agencies was soon implemented by the passage of Act 211-2018 in August 2018. The result is a Public Service Regulatory Board that now encompasses the Public Service Commission, the Telecommunications Regulatory Board, and the Energy Bureau.

The Puerto Rico Energy Public Policy Act, Senate Bill 1121, was introduced on October 17, 2018, it passed the Senate on November 6, and the House will take up the bill in the next legislative session that begins in January 2019.

A. Regulatory Agency Structure

SSEB performed a comprehensive assessment of existing regulatory agencies' structure and function throughout the United States and its territories, the results of which are identified in the figure below. In the continental United States, plus Puerto Rico and the U.S. Virgin Islands, the public service commission is a multi-member board responsible for the regulation of utilities, with a total of 213 seats on public service commissions. Most commissions have three seats, though some have as many as seven seats. Public service commissioners are appointed in 41 states and territories and elected in the other 11. Of those states that appoint public service commissioners, all but Virginia give the power of appointment to the governor. In 2017, public service commissioner salaries ranged from $90,000 in New Mexico and West Virginia to $195,658 in South Carolina.



Existing law mandates a five-member Puerto Rico Energy Bureau, with one Chairman and four Associate Commissioners. Commissioners are appointed by the Governor and confirmed by the Senate, and the structure provides for staggered terms. On August 20, 2018, Governor Ricardo Rosselló Nevares announced the first appointments to the recently-established PREB. The first three individuals announced include: Chairman Edison Avilés Deliz, and Associate Commissioners Lillian Mateo Santos and Ferdinand Ramos. These three new regulators join sitting Associate Commissioner Ángel R. Rivera who has served at the PREB since 2014.

VI. ESTABLISHING A STRONG PUERTO RICO ENERGY BUREAU

A strong public utility commission (PUC) is an essential element for developing an electric system that can support a robust economy for Puerto Rico. So much so that the Financial Oversight and Management Board for Puerto Rico (FOMB) certified that:

> The long-term sustainability of Puerto Rico's energy sector depends on having a strong, independent, and professional regulator.[4]

[4] "New Fiscal Plan for Puerto Rico: Restoring Growth and Prosperity," as certified by the Financial Oversight and Management Board for Puerto Rico, October 23, 2018, Pg. 56.

PUCs[5] historically have been charged with assuring safe, reliable, and affordable service. Across the United States and in Puerto Rico, this charge is expanding to include greening the industry to reduce carbon emissions and ensuring system resilience.

PREB[6] has a unique challenge. It is charged with steering the transition of Puerto Rico's electric utility industry through three phases to become a world class electric system. The three phases are:

1. Current state. PREPA is a bankrupt municipal utility under the financial control of the FOMB that is regulated by the PREB. In practice, the mentioned structure results in two authorities overseeing PREPA, often with conflicting goals. For example, the FOMB is mainly concerned with aligning the PREPA budget with milestone guidelines it has established to track the utility's progress out of bankruptcy, while PREB must be certain that PREPA's services still comply with certain industry quality standards and that rates are just and reasonable and not discriminatory.[7] Each mentioned goal may conflict or be unattainable at the same time.
2. Transformation of PREPA. Current policy calls for significant changes to PREPA in the future. The initial step in this process may be the creation of a "concession" that will operate Puerto Rico's transmission and distribution system. Further steps will include the divestiture of PREPA generation. The way in which the concession is established and generation is divested will play an important role in determining the cost of power to ratepayers as well as options for transforming the electric system.
3. A 100% renewable Puerto Rico. The end-state vision of the transformation of the Puerto Rican electric system is to create a system in which 100% of the energy comes from renewables.

In the event that S. del P. 1121 is adopted in the 2019 legislative session, the challenge for the PREB in the short-term will be implementing the established public policy while concurrently working within FOMB's budgetary guidelines to develop an energy system that in the future will be 100% renewable. To meet that challenge, the PREB will need to undertake a long list of activities that fall into six general categories:

1. Customer protection;
2. Carrying out the policies of the Legislature towards a green future;
3. Monitoring and streamlining PREPA performance;
4. Design of rates;
5. Determining the role of the utility and competitive entities; and
6. Design of markets.

To do so, PREB will establish rates, oversee the development of a market for power, determine the rules by which power is sold by distributed energy resources and micro-grids, enforce competitive market policies, and protect low-income customers.

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[5] Puerto Rico Legislature recently approved Act 211-2018, in which it created the Puerto Rico Public Services Board (PRPSB) an entity very similar to the states' public utilities commissions. The Puerto Rico Energy Bureau is part of the PRPSB, and one of its main responsibilities is to regulate the Puerto Rico's energy sector.
[6] Previous to Act 120-2018 approval, it was known as the Puerto Rico Energy Commission.
[7] https://www.utilitydive.com/news/federal-oversight-board-orders-changes-to-prepa-budget/530033/

A. The Objective of Regulation

Utility regulation is more art than science and is largely the art of compromise. Historically, it has required the balancing of three primary principles articulated by James C. Bonbright, an eminent academic observer of utility regulation, as:

1. The financial-need principle: allowing utilities a fair return;
2. The fair-cost-apportionment principle: distributing revenue requirements fairly among the beneficiaries of the service;
3. The optimum-use principle: designing rates to discourage wasteful use while promoting all use that is economically justified in view of the relationships between the costs incurred and the benefits received.[8]

Among these three objectives, there is tension between the concepts of a just and reasonable price (objective 2) and economic efficiency (objective 3). The concept of just price originated with Saint Thomas Aquinas' views about the immorality of raising prices in times of shortage and was incorporated in early price regulation in England.[9] Economic efficiency is concerned with creating an optimal allocation of resources as a way of maximizing social welfare. Economic efficiency does not reflect views of just prices or equity. It is the role of regulation to sort out and weigh the importance of each principle when establishing rates.

Historically, regulatory commissions have been charged by their enabling legislation with overseeing a regime that would produce safe and adequate service at just and reasonable rates. Adequacy in electric power regulation has often been equated to maintaining a generation reserve margin that allows the electric system to withstand generation outages in a way that allows it to operate without interruption. The concept of adequacy has evolved over time, from generation-centric criteria to resource criteria that includes demand side resources (such as demand response) as methods of enabling the system to withstand disruptions. The vehicle for evaluating and developing plans for maintaining resource adequacy is the Integrated Resource Plan (IRP) which effectively serves as Puerto Rico's energy plan.

The process by which PUCs establish just and reasonable rates is largely guided by Supreme Court precedent. For example, the legal standard for setting a fair rate of return has been established by the United States Supreme Court initially by the *Bluefield*[10] and *Hope* decisions.[11] In *Bluefield*, the court found that:

[8] James C. Bonbright, *Principles of Public Utility Rates,* (New York: Columbia University Press, 1961), 292.
[9] Martin Gustav Glaeser, *Public Utilities in American Capitalism,* (New York: Macmillan, 1957).
[10] *Bluefield Water Works & Improvement Co. vs Public Service Commission of West Virginia* (1923) 262 U.S. 679.
[11] *Federal Power Commission vs. Hope Natural Gas Co.* (1944) 320 U.S. 591.

> The return should be reasonably sufficient to assure confidence in the financial soundness of the utility, and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise money necessary for the proper discharge of its public duties.

The traditional regulatory regime created incentives that led to inefficient investment and operations. For example, the Averch-Johnson effect[12] is a well-recognized incentive that leads to a capital bias (building ratebase) on the part of regulated utilities. This is due to the fact that the utility earns a return for its investments that goes into the utility's rate base. Operating expenses are recovered with no profit. Similarly, fuel adjustment clauses that allow the pass through of fuel costs above those forecast in the development of rates were found to dull incentives for pursuing the efficient delivery of service. Regulation has responded to these incentives by decoupling rates and creating incentive programs, such as partial pass-through fuel adjustment clauses.

B. The Importance of Transparency

Transparency is vitally important to the success of PREB and the transformation of the electric system in Puerto Rico. There are different dimensions of transparency, including process, price, and the product of regulation. The three Ps of transparency will determine the confidence of stakeholders, credit rating agencies, and the people of Puerto Rico in the PREB and the process of transforming the electric sector. Investor and consumer confidence are vital to the successful transformation of the Puerto Rican electric sector.

There are a variety of procedural approaches that can provide the basis for regulatory decisions. These range from adversarial proceedings that follow the strictures of administrative law to collaborative proceedings that allow parties to work together to reach a joint decision. The level of information content differs in these two approaches. Litigated proceedings are information revealing because opposing sides have the ability to cross-examine the basis and veracity of the other party's positions. An administrative law judge or hearing officer will make a preliminary decision that will be affirmed or modified by the PUC in its final decision (which can then reviewed by the courts). In a collaborative proceeding, parties seek to find common ground. There is a give and take, based upon each parties BATNA (Best Alternative to a Negotiated Agreement). Although a pure negotiation process is not information revealing, it provides direction based on the views of participating parties.[13] The term participating parties here is important because those that do not participate do not have a voice and their interests are not represented. In either case, it is important that the ultimate decision by the PUC be supported either by the results of a litigated or collaborative process. Transparency in decision making will increase investor and consumer confidence that the PREB is building a sustainable energy future for Puerto Rico.

[12] Averch, Harvey; Johnson, Leland L, "Behavior of the Firm Under Regulatory Constraint," American Economic Review, 1962, 52 (5): 1052–1069.

[13] It should be noted that in the regulatory environment there are many instances in which negotiations occur after discovery and fact finding.

From an economist's perspective, the single most important source of information for consumer and investor decisions is price.[14] Two categories of prices are important. The first is the retail price, which provides customers with information for consumption (and increasingly self-generation) decisions. The second is an energy market price, which provides investors in supply and demand side resources with information to determine levels of investment. Different approaches to market prices and the importance of transparency are discussed in the section on markets (pages 26-28).

Regulation frames the development of the electric system determining the cost of electricity to customers, its resilience, level of greenhouse gas emissions, and system reliability. The objective of regulation is often prescribed by legislation and public policy (*e.g.*, a target of 100% renewables). As described more in the chapter/section on fuel diversity, regulation can play a vital role in informing the public, Legislature, and public policy of the status of the system. Doing so provides feedback on the prudence of updating objectives assuring that the transformation of the electric system best meets the needs of the people of Puerto Rico.

C. Shared Responsibilities

The Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) created the Oversight Board. The purpose of the Oversight Board is "to provide a method for a covered territory to achieve fiscal responsibility and access to the capital markets."[15] The Oversight Board's principal function is to recover money for debtors: "(t)he Oversight Board may take any action necessary on behalf of the debtor to prosecute the case of the debtor."[16] The Oversight Board will "retain its powers as long as PREPA remains a covered entity under PROMESA." The Oversight Board contrasts its role and that of the PREB as follows:[17]

[14] Hayek, F., "The Use of Knowledge in Society," American Economic Review, 1945, 35, 519-530.
[15] PROMESA, Title 1, Sec. 101 (a)
[16] PROMESA, Title 3, Sec. 315 (a)
[17] "New Fiscal Plan for Puerto Rico: Restoring Growth and Prosperity," as certified by the Financial Oversight and Management Board for Puerto Rico, October 23, 2018, pg.58.

Action	Oversight Board	PREB
IRP	The Oversight Board approves revenue requirements and expenditures, including a capital plan, in the New Fiscal Plan for PREPA. The IRP process should be informed by and based on the New Fiscal Plan as additional data and more details on the capital plan and revenue requirements become available.	PREB will approve the IRP. The IRP should test the scenario and alternatives in the New Fiscal Plan to achieve the principles of affordable, reliable and secure power. PREB should ensure that the IRP process is open and transparent so that third parties can understand inputs and methodologies behind each scenario and be able to participate and attend hearings to understand tradeoffs and decisions driving approval of the final capital plan and revenue requirement.
Budget and Ratemaking	The Oversight Board approves a yearly budget that aligns with the New Fiscal Plan for PREPA and thus should align with revenue requirements and expenditures.	PREB shall authorize rates (either formulaic or on an expedited manner) which align with the budget as certified by the Oversight Board.
Utility Debt	The Oversight Board approves restructuring of existing debt through the Plan of Adjustment for PREPA.	According to Act 57-2014 and Act 4-2016, PREB has the responsibility of adopting and implementing PREPA's approved restructured debt in the consumers rates.
Transformation	As the representative of PREPA in Title III, the Oversight Board has the exclusive right to file a plan of adjustment, which will contain the transformation agreements.	According to Act 120-2018, PREB has the responsibility of certifying that any transaction related to PREPA's transformation complies with the existing legal framework.
Other		PREB will continue to exercise its duties and responsibilities as outlined in its enabling laws except when doing so is inconsistent with the powers and authorities delegated to the Oversight Board under PROMESA.

Even when the powers of the Oversight Board are considerable, Puerto Rico's Legislature retains its policy power to regulate the energy sector and to adopt the energy public policy. PREB must implement the adopted energy public policy, unless a federal court judge's decision rules otherwise. The PREB's role is largely to approve within choices framed by the Puerto Rico's Legislature and within the Oversight Board budgetary constraints. These actions will define the future structure of Puerto Rico's electric system. Further, they have different objectives. The FOMB is concerned about recovery for bondholders, and the PREB's concern is what is good for the people of Puerto Rico. It is appropriate for the PREB and FOMB and other agencies within the government to enter into a mutual collaborative arrangement to build a working compact to guide the transformation of PREPA. In the short run, the Oversight Board will establish new relationships due both to the divestiture of generation and selection of a concessionaire to operate PREPA's transmission and distribution system. This collaborative relationship should also include the Puerto Rico Public-Private Partnerships Authority (PPP), which is the agency overseeing the development of contracts. PPP's Request for Qualifications for a concessionaire to take over the operation of PREPA's transmission and distribution system states that:

> Respondents should note that the PPP Committee has been vested with the authority to negotiate the terms of the PPP Contract. PREPA has been vested with the authority to execute the PPP Contract negotiated by the PPP Committee with a Private Partner, subject to the approval of (i) the Puerto Rico Energy Bureau created by Act 57-2014, as amended, to regulate, monitor and enforce the energy public policy of the Government (the "Energy Bureau").[18]

Auction theory suggests that bidding is enhanced by the clarity of the product, in this case services, to be procured. In this regard, a clear articulation of the future regulation of the concessionaire will provide information that potential concessionaires can use to better judge their bidding strategy. Doing so should increase the number of bidders and lead to a more robust outcome.

D. Performance Based Regulation

Former Chairman of the New York Public Service Commission and eminent scholar of regulation Alfred Kahn has opined that "[t]he essence of regulation is the explicit replacement of competition with governmental orders as the principal institutional device for assuring good performance."[19] Therefore, regulation is a proxy for markets where competitive markets are infeasible. Without judging the long-run, in the short-run a competitive market is infeasible for Puerto Rico. Market forces are being brought to the electric system with actions such as "retail wheeling." As a consequence, the PREB will create regulations that incent entities providing service to Puerto Rico's ratepayers. Performance Based Regulation (PBR) refers to explicit efforts to create regulatory incentives.

There are two types of PBR:

1. Targeted incentives - such as maintaining reliability to deliver based upon the CAIDI, SAIDI and SAIFI metrics;[20] and
2. Enterprise-wide incentives – such as price cap regulation that has a formula to determine rates and how they can change over time and with different conditions.

Targeted incentives are used to improve particular services. Ultimately, a targeted incentive requires a metric, which could be the reliability metrics cited above, targets for energy efficiency or metrics for improving transmission and distribution maintenance. Targeted incentives are generally thought of as a positive action, providing additional profits to the enterprise. But, targeted incentives can also be penalties, such as the penalties that the NERC is able to impose for failure to maintain reliability standards,

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[18] Puerto Rico Public-Private Partnerships Authority, "Request for Qualifications, Puerto Rico Electric Power Transmission and Distribution System RFQ 2018-2," Issued October 31, 2018. Pg.2. with additional information to supplement table.

[19] Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions*, Vol. 1, 1970. pg. 20.

[20] CAIDI – Customer Average Interruption Index equal to average duration of customers outages.
SAIDI - System Average Interruption Duration Index – average duration of outages for each customer served, which is equal to the annual aggregate average duration divided by the number of customers,
SAIFI - System Average Interruption Frequency Index equal to the total number if interruptions divided by the number of customers.

Enterprise-wide incentives are frequently referred to as price cap regulation. Under this incentive regime, next year's price is equal to this year's price increased for inflation and reduced by an adjustment for system improvements. The enterprise is then free to maximize profits given the revenues associated with price caps. It is important that the PUC maintain oversight of the performance of the enterprise. For example, one way for an electric utility to produce immediate profits is to cut back on tree trimming, but this profit increase strategy can have the detrimental effect of starting a fire. PUC oversight can reduce these detrimental effects by combining price cap regulation with targeted incentives.

The type of the incentive program adopted will have a direct effect on the cost and quality of service. For example, price cap regulation will determine the way in which the electric utility makes a profit. It is difficult to develop an incentive program for PREPA, because it has no stockholders. As a consequence, money provided for incentives will be paid by customers and unless provided as bonuses to employees, it will go back to customers. Similarly, any penalties other than those specifically targeted at management will come from customers and go back to customers. It is important to begin evaluating and establishing metrics now so that when competitive enterprises, such as the concessionaire, begin to provide service, analytical methods are in place and there is a history of metrics that track their performance.

The nature of incentives will be critical for the PREB oversight of the concessionaire. Foreknowledge of incentive programs will help potential concessionaires better understand the metrics for the service that they are offering. Providing certainty about the future relationship with the regulator will provide clarity to bidders for the concession, ultimately reducing the probability of future disputes over the terms of the concession.

E. PREB's Scope

The PREB's scope determines what it can affect and how. Scope is three dimensional. The first dimension is time, when regulatory actions begin. The second dimension is breadth; for example, it should be determined whether it makes sense for PREB's regulatory authority to focus on electricity without also having authority over natural gas. The third dimension is depth. The PREB regulatory authority extends to what are traditionally thought of as wholesale and retail markets. This leaves the issue of how deep the PREB should go in regulating down to the customer level. For example, many PUCs regulate distribution level interconnection standards, and it appears reasonable that PREB do so as well.

As discussed, in the continental United States, state PUCs regulate retail service and rates – often called sales to final customers. Wholesale markets are regulated by the Federal Energy Regulatory Commission (FERC) (with the exception of Texas). Wholesale transactions are often referred to as a sale for resale because an intermediary, such as a local distribution utility or power marketer is purchasing power and reselling it to either another wholesale customer or to the final customer. As new options develop on the customer side of the meter, the bright line between wholesale and retail is becoming blurred leading to regulatory ambiguity regarding state and federal jurisdiction.

Even when the powers of the Oversight Board are considerable, Puerto Rico's Legislature retains its policy power to regulate the energy sector and to adopt the energy public policy. PREB must

implement the adopted energy public policy, unless a federal court judge's decision rules otherwise. The PREB's role is largely to approve within choices framed by the Puerto Rico's Legislature and within the Oversight Board budgetary constraints.

It would be useful for the PREB to solicit stakeholder comment on their expectations of the scope of PREB's authority. It seems that different parties will have different views largely dependent on their answers to the following questions that will help to define the future organizational structure of Puerto Rico's electric system.

- What is the role of regulation versus competition in providing different services?
- Which segments of the electric system are [should be?] competitive?
- What is the appropriate method for calculating grid charges?
- How do we assure reliable service to low income customers?
- Will liquefied natural gas (LNG) play a key role in powering Puerto Rico's electric system? If so, for how long? How will LNG be transported on the Island, and how or should it would be regulated?
- Are there rules that PREPA now establishes that would more appropriately be determined by the PREB, *e.g.,* interconnection standards?

Understanding the parties' expectations and desires will provide clarity on needed authority, not currently provided by law, which will better enable PREB to fulfill its responsibility to "regulate, monitor and enforce the energy public policy of the Commonwealth of Puerto Rico." The PREB can then work with the Governor and Legislature to secure authority to better enable it to implement the development of a world class electric system.

F. Regulatory Agenda

The PREB has hit the ground running. It has a significant agenda before it. Early steps in guiding the transformation of the Puerto Rico electric system will require the PREB to take action in several areas as indicated below.

Governance:

- Evaluate whether divestiture plans for PREPA generation will support an economically efficient transition of the electric system and whether it will convey market power to the entities that acquire generation. It is suggested that criteria for review be established prior to the issuance of an RFP to sell the plant.
- Determine the scope of authority for customer protection and establish mechanisms for customer protection.
- Develop rules for ownership of EV charging infrastructure and establish tariffs for EV charging and use of the EV as a grid resource.

Operations:

- Adopt and track power system operation metrics.
- Evaluate criteria and methods for maintaining system security (both operating and installed reserves).
- Determine requirements for upgrading power system dispatch.
- Oversee the energy efficiency efforts.

Markets:

- Assess the structure of an electricity market for Puerto Rico and the process for determining a market price.
- Evaluate generation market power and determine how the potential existence of market power will frame the options available to transform the electric system.
- Evaluate alternative approaches to establishing demand response.
- Evaluate the PREPA generation fleet and determine which units are no longer used and useful
- Review and, if warranted, update the interconnection process.
- Evaluate how alternative market structures support resource adequacy, including the vertically integrated utility model, the California model, restructured utilities with capacity markets, such as those found in the Northeast and energy only markets in Texas.

Accounting:

- Audit PREPA billing protocols and determine why customers are not being billed.
- Review data needs and availability including accounting data and cost data.

Price formation:

- Determine method for compensating DERs and micro-grids for power injected into the grid.
- Evaluate current rates, including evaluation of underlying cost studies.
- Determine whether the contract with the concessionaire is just and reasonable. It is suggested that the criteria for review be established prior to the issuance of an RFP for the concessionaire.
- Evaluate options for instituting performance based regulation, in particular in the concessionaire contract.

Management:

- Establish rules and regulations for right of way management.

Planning:

- Evaluate the IRP and determine regulatory actions required to implement IRP recommendations.
- Develop requirements for resilience plans.

VII. MARKETS

A. The Role of the Market

The transformation of the Puerto Rican electric system will increasingly rely on markets with multiple parties generating and selling power. Markets for electric power do not develop spontaneously, rather, they are guided by public policy and regulation that help define their structure and operation. In the mainland United States, wholesale organized markets are regulated by the FERC[21] and market rules are codified in tariffs. As an island isolated electrically, Puerto Rico is not under the FERC's jurisdiction and any market regulation will be performed by PREB.

The key benefit of markets is gains from trade. Historically, these gains derived from differences in the cost of generation and the diversity of demand, where some regions might be winter peaking and the other summer peaking. In a renewable based electric system, those gains might occur when one intermittent renewable is not generating due to either low sun or wind conditions and relies on excess power generated and injected into the grid by other renewable generators.

In an efficient market, there is a single market price against which buyers make consumption decisions and suppliers make production decisions. The market price is transparent providing information to all buyers and sellers. Price in a competitive generation market is established by the resource providing service to marginal changes in demand.

Interestingly, the method of economic dispatch used by vertically integrated electric utilities produces the same generation mix supplying load as a competitive market. That is because the theory of dispatch, originated by Steinberg and Smith in the 1930's, requires a loading of generators so that the marginal costs of all units following load are equal. That marginal cost is equal to the competitive market price.

The equivalence of the generation mix operating to provide load with power is important because historically dispatch systems that did not support competitive markets (e.g., the New York Power Pool), due of the nature of the dispatch algorithm and did not reveal the marginal cost of the load following unit, and as a consequence did not produce a system price. Importantly, the results in terms of generation operation would be the same as that which would be produced by a competitive market. But, in an era without real-time pricing for either buying generation or providing price signals to load, there was no need to provide a market price. However, as technology changes the role of the customer and new non-utility generators are increasingly providing service, the need for a real-time price signal increases. Transforming dispatch systems to enable them to produce a market price is costly.

[21] ERCOT in Texas is an exception.

In the short run, it is important to ask whether producing a market price is necessary? Perhaps not immediately. In systems of dispatch in non-competitive power systems, the system operators have information on the actual cost of generation over the generating units output (i.e., a multi-part heat rate combined with actual fuel costs). In order to incorporate competitive generation into the plant mix supplying Puerto Rico's electric customers, the PREPA dispatchers use the contracted price for power as the marginal cost. Therefore, mechanisms exist to carry out efficient dispatch while incorporating a variety of non-utility resources into the dispatch process. In the long run a market price will increase transparency and efficiency of the market.

There are viable methods for establishing prices for the sale of electricity injected into the grid by distributed generation and microgrids. The first is a tariff rate. This method can be established in much the same way that buy-back rates were established in many states under PURPA. It requires estimating the value of power using a production costing model, such as PROMOD. PROMOD is one of the models being used by Siemens in the preparation of the Integrated Resource Plan. Hawaii has produced a time of use schedule for power exported by distributed energy resources to the Hawaiian Electric companies.[22]

Another alternative structure is a bi-lateral market. In such a market, buyers and sellers of power enter into transactions at negotiated prices. A system of retail wheeling is necessary to enable the delivery of power at prices agreed to between buyers and sellers.

Each of these three systems (market prices, tariff prices, and bi-lateral contracts) have different levels of transparency. The market is most transparent. Tariff prices are established in regulatory proceedings where the methods all calculations are transparent. The bi-lateral market is not a transparent system, because it is based upon a negotiation. There are ways to make bi-lateral transactions more transparent. One way is to post results of these transactions on an exchange. This would increase the efficiency of price discovery and drive prices closer to what they would be in a competitive market.

B. Increasing Efficiency of System by Increasing Service Options

Currently, operating reserve required to maintain system frequency in the event of the loss of a generating unit is available by spinning reserve. Spinning reserve, which is provided by operating generation by restricting their output to enable them to ramp up in the event of the loss of another generation unit fails, decreases over its range of output. Because generation typically has a declining cost curve, where once started the marginal cost of generating declines. As a consequence, the provision of operating reserve from spinning generation reduces generation efficiency.

There are two alternatives to spinning reserves for maintaining operating reserves, peakers and demand response. Peakers are aero-derivative generators that have low capital cost and high operating costs. The reason for having peakers on the electric system is to provide reserves and to operate when needed to support reliability. Currently, while PREPA has peakers, they are not operational. Demand response is a program in which consumers are paid the market price for producing generation to curtail their consumption. The use of demand response has provided an

[22] https://www.hawaiianelectric.com/products-and-services/customer-renewable-programs/smart-export

effective source of operating reserves, for example during the drop of significant wind resources in the ERCOT (Texas) system.

It would be prudent for PREPA to: 1) evaluate and report to PREB the results of the analysis of the cost and benefits of returning its peakers to operational status; and 2) in consultation with its customers, submit tariffs to PREB for its approval of a customer-centric regime of demand response.

C. PREB Oversight Role

No matter the method of producing prices, the PREB has an important oversight role to play. Of particular concern are inefficiencies in market design and also the potential to exercise market power. The choice of resources used to provide ancillary services to the electric system is one form of market inefficiency. Currently, all operating reserves are provided by spinning reserves. Providing spinning reserves reduces the efficiency of the generation fleet. Alternative approaches are aero-derivative turbines or demand response. At this point, the aero-derivative turbines are not operational, and demand response is not used. A customer centric system would rely, at least in part, on demand response to increase the efficiency of the system.

Regulatory oversight also is warranted on whether market power exists or is being exercised. In particular, there is a tension between the value of generation divested and the degree of market power conveyed in the bundling of generation. In addition, given the generation mix in Puerto Rico, it is conceivable that market power exists even if generators are not sold in bundles. In that case, special precaution would be needed to protect Puerto Rico's electric customers when PREPA generation is divested. It is therefore important to evaluate the extent that market power exists in the electric system as found.

VIII. THE BLUE RIBBON TASK FORCE

The SSEB, in partnership with the Puerto Rico Governor and Legislature, conducted a stakeholder engagement strategy process designed to support and inform the work of a Blue Ribbon Task Force (BRTF). The BRTF worked collaboratively to identify potential regulatory framework models and functions of a Puerto Rico regulatory agency whose responsibilities included the development of a strategic energy plan, ensuring a safe, reliable, resilient electric grid. In accordance with Puerto Rico's Act 120-2018, Governor Ricardo Rosselló Nevares, Senate President Thomas Rivera Schatz, Speaker of the House Carlos "Johnny" Méndez Núñez, and the SSEB selected the distinguished BRTF members.

A. Blue Ribbon Task Force Members

On August 30, 2018, SSEB issued a press release publicly announcing the BRTF members. The following individuals currently serve in this capacity:

1. Governor Ricardo Rosselló Nevares (ex officio)
2. Senate President Thomas Rivera Schatz (ex officio)
3. Speaker of the House Carlos J. Méndez Nuñez (ex officio)
4. Scott I. Aaronson, Vice President, Security and Preparedness, Edison Electric Institute

5. Edison Avilés Deliz, Chairman, Puerto Rico Energy Bureau
6. Malu Blázquez, Executive Director, Resilient Puerto Rico Advisory Commission
7. Julie Imanuel Brown, Commissioner, Florida Public Service Commission
8. Nisha Desai, President, Aurora Clean Energy Partners LLC
9. Martha Duggan, Senior Principal, Regulatory Affairs for the National Rural Electric Association
10. Dr. Cris Eugster, Chief Operating Officer, CPS Energy
11. Julia Hamm, President & Chief Executive Officer, Smart Electric Power Alliance
12. Mike Henchen, Manager, Rocky Mountain Institute (Roy Torbert, Alternate)
13. Dr. Mark A. Jamison, Director, Public Utility Research Center, University of Florida
14. Sergio Marxuach, Public Policy Director & General Counsel, Center for a New Economy
15. José Ortiz, Chairman & CEO, Puerto Rico Electric Power Authority
16. Dr. Carl Pechman, Director, National Regulatory Research Institute
17. Andrés Rodriguez Figueroa, President, Cygnus Healthcare and Technologies, Inc.
18. Erasto Rodriguez Molina, President, Solar Energy & Resources, Inc.
19. Marc G. Roumain Prieto, CPA, Esq., Legal & Consulting, Windmar Group
20. Francisco Rullán, Executive Director, Puerto Rico Office of Energy Policy
21. Janet L. Sena, Senior Vice President and Director of Policy and External Affairs, North American Electric Reliability Corporation
22. Tomás Torres, Executive Director, Institute of Competitiveness and Economic Sustainability
23. Dr. Mary Beth Tung, Director, Maryland Energy Administration
24. Alejandro J. Uriarte, Managing Partner & CEO, New Energy Consultants
25. Pablo Vázquez, President, College of Engineers and Land Surveyors of Puerto Rico

B. Work Product

Based on input from the Blue Ribbon Task Force and additional assessments being conducted within the project's scope, SSEB is developing a regulatory blueprint that will be presented to the Governor of Puerto Rico and the Legislature that provides options and recommendations for a legal and regulatory framework for the electricity sector and other utility sectors. The impact of the regulatory blueprint will be assessed until the end of the performance period and will be documented in the project's Final Report.

Specific portions of the scope of work related to the Blue Ribbon Task Force's work products include the following tasks:

- Establishing a Blue Ribbon Task Force and soliciting input from its members on the possible regulatory framework models that provide Puerto Rico with a transparent and robust regulatory regime;
- Developing a blueprint of regulatory framework models, incorporating recommendations from the Blue Ribbon Task Force;
- Coordinating and convening a Puerto Rico Energy Summit during which preliminary BRTF findings and recommendations will be presented and stakeholder input will be encouraged and documented; and
- Coordinating and convening subsequent Puerto Rico energy workshops or briefings related to specific stakeholder objectives and goals.

C. Blue Ribbon Task Force Meeting

The BRTF assembled for its first meeting in San Juan, Puerto Rico, on October 16-17, 2018. The meeting began with keynote addresses by Governor Ricardo Rosselló Nevares, Speaker of the House Carlos "Johnny" Méndez Núñez, Senator Angel Edgardo "Gary" Rodríguez Mireanda, and Hon. Eddie Joe Williams, SSEB's Federal Representative.

To begin developing recommendations for the regulatory framework models, the majority of BRTF members provided brief presentations focused on their perspective of key issues to be considered by the Government of Puerto Rico when establishing the energy policy and regulatory framework. Throughout the meeting, the BRTF members frequently engaged in roundtable discussions for consensus building and knowledge sharing. Additionally, the members participated in three breakout sessions focused on markets, permitting, and regulatory frameworks.

Each subgroup was assigned co-chairs to facilitate the discussion. The markets subgroup was co-chaired by Mr. Sergio Marxuach, Center for a New Economy, and Dr. Carl Pechman, National Regulatory Research Institute. The permitting subgroup was co-chaired by Ms. Malu Blázquez, Resilient Puerto Rico Advisory Commission, and Ms. Janet Sena, North American Electric Reliability Corporation (NERC). The regulatory frameworks subgroup was co-chaired by Mr. Tomás Torres, Institute of Competitiveness & Economic Sustainability, and Dr. Mark Jamison, University of Florida.

The meeting resulted in a list of the BRTF subgroups' consensus-based recommendations that are outlined below in Sections D, E, and F. It is important to note that the Puerto Rico Energy Public Policy Act, Senate Bill 1121 (P. del S. 1121) was introduced while this meeting was being convened, and the legislation's content was not considered during the development of these recommendations.

D. Subgroup Recommendations: Markets

The following recommendations were reported by the co-chairs of the markets subgroup:

- The regulator should evaluate rate allocation of legacy costs which could affect customer choices.

- The regulator is encouraged to evaluate the price of energy injected into the grid from distributed generation. Three options to be considered include:
    - Real-time prices based on system dispatch;
    - Administratively determined price; and
    - Buy back purchase agreements.
- The regulator is encouraged to review interconnection requirements to determine whether they are reasonable and consistent with industry norms.
- The regulator is encouraged to consider requiring PREPA and its successor(s) to provide statistics on reliability and system operation. These categories are:
    - System Average Interruption Duration Index (SAIDI);
    - System Average Interruption Frequency Index (SAIFI); and
    - North American Electric Reliability Corporation system operating statistics.
- The regulator is encouraged to work with North American Electric Reliability Corporation and other appropriate authorities to develop Puerto Rico-specific reliability standards and procedures.
- The regulator is encouraged to monitor and report on the efficiency and fairness of the dispatch of generating units on a regular basis.
- The regulator is encouraged to monitor and report on a regular basis the curtailment, and the reason for curtailment, of renewable generation.
- The regulator should be cognizant of different storage ownership and dispatch approaches.
- To inform potential market participants, the regulator is encouraged to require that a locational, real-time market price (cost) be developed and communicated based upon the power control dispatch algorithm.
- The regulator is encouraged to evaluate the benefits of demand response and, if appropriate, develop rules for its incorporation into system operation.

E. Subgroup Recommendations: Permitting

The following recommendations were reported by the co-chairs of the permitting subgroup:

- The permitting process should be independent from PREPA with suggested organizational placement of PREB, or another independent body.
- Any statutory permit conditions, including expedited permitting processes, should be enforced to ensure the permitting agency is following legal requirements.
- The permitting agency should ensure that all new sources of generation comply with a uniform permitting and approval process, regardless of the project size.
- A review of the current net metering recertification process, currently required every five years, is needed to not only standardize requirements but also determine overall need of the recertification process.
- The permitting agency should establish a mandatory certification or licensing process for solar installers, including for maintenance, and ensure it is widely available to all interested.
- The permitting agency should work with all branches of government and other relevant agencies, including the PREB, to establish an incentive program that provides clear and expedited permitting requirements for future development.

- The permitting agency should review processes currently in place, specifically relating to environmental permits and land rights, for current and future major transmission lines and base load generation.

F. Subgroup Recommendations: Regulatory Frameworks

The following recommendations were reported by the co-chairs of the regulatory frameworks subgroup:

- The regulatory framework should be performance-based and designed to strengthen utility performance through incentives.
- The regulatory framework should be designed to provide the PREB complete authority without political intervention.
- Electric cooperatives should be an integral part of the Puerto Rico energy system.
- The regulatory framework structure should be based on the most applicable aspects of the Florida and Texas Public Service Commission models.
- Legislation should authorize the PREB to designate the service territories of the energy providers.
- The Puerto Rico Energy Bureau should develop regulations and standards for utility scale and residential solar systems, including Community Solar applications.
- The PREB should develop regulations that addresses Cost Recovery for energy providers through the use of cost-based rates.
- The regulatory framework structure and operation should be totally transparent and decision-making authority should be exercised in a collaborative manner. There should be a balance between how quickly decisions are made and what is being decided.
- The PREB should be provided the resources and authority to recruit and hire competent, professional staff.
- The PREB should have the authority to access relevant documentation from regulated energy providers and possess the necessary enforcement authority with associated penalties.
- The PREB should consist of three to five Commissioners appointed by the Governor with the consent of the Senate and with staggered appointments. Appointed Commissioners should be qualified, competent candidates and fully vetted by the cognizant Legislative committees.
- The PREB Executive Director should be bipartisan and independently appointed by the Commissioners.
- The regulatory framework should allow for Consumer Advocates and related organizations to provide relevant information.
- The regulatory framework should properly consider the role of energy efficiency, demand side management, energy storage, distributed energy resources, and electric vehicles (EV).
- With energy being provided from a variety of resources, a regulatory framework needs stakeholder buy-in which considers reliability and economic impact to all customers.
- The regulatory framework needs an appeal mechanism when regulated organizations disagree with the PREB decisions. The frameworks need to distinguish between legal and policy requirements.

IX. IMPACTS OF PREPA'S PRIVATIZATION

Hurricane Maria devastated critical energy infrastructure and knocked out power on the entire Island. In the months after the initial impact, Governor Ricardo Rosselló Nevares began discussing the potential privatization of PREPA. Many steps have been taken in the past year that have moved the Government closer to this goal.

On June 20, 2018, Governor Ricardo Rosselló Nevares signed Act 12-2018 into law to partially privatize PREPA, to sell generation assets, and to make a concession of its transmission and distribution (T&D) lines.[23] On August 24, 2018, José Ortiz, Executive Director of PREPA, said that the private company that will run the operations of the utility will be selected in May 2019. In November 2018, PREPA published a request for proposals (RFP) seeking to identify companies that are interested in the operation of the utility´s transmission, distribution, and customer service. That proposal should be adjudicated by May 2019. "The idea is to have the new operator of the Authority already working by July (2019). In parallel, we will be working on the sale of generation assets," said Mr. Ortiz.[24]

The impacts of PREPA's privatization are examined below, with an emphasis on the issues to be addressed to provide positive assurances to potential investors. These issues include the current financial situation, the anticipated regulatory environment, restoration funding, condition of existing infrastructure, fuel sources, existing power purchase agreements, labor relations, pension funding, and other topics.

A. Financial Situation

Timely financial data on PREPA has been limited, with the most recent audited financials being posted on May 9, 2018, and subsequently updated on May 29, 2018. The audited financials posted on May 29, 2018, are for PREPA's fiscal year (FY) 2014-2015.[25] No audited financial data are available for FY 2015-2016 or FY 2016-2017. FY 2017-2018 ended on June 30, 2018. Given the vast change that has occurred with respect to PREPA's operating condition, more current financial information will be necessary for potential purchasers to make an informed decision regarding the valuation of PREPA's various assets. PREPA may be preparing audited financials in advance of the RFP process, and Puerto Rico has been actively providing government unit liquidity on a monthly basis as well as posting the August 2018 Revised PREPA Fiscal Plan.[26] These are all positive achievements. Investors may wish to see additional data, and the ability to provide audited financial statements gives potential bidders supplemental data points and some comfort that extra measures have been taken to review the material. The ability to examine trends in annual financial data is just one step in the evaluation process.

Audited financial statements may not be required, but explanations regarding current financial disclosure should be anticipated by PREPA. Determining a valuation for PREPA may be challenging for any potential purchaser. The amount an entity is willing to pay for PREPA

[23] http://newenergyevents.com/puerto-ricos-governor-signs-law-for-partial-privatization-of-prepa/.
[24] https://www.elnuevodia.com/english/english/nota/searchforprepasoperatortobegininnovember-2443338/.
[25] 2015 Fiscal Audit, https://emma.msrb.org/ER1131509-ER885495-ER1286157.pdf.
[26] 2018 Fiscal Plan, https://emma.msrb.org/IssueView/Details/95F9125867FAF62C9F5E82554E875984.

assets will be determined by reviewing the economic situation and determining the potential to make a reasonable return over time based on a purchase price of "X." In determining a purchase price, any entity will look at the financial situation of PREPA as well as other factors that may impact future profitability and discount those values to a purchase price.

B. Bankruptcy Proceedings

PREPA has approximately $9 billion in debt and is unable to support its current debt load. In July 2017, PREPA filed for bankruptcy and, after numerous attempts, announced a preliminary agreement with some bondholders to restructure a portion of that debt in July 2018.[27] Potential investors will be monitoring the bankruptcy proceedings. The final outcome of these negotiations, and possible impacts on energy prices and structure, will be considered as part of investors due diligence. Regarding bankruptcy proceedings, negotiations with Bondholders may or may not fit within the framework proposed by the Puerto Rico Government or judicial authority.

C. Reduction in Energy

Prior to the hurricanes, Puerto Rico was struggling with an ongoing recession, high unemployment, and declining population due to migration. PREPA experienced a 18% drop in demand from 2007 to 2017.[28] These reductions are compounded by a high level of technical losses and theft. Technical losses and theft can be contained and reduced, but other potential changes post-hurricane may continue to drive traditional electricity sales lower on the Island.

The use of privately owned commercial and residential renewable systems (wind and solar) may further reduce power purchased from traditional PREPA generation assets in future years. In a similar way, microgrids may develop and operate in conjunction with PREPA's existing infrastructure or could develop outside of PREPA's infrastructure and operational control. Migration of industrial and residential clients' privately-owned renewable generation and external microgrids would likely result in additional reductions in energy sales from PREPA-owned generation assets.

Increases in privately owned renewable systems, energy efficiency, and microgrids will reduce the need for future generation, transportation, and distribution and may reduce the amount investors are willing to pay for existing assets.

D. Anticipated Regulatory Environment

The expected regulatory environment post-sale will influence the participation in bidding for the T&D concession as well as the participation in, and potential sale of, generation assets. Investors will be interested in the details of the regulatory environment so they will be able to make financial assumptions for models which will be used to determine potential asset purchase prices.

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[27] https://www.reuters.com/article/us-usa-puertorico-prepa/puerto-rico-utility-debt-restructuring-deal-points-to-path-forward-idUSKBN1KL2RJ.

[28] 2018 Fiscal Plan, https://emma.msrb.org/IssueView/Details/95F9125867FAF62C9F5E82554E875984.

Transparency on the expectations, requirements, and authorized returns for the generation and T&D operators will provide assurances to any firm or firms considering a purchase. The more details the Government of Puerto Rico can provide potential investors about the future regulatory environment, the better. Investors will be looking for clarity on how the regulatory body will operate post concession and sale of assets.

E. Restoration Funding

The amount of restoration and who will be responsible for repayment of these funds will be very important to a potential purchaser. Insurance proceeds also will be available for the restoration, but the total amount obtainable is limited and the majority of PREPA assets were self-insured through a self-insurance fund. Based on detail from the 2015 audit[29], some of the storm related costs would be covered by existing insurance while transmission and distribution lines are excluded from the policy and covered under the self-insurance fund.

The main insurance policy covers all risk properties, excluding overhead transmission and distribution lines. The combined coverage is $750 million, with a $45 million deductible for windstorm losses. Business interruption is $200 million. Regarding the Self-Insurance Fund for transmission and distribution, a total of $91.9 million was in the fund as of June 30, 2013, and $100.152 million was in the fund as of June 30, 2015, as stated in the audit report posed on May 29, 2018.

Insurance proceeds and the Self-Insurance Fund will not be sufficient to fund restoration. Several U.S. Government funding sources are available for PREPA as it looks to rebuild, such as Stafford Act emergency and other permanent funding, but final support solutions may be subject to U.S. Congressional approval.[30]

Community Disaster Loans (CDL) are advances to carry on existing local government functions of a municipal operation that have incurred a significant loss in revenue, due to a major disaster, that has or will adversely affect their ability to provide essential municipal services. A CDL, either directly or through the Government of Puerto Rico, will be necessary for PREPA to maintain the necessary liquidity to operate for the 18-month period of continued operations required by the fiscal plan. CDLs available to Puerto Rico will require the Island to show that there are insufficient funds available to address current needs before the Island can draw down CDLs.

Restoring the Island's infrastructure may not occur prior to the concession or sale of some or all generation assets. Investors will be interested to know if funds will be available to complete restoration efforts and, if so, what type of funding will be available and what are the repayment expectations.

[29] 2015 Fiscal Audit, https://emma.msrb.org/ER1131509-ER885495-ER1286157.pdf.
[30] 2018 Fiscal Plan, https://emma.msrb.org/IssueView/Details/95F9125867FAF62C9F5E82554E875984.

F. Condition of Existing Infrastructure

Investors purchasing assets or entering into a concession will consider the existing condition of each asset and determine if that asset can generate value sufficient to recover the purchase price and generate an appropriate return. Within that analysis, investors will consider the existing condition of the asset, what type of maintenance has been done, what type of maintenance will need to be done in the future and what regulatory requirements may need to be met to continue operating specific assets.

PREPA's transmission, distribution, and generation assets were in need of significant maintenance prior to the hurricane. The extent of the repairs and level of quality will need to be evaluated by potential investors. It is likely that prospective purchasers will be required to promptly comply with Mercury Air Toxic Standards (MATS) on existing generation assets. The cost of compliance will be reflected in the amount investors are willing to pay for these generation assets.

G. Fuel Sources

Approximately 45% of PREPA's generation assets operate on fuel oil. Due to volatile oil prices, costs have increased approximately 34% since April 2018.[31] These escalating costs comprise a large component of higher bills for customers. Reduction in dependency on fuel oil will be necessary to reduce volatility in energy prices and provide opportunities to decrease the overall cost structure. Converting to and or replacing existing fuel oil generation assets will require time and significant capital. Investors will want to ensure the ability to receive an appropriate return for investments made to convert or replace existing fuel oil generation.

H. Existing Power Purchase Agreements

Any concession will need to account for existing power purchase agreements PREPA entered into with 3rd party generators (independent power producers). A new operator's ability to change contracts may be limited based on language in existing contracts.

I. Labor Relations

PREPA's labor force is 70% unionized and is comprised of four unions. It is likely that any purchaser will need to renegotiate union contracts.

J. Pension Funding

PREPA has an unfunded pension liability of approximately $3.6 billion. The estimated return for the fund is 8.25%. The $3.6 billion is based on 2014 actuarial numbers and has not been confirmed by PREPA's Employee Retirement System (ERS). PREPA received census level data from ERS in July and is working on actuarial review with counsel and financial advisors.[32]

[31] 2018 Fiscal Plan, https://emma.msrb.org/IssueView/Details/95F9125867FAF62C9F5E82554E875984
[32] 2018 Fiscal Plan, https://emma.msrb.org/IssueView/Details/95F9125867FAF62C9F5E82554E875984

Results from the analysis and reforms taken to reduce existing pension funding shortages will impact the existing workforce.

X. FUEL DIVERSITY AND GRID OPERABILITY WITH RENEWABLE ENERGY GOALS

The Puerto Rico Energy Public Policy Act, Senate Bill 1121, was introduced on October 17, 2018, it passed the Senate on November 6, and the House will take up the bill in the next legislative session that begins in January 2019. The bill sets a requirement to meet Puerto Rico's electricity demand with 100% renewable energy by 2050, in addition to streamlining grid interconnection of distributed energy and microgrids. The Puerto Rico Energy Public Policy Act also seeks to eliminate coal-fired generation by 2028 while continuing to support investments in fossil fuels by mandating oil-fired power plants be converted to dual-fuel capability.[33]

Interim goals are for renewables to comprise 20% of the system by 2025; 50% by 2040; and includes a goal of 30% energy efficiency by 2040. Within the framework of the Integrated Resource Plan (IRP), which is updated every three years, the planning horizon of the IRP is 20 years (i.e., nearing 2040).

While Puerto Rico considers the decision to mandate a 100% renewable energy portfolio by 2050, there are a number of issues to explore and, from a high-level vantage point, a few obstacles must be overcome from a technological and engineering perspective in order to achieve this goal. Politics, incorporating long-term LNG commitments into the future energy mix, and other non-engineering concerns should be explored separately; for now, engineering solutions and economically viable renewables are available today, as discussed in this section.

Some issues typically raised when discussing an electrical system comprised of all renewable resources include: operability of a system comprised of intermittent, distributed resources; ability of the electrical grid to provide reliable, affordable power; the lack of fuel diversity; and the ability to transform the entire electrical system to remove all carbon-emitting fuel sources. While working to achieve this goal, new options currently unforeseen will evolve over this long timespan that might justify re-evaluation of this goal. As a consequence, the Puerto Rico Energy Bureau has an important role to play, not only as the administer of change but also as the eyes and ears of the Legislature on new options and potential changes in policy that will enhance the electric system and the welfare of the people of Puerto Rico.

Electrical generators have been added to utility infrastructure based on several factors. As technology has developed and fuel prices fluctuated, first hydro, then coal, then natural gas, nuclear and later wind, solar, and biomass capacity have all become part of the current legacy system of generators. While Puerto Rico's system does not include all of those resources, the overall context is important in understanding the evolution of the electrical system.

[33] Burger, A., Puerto Rico Bill Would Seek 100 Percent Renewable Energy & Streamline Interconnection. October 31, 2018.

Customer demand for electricity also has continued to grow over time, yet in the last ten years or so that demand growth has flattened or declined significantly. In the last half of the 20th century, demand grew at a rate such that large increments of generating capacity were added to meet those increasing loads. Large, central-station generators also provided economies of scale to utilities, driving down the cost of power. In turn, a bulk transmission system evolved over time that supported the movement of electricity from these central sources to demand centers. With a recent emphasis on energy efficiency and a subsequent decoupling of demand with growth in gross domestic product, utility resource planning has become more nuanced. For example, capacity is no longer needed in large blocks. The price of renewables, especially wind and solar, has declined dramatically; states and utilities have made commitments to reducing carbon-based generation; and a strong market demand for clean energy has dramatically increased the urgency of generating systems to turn toward renewable resources.

In fact, electricity generated by wind and solar capacity continues to decrease in cost while increasing in efficiency and effectiveness. In the November 2018 release of Lazard's Levelized Cost of Energy Analysis:[34]

- Wind turbines continue to increase in size: the popular 1.5 MW GE turbine is over 200 feet tall and has a 120-foot diameter blade; and the average operating capacity factor nationwide is now 35%, compared to around 20% less than 10 years ago.[35]
- Wind speed (also known as resource) maps of potential onshore and offshore wind resources in Puerto Rico indicate potential exists, especially on ridges and offshore.
- Utility scale solar also continues to drastically reduce in cost and improve operational performance.
- Solar insolation is excellent in Puerto Rico and provides significant opportunity to produce abundant amounts of electrical supply.
- In Hawaii and California, for example, both whom have committed to 100% renewable energy by 2050, rooftop solar and utility scale solar are expected to provide significant amounts of electricity.

In the report, Lazard forecasts the unsubsidized levelized cost of energy comparison. Selected fuel sources are provided in the table below.

Fuel Source	$/MWh
Wind	29-56
Solar Rooftop	160-267
Solar PV	36-44
Solar Thermal with Storage	98-181
Integrated Gasification Combined Cycle	152-206
Nuclear	112-189
Coal	60-143
Natural Gas Combined Cycle	41-74

[34] Lazard, Levelized Cost of Energy Forecast, https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf, November 8, 2018.
[35] EIA, Levelized Cost of Electricity Forecast, https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf, March 2018.

According to a 2015 National Renewable Energy Laboratory (NREL) study, "*Greening the Grid*," costs for wind power contracts are as low as $20/MWh, and solar has been contracted at around $40/MWh.[36] The study suggests, for example, wind and solar utilizing inverters and information technologies can supply essential reliability services.

In Hawaii, a key question utilities are considering is how to incorporate solar and wind at very high levels while keeping the electrical grid stable? Currently, Hawaii gets 33% of its electricity from rooftop solar and has 60 utility scale renewable energy projects feeding power into the grid. The Legislature set a goal of 100% renewable energy by 2045. A recent study by NREL's Energy Systems Integration Facility shows the use of smart inverters, switches that automatically respond to potential overloads, help the grid handle the fluctuations of solar power. Currently, up to 60% of the electricity generated in Hawaii comes from renewable resources.[37]

While this is not a trivial problem, there are multiple agencies and experts studying these phenomena. Studies include those by the Electric Power Research Institute (EPRI) and NREL. Recommendations include:

1. EPRI suggests the need for an increased understanding of high penetration of variable renewable resources in order to increase confidence in model solutions; and
2. NREL is studying how backup power will be made available during off-wind, off-solar events; and the emergence of large, reliable, affordable energy storage systems. In California, NREL is testing a 300 MW solar plant that could balance grid supply and demand with electronic inverters to cycle power levels and turndown.

The majority of the issues surrounding the deployment of intermittent resources have to do with computational, forecasting, and engineering issues especially such as the design, operation, and control of inverters. There are multiple agencies working to ensure these engineering and computational challenges are met, including the Institute of Electrical and Electronics Engineers (IEEE), the American National Standards Institute, DOE, NREL and its Energy Systems Integration Facility (ESIF), NERC, EPRI, state organizations such as Hawaiian Electric and the California Independent System Operator; all working to develop standards and procedures necessary to successfully operate tomorrow's grid.[38]

The IEEE also has a committee structure dealing specifically with many of the issues discussed in a document entitled "*IEEE Power System Operation, Planning and Economics Committee: Bulk Power System Planning Subcommittee,*" which examines issues such as resource adequacy and fuel diversity; resource integration including conventional, renewable, storage, demand-side and distributed resources integration; interconnection planning; renewable resource forecasting in power system planning; and long-term demand forecasting.

Other countries also have proved that renewable electrical supply can provide stable grid operation, especially for those systems that are largely interconnected; however, Ireland, which is isolated electrically, met 39% of its power needs in December 2015 with wind

[36] NREL, Greening the Grid, Wind and Solar on the Power Grid: Myths and Misconceptions, https://www.nrel.gov/docs/fy15osti/63045.pdf, 2015.
[37] Fialka, John, E&E News, As Hawaii Aims for 100% Renewable Energy, Other States Watching Closely, April 27, 2018.
[38] Hoke, Andy, et al, Setting the Smart Solar Standard, IEEE Power & Energy Magazine, October 18, 2018.

power. Germany, heavily interconnected, has met 100% of its electrical load with wind and solar at times.

More conservative, traditional industry sources suggest operational challenges and reliability concerns could prove too difficult for modern power supply planners and operators to overcome. Edison Electric Institute, for example, suggests a range of generating options such that:

- Electric utilities use a balanced energy mix to deliver safe, reliable, affordable, clean energy and that diverse resource mix helps manage risk;
- Integrating renewable energy sources with traditional sources using smarter energy infrastructure is key to delivering value to all customers; and
- Over the past ten years, the generation mix in the U.S. has changed dramatically and has become increasingly clean. Nuclear, hydro, and other renewable energy provided 37% of electrical generation in 2017 (natural gas generated 32% and coal 30%).[39]

IHS Markit describes six principles for successful, reliable operation of the electric grid. [40]

- Cost effective power supply requires integrating a diverse fuel and technology supply mix;
- A reliable, resilient, efficient supply portfolio requires diverse power supply rather than maximum diversity;
- System efficiency trumps individual plant efficiency;
- A cost effective mix of generating resources does not need the same level of operating flexibility in each resource;
- Incorporating grid-based electricity storage likely increases base net-load requirements; and
- Environmental policy initiatives can harmonize with market operations (IHS Markit, 2017).

NERC, in a 2009 report on accommodating high levels of variable generation, made the following recommendations for further study, coordination, and consideration:

- Deploying different types of variable resources across geographical locations and using advanced control technology should level fuel diversity and address ramping, supply surplus, and voltage control conditions;
- Significant transmission additions and reinforcements will be required to move power from remote sources to demand centers;
- Additional flexible resources such as demand response, storage, and EVs may help balance steep ramps of variable generation assets;
- Enhanced measurement and forecasting of variable generation output is needed with forecasting incorporated into real-time operating practices;

[39] EEI, Balanced Energy Mix is Key to Reliability and Affordability, http://www.eei.org/issuesandpolicy/generation/fueldiversity/Documents/Balanced_Energy_Mix.pdf, March 2018.
[40] IHS Markit, Ensuring Resilient and Efficient Electricity Generation: The value of the current diverse US power supply portfolio, September 2017.

- More comprehensive planning approaches are needed from distribution system to bulk power system;
- Greater access to larger pools of generation and demand may be important;
- Power system planners must consider impacts of variable generation in power system planning and design and develop necessary practices and methods to maintain long-term bulk power system reliability;
- System operators will require new tools and practices and standards;
- Planners and operators would benefit from a reference manual describing changes needed to plan and operate bulk power and distribution systems to accommodate large amounts of variable generation; and
- In addition, industry has a role to play including development of models, planning techniques and approaches that will better enable reliable, efficient system operation.[41]

In 2014, NERC issued a "*Concept Paper on Essential Reliability Services that Characterizes Bulk Power System Reliability*," suggesting that all new resources should have the capability to support voltage and frequency; monitoring essential reliability services measures, trends, and practices to ensure adequate planning and engineering practices; and that further examination of forecasting, visibility, and participation of distributed energy resources are an active part of the electric grid (NERC, 2014).[42]

In February 2017, NERC issued another report related to these issues, "*Distributed Energy Resources: Connection, Modeling, and Reliability Considerations*." This report states that modeling and data requirements should be strengthened; data requirements should be developed across the transmission-distribution interface to ensure adequate system assessments; modeling of Bulk Power System interactions with distributed resources should include explicit modeling in steady-state power flow and short-circuit studies and transient studies; and finally that transmission and distribution entities should coordinate their efforts in planning and operating studies.[43]

These concepts of a more robust planning system and standards are highlighted in NREL's study, "*Greening the Grid*." In their report, they suggest the following:

- New forecasting techniques and technologies are helping reduce uncertainty and thus the need for increasing system reserves to cover renewables;
- Employing the inherent flexibility present in the power system helps mitigate modest impacts of renewables; and
- Recent studies have shown that variable renewable resources can be integrated into power systems without adverse impacts on system costs or emissions.[44]

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[41] NERC, Accommodating High Levels of Variable Generation, April 2009.
[42] NERC, https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSTF%20Concept%20Paper.pdf, October 2014.
[43] NERC, Distributed Energy Resource: Connections, Modeling, and Reliability Considerations, https://www.nerc.com/comm/other/essntlrlbltysrvcstskfrcDL/Distributed_Energy_Resources_Report.pdf, February 2017.
[44] NREL, Greening the Grid, Wind and Solar on the Power Grid: Myths and Misconceptions, https://www.nrel.gov/docs/fy15osti/63045.pdf, 2015.

The *Greening* report also indicates how countries have provided balancing of their grids with large amounts of wind: Denmark received 39% of its electricity from wind in 2014 through interconnections, flexible generation including CHP, and good markets; Spain, with 21% in 2013, used hydro as well as other system market conditions to balance its grid.

Energy storage also will play a vital role in the successful integration of renewable resources into bulk electrical systems. An August 2018 report issued by the Smart Electric Power Alliance, "*2018 Utility Energy Storage Market Snapshot*," explores several keys to the role of storage in integration of renewables into an electric grid.[45] The FERC Order 841 issued earlier this year requires grid operators to establish market rules to allow energy storage to participate in wholesale markets as capacity, energy, and ancillary service providers. It also sets standards for dispatchability, project size, and pricing for wholesale energy for charging. Market trends for energy storage include residential storage systems; non-residential storage such as commercial and industrial customer peak shaving devices; stand-alone battery storage as grid assets for frequency response, peak shaving or black start capability (Imperial Irrigation District); and utilizing distributed energy resources to defer transmission and distribution upgrades.

In an IEEE Power and Energy article, wind power "myths" were discussed and solutions to these issued were described as "solvable."[46] In this extensive report, the authors lay out several key insights:

1. The power system was designed to handle significant variability in loads as demand varies over timescales ranging from seconds to years. System operational procedures are designed around this variability and much is known about those ranges based on analysis and operational experience.
2. The output of wind (and solar) plants is variable and, because wind variability is added to a system that is already variable, there will be some incremental variability that must be managed by system operators. In general, relative variability of wind decreases as the generation of more wind (and solar) plants are combined. Grid operators handle wind variability using existing flexible generation resources; wind forecasting; and sub-hourly scheduling, since production from renewable resources is more predictable when evaluated closer to real time.
3. A number of other operational issues are reviewed including incremental costs of operating a system with significant wind resources.

Another issue to consider is that if generating assets are privatized, might the market provide adequate operational innovation to handle the needs of the system operation? Puerto Rico has generation assets that are scheduled to be privatized. At some point, the market, properly constructed, will not be concerned with what generation resource is utilized. The properly functioning market will value ancillary services, if needed, and generation will be 'bid in' accordingly, along with the necessary services to efficiently and reliably operate the electrical system.

There is one additional consideration that concerns the timeframe of the 100% renewable requirement. Thirty-two years ago, in 1986, the Chernobyl nuclear disaster occurred; the

[45] Smart Electric Power Alliance (SEPA), 2018 Utility Energy Storage Market Snapshot, August 2018.
[46] Institute of Electrical and Electronics Engineers (IEEE) Power and Energy Magazine, Wind Power Myths Debunked, December 2009.

Goodwill Games were first held in Moscow; USSR launched the Mir space station; *Top Gun* was a box office hit; the Bears beat the Patriots in Super Bowl XX; and the *Phantom of the Opera* debuted in London. Amazon was founded in 1994, 24 years ago; Google in 1998, 20 years ago; Facebook and YouTube, 2004 and 2005, less than 15 years ago. And the ubiquitous iPhone was introduced to us only 11 years ago, followed by Uber in 2009. The capacity factor of nuclear units was sitting at 57% in 1986, while planners optimistically forecast levels of 60%, while today's nuclear unit capacity factors are in the range of 92-93%. Longer fuel cycles, improved computational and operational parameters, and other factors have led to much improved ability to utilize more of the fuel in the reactor core. Coal generation, on the other hand, accounted for 56% of total electricity generated in 1986, while in 2017 coal produced 30% of the electrical generation nationwide.

Thirty-two years ago, it was illegal to use natural gas in large electrical generators due to the 1978 Power Plant and Industrial Fuel Use Act (FUA), passed in response to concerns over national energy security brought about by the 1973 oil crisis. The FUA restricted construction of power plants using oil or natural gas as a primary fuel and encouraged the use of coal, nuclear energy, and other alternative fuels. Some ten years later, falling natural gas demand and prices finally spurred the repeal in 1987 of sections of the FUA that restricted the use of natural gas by industrial users and electric utilities, and natural gas could again be used to fuel large new baseload electric power plants.

In essence, 32 years is a very long time in terms of technological innovation (as well as social and political history). Regarding the 2050 goal, it is safe to say that innovations in both the use of electricity to power consumer devices and the ways in which that energy is produced will have made many of today's issues obsolete. It is important for policy to adapt in order to provide least cost power that will meet society's goals of equity, resilience, reliability, and environmental excellence. Therefore, a key role of the regulator is to provide a feedback loop to public policy. Through rulemaking, hearings, and periodic reporting, PREB can fulfill this role by soliciting input from the various stakeholders and maintaining frequent, open, and transparent communication with the Legislature.

XI. CONCLUSION, FUTURE ACTIVITIES, AND ANALYSES

Future activities and analyses will center on the development of regulatory framework options to be considered by the Puerto Rico Legislature in the next session in January 2019. Examples of topics to be explored and analyzed include methods that will lead to the following positive impacts:

- Enhance leadership at the utility;
- Strong energy policy to provide;
- Establish a strong utility regulator model with autonomy;
- Eliminate impact of political pressure on rates;
- Enforce conditions to ensure all citizens and governments obtain electricity legally and pay electric bills;
- Invest wisely in capital improvement projects;
- Efficiently use well-paid employees by amending work rules;

- Establish compensation practices to recruit and retain qualified and experienced personnel;
- Adopt systems to improve and maintain current and accurate record keeping and modernize administrative procedures;
- Reduce existing pension funding shortages;
- Execute comprehensive emergency response plan and disaster recovery plan;
- Retire $9.2 billion debt; and
- Regular maintenance of energy generation, transmission, and distribution assets.

SSEB, its partners, and the BRTF will continue to examine viable energy policy and regulatory framework options that support the goals of the Government, industry, and citizens of Puerto Rico. This activity will include direct consultation, testimony before legislative committees, group meetings and teleconferences, and public outreach.

XII. ACRONYMS

BRTF	**Blue Ribbon Task Force**
CDL	Community Disaster Loans
DOE	U.S. Department of Energy
EPRI	Electric Power Research Institute
ERS	Employee Retirement Systems (Puerto Rico Electric Power Authority)
ESIF	Energy Systems Integration Facility (National Renewable Energy Laboratory)
EV	Electric vehicle
FERC	Federal Energy Regulatory Commission
FOMB	Financial Oversight and Management Board for Puerto Rico
FUA	Fuel Use Act
FY	Fiscal year
IEEE	Institute of Electrical and Electronics Engineers
IEEFA	Institute for Energy Economics and Financial Analysis
IRP	Integrated Resource Plan
kWh	Kilowatt hour
MATS	Mercury Air Toxic Standards
NERC	North American Electric Reliability Corporation
NREL	National Renewable Energy Laboratory
OE	Office of Electricity (U.S. Department of Energy)
PBR	Performance Based Regulation
PPP	Puerto Rico Public-Private Partnerships Authority
PREB	Puerto Rico Energy Bureau
PSRB	Public Service Regulatory Board
PREPA	Puerto Rico Electric Power Authority
PROMESA	Puerto Rico Oversight, Management, and Economic Stability Act
PUC	Public utility commission
PURPA	Public Utility Regulatory Policies Act
RFP	Request for proposal

SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SSEB	Southern States Energy Board
T&D	Transmission and distribution

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