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RE: Review of the Puerto Rico Electric Power Authority Integrated Resource Plan
Case No.: CEPR-AP-2018-0001
Subject: Amicus Brief filing of Rocky Mountain Institute
Date: December 20th, 2019

Rocky Mountain Institute (RMI) respectfully submits the following brief containing evaluation of PREPA's proposed integrated resource plan (IRP). Within the context of RMI's status as *amicus curiae*, this brief contains:

- Note regarding amended *Amicus Curiae*
- Evaluation of PREPA's proposed integrated resource plan (IRP)
- Appendix 1: The Important Role of Energy Efficiency
- Declarations required by Regulation No. 8543

Note regarding amended *Amicus Curiae* brief

This document represents an amended version of Rocky Mountain Institute's (RMI) Amicus Curiae brief first submitted on September 20th, 2019. RMI now files the amended document on December 20th 2019, per the current procedural schedule. This amended version represents RMI's current views given new developments in the energy sector in Puerto Rico and additional input based on further details regarding the integrated resource plan.

Evaluation of PREPA's Proposed IRP

Summary of RMI remarks

PREPA's proposed IRP represents a massive transformation of Puerto Rico's electric power system, from a reliance on imported oil, gas, and coal, to a mix of solar power, battery storage, even more gas, and substantial energy efficiency. The configuration of the power grid and location of new resources would also change, in order to enable individual regions of the grid to operate independently in case of major outages.

Given the condition of Puerto Rico's electric system –still a patchwork of substations, old lines, and new lines rebuilt after Hurricanes Irma and María, powered mostly by old and polluting power plants – major upgrades are urgently needed, and the scale of transformation proposed in this IRP reflects that critical need. However, there are several shortfalls in the composition of this plan which, if not remedied, pose substantial risks to the people and businesses of Puerto Rico, who could overpay for a suboptimal system, bear the burden of expensive, overbuilt, and underutilized gas infrastructure for decades to come, and miss the opportunity for local participation and economic development associated with distributed, customer-centric energy resources. In the remainder of this document, we will describe how the proposed IRP relies on flawed logic to support a predetermined outcome, is overly biased toward natural gas, and fails to fully consider customer-centric solutions.

First, this IRP proposes a plan that relies heavily on predetermined outcomes favoring gas investment (the Electricity System Modernization or ESM plan) and presents a flawed justification for doing so. The ESM is between 81 and 587 million USD **more** expensive (in net present value) than alternatives (such as scenarios S4S2 or S3S2). The IRP justifies its recommendation by claiming ESM provides a valuable hedge against uncertainty, but in fact the ESM is less robust to demand uncertainty than other plans, both in the case of cost (its cost disadvantage to S4S2 grows under high or low demand) and in compliance with the renewable portfolio standard (it fails to keep up with RPS targets under high or low demand). And the reliance on perceived "technology risk" of solar photovoltaics – given equal weighting to overall cost – is not justified on technical grounds nor adequately explained in the context of supporting customers. Considering the flawed logic presented as justification, we cannot discern why the ESM is selected over other scenarios. This presents a fundamental inadequacy of this IRP.

Second, this IRP retains a bias toward natural gas power generation. It places arbitrary limits on the pace of solar and storage expansion, based on perceived utility administrative capacity to execute procurements and integrate new resources into the grid, but acknowledges no similar limits on new fossil fuel infrastructure. The ESM scenario proposes more gas infrastructure than the analysis supports, including advancing plans for gas import terminals and new gas generation in Mayagüez and Yabucoa which are only selected for development in 2025 in the not fully optimized ESM plan and not in the remaining 29 long term capacity expansion plans. And it does not consider the long-term risks associated with gas investments, including that these assets may become underutilized, or "stranded" assets, which fail to deliver value equal to their cost.

Third, this IRP inadequately considers customer-centric solutions. There is no recognition of customer-owned solar and storage as a meaningful resource. The document only reflects plans to integrate customer solar, not to encourage it or even use it as a valuable resource in meeting RPS requirements. It ignores the value of customer storage, which could be dispatched in service of the grid, empowering customers with battery storage to support a more resilient, flexible, and reliable island-wide energy system and compensating them accordingly. Failure to incorporate this distributed storage resource represents a huge opportunity cost. As a whole, the document ignores local priorities of energy democracy and local control, and places little value on customer or community ownership of assets, microgrids other than those owned by PREPA, or energy cooperatives.

Context

The Puerto Rico Energy Bureau (PREB) ordered the utility (PREPA) to develop and submit for review a new IRP, laying out the next 20 years of planned investments in resources for electric power generation, along with demand side management and transmission and distribution (T&D) upgrades. While planning for future investments, PREPA is tackling issues that persist in today's grid. Two years after the 2017 Hurricane season, Puerto Rico's electric services remains unstable (when compared to other U.S. utilities); frequently experiencing grid outages and remains vulnerable to future natural disasters.

PREPA has contracted Siemens to conduct the IRP, with PREPA management input. The proposed IRP filed in February 2019 was rejected by PREB, based on several deficiencies including:

- PREPA recommended an "Energy System Modernization" plan (ESM) that largely comprised predetermined investment commitments, rather than an investment plan based on outputs of rigorous analytical optimization
- PREPA's sensitivity analyses were incomplete and were not incorporated into recommendations
- PREPA did not adequately consider multiple priorities when recommending a preferred scenario

Furthermore, the February 2019 IRP was inconsistent with subsequently passed Puerto Rico energy policy legislation (Act 17-2019), which established a new Renewable Portfolio Standard (RPS), currently renewables make up only 2% of Puerto Rico's generation, as listed below.

- 20% by 2022
- 40% by 2025
- 60% by 2040
- 100% by 2050

On June 7, 2019, PREPA submitted a revised IRP in response to PREB's concerns. The new IRP presents scenarios that do comply with the RPS – though they fail to do so under some assumptions. Rocky Mountain Institute has been approved to participate in this proceeding as *amicus curiae* and presents here arguments regarding the substance of the IRP.

Version

Where this amicus brief refers to page numbers or exhibit numbers in the draft IRP, it refers to the "Errata" version filed June 19, 2019.[1]

Key contents of proposed IRP

Below is a summary of three scenarios which will be discussed throughout this brief. In addition to PREPA's recommended scenario, ESM, the RMI team focuses on S4S2 and S3S2S8B. We selected S4S2 scenario because the IRP identifies it as the preferred cost-optimal scenario that does not depend on the ESM's pre-determined outcomes. The S3S2S8B scenario illustrates a high renewable scenario that relies on the base renewable cost assumptions and equivalently scores favorably on a more balanced scorecard.

Figure 1: Net Present Value of key scenarios

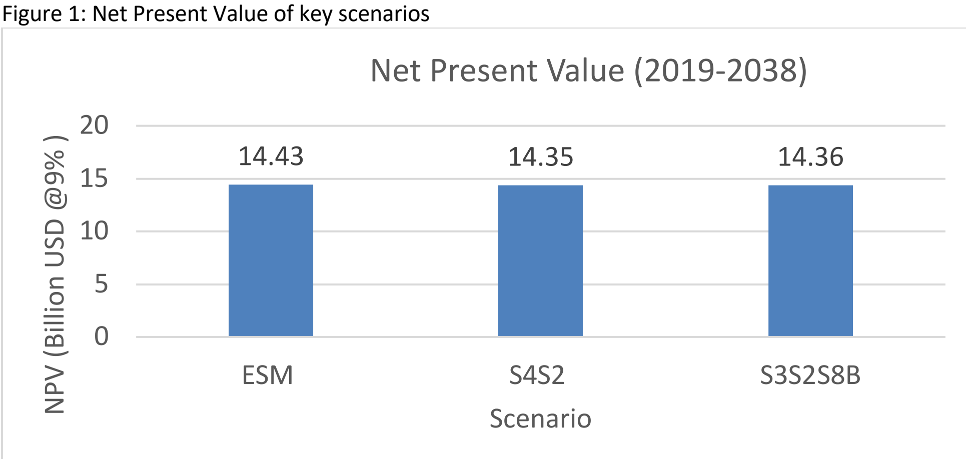
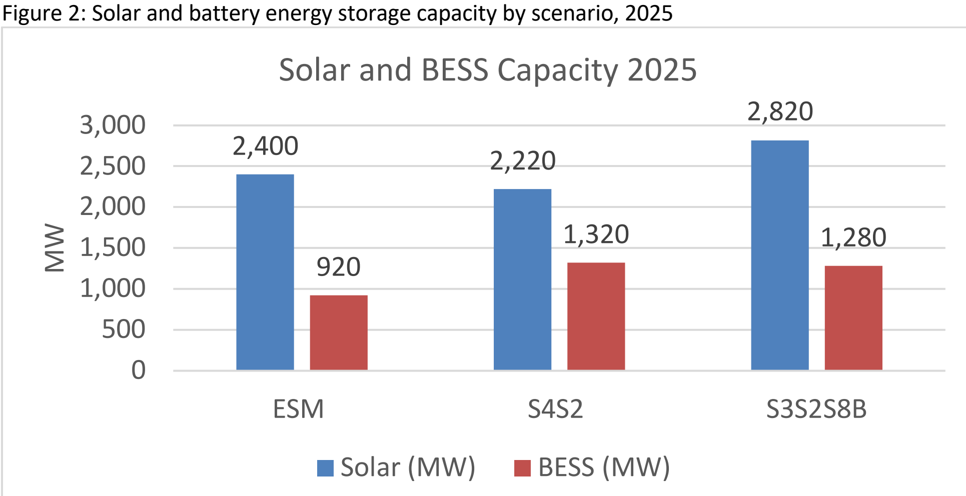


Figure 2: Solar and battery energy storage capacity by scenario, 2025



[1] http://energia.pr.gov/wp-content/uploads/2019/06/IRP2019-Main-Report-REV2-06182019-wERRATA.pdf

Figure 3: Solar and battery energy storage capacity by scenario, 2038

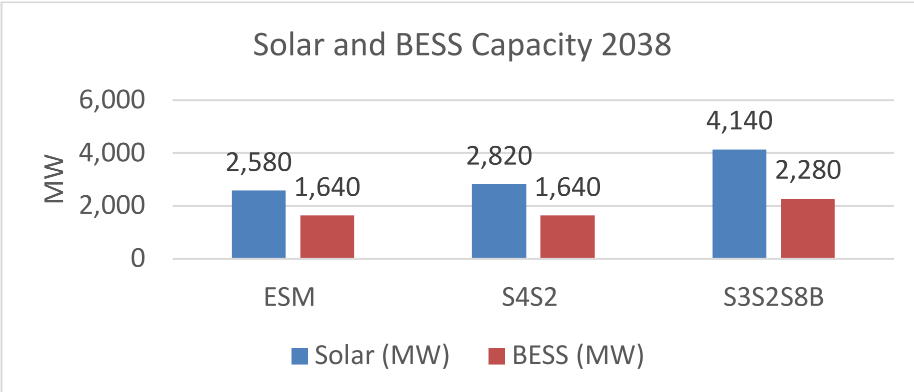


Figure 4: Renewable portfolio standard performance by scenario, 2038

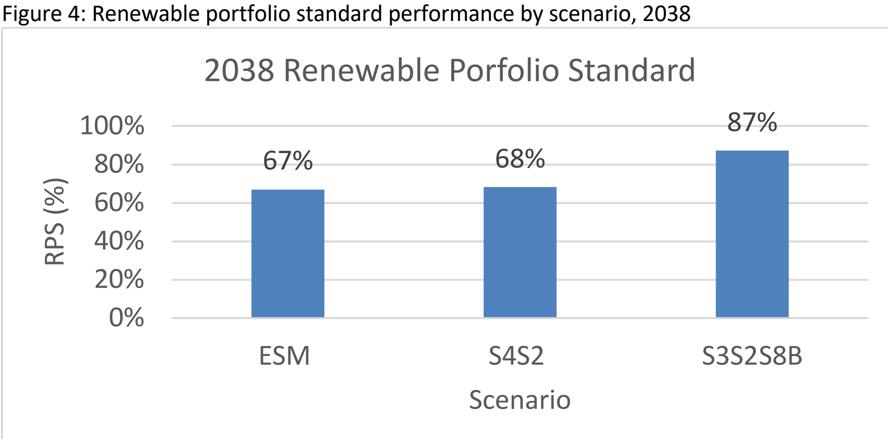


Table 1: Summary of gas infrastructure by scenario, 2025

Gas Infrastructure Summary, 2025			
Scenario:	**ESM**	**S4S2**	**S3S2S8**
Liquefied Natural Gas (LNG) Terminals:	• EcoElectrica (Peñuelas) • San Juan (ship-based) • San Juan (land-based) • Yabucoa (ship-based) • Mayagüez (ship based)	• EcoElectrica (Peñuelas) • San Juan (ship-based) • San Juan (land-based)	• EcoElectrica (Peñuelas) • San Juan (ship-based)
Gas Capacity in 2025:	• San Juan 5&6 (440 MW) • Palo Seco (302 MW) • EcoElectrica contract renewed (507 MW) • Yabucoa (302 MW) • Conversion of Mayagüez units (200 MW) • Mobile generators (421 MW)	• San Juan 5&6 (440 MW) • Palo Seco (302 MW) • Costa Sur (302 MW) • Gas Peaking Generation (371 MW)	• San Juan 5&6 (440 MW) • Costa Sur (302 MW) • Gas Peaking generation (348 MW)

1. The justification for ESM as the preferred plan is incomplete and flawed.

The proposed IRP describes both Scenario 4 Strategy 2 (S4S2) and the Energy System Modernization (ESM) plans as leading scenarios for consideration, and concludes that the ESM should be the basis for a proposed action plan, "since it represents a low cost, practical option that provides the high level of renewable energy contribution and significantly improves the resiliency of the system."[2] The ESM is further described as "an optimization of S4S2 to account for uncertainties"[3] and as a "hedge against uncertainties".[4]

The ESM plan is higher cost than two key plans that include more renewable generation and less gas infrastructure – S4S2 and S3S2S8. Note that while Scenario 3 is constructed based on low price of renewables and battery storage, the version S3S2S8 assumes the same large amount of solar and storage construction and applies the base renewables pricing, so it is directly comparable to the ESM and S4S2 plans. PREPA and Siemens support the ESM plan based on the claim it is robust and is a "hedge" in case demand reductions do not materialize; but in fact when demand is high or low it fails to meet the RPS requirements and becomes less cost-competitive with other plans.

In the text below, we show that the ESM plan is in fact less robust than higher renewable alternatives, that it poses significant risk of failing to comply with the RPS established in Act 17-2019, and that the "balanced scorecard" used to justify the preference for the ESM plan is arbitrary and flawed.

1a. The load forecast is highly uncertain and omits important factors

The load forecast presented in this IRP is very uncertain, so it is critical that a plan be robust to changes in load, especially if load is higher than forecasted. Three factors in particular present risk that load will deviate from the forecast – achievement of energy efficiency (EE) targets, impact of the draft restructuring support agreement (RSA), and the potential impact of electric vehicle adoption.

At PREB's direction, PREPA and Siemens assume energy efficiency (EE) targets are achieved at a rate of two percent energy reduction per year. This has a significant impact on the demand forecast, amounting to total reductions of 12% and 35% by 2025 and 2038.

Table 2: Impact of energy efficiency on demand forecast

Year	2025	2038
Energy Efficiency Implemented (GWh)	2,315 GWh	6,178 GWh

[2] Errata IRP, Section 10.1
[3] Initial technical hearing, https://youtu.be/2cwdxD3rTno?t=2887
[4] Errata IRP, Section 10.1

Reduction in load forecast (% of energy)	12%	35%

PREB, per best practices for energy efficiency programs, plans to contract a third-party administrator to implement EE programs and achieve these targets;[5] however, that procurement process will only start in late 2019 at the earliest, resulting in a contract that starts in 2020 at the earliest. PREB envisions the first year will largely be a planning year, followed by 3-year implementation plans. The implementation of the first 3-year plan would not start until 2021 at the earliest[6]. This lead time is critical since most EE programs, even after contracting is complete, take years to develop the required extensive customer, supplier, and vendor relationships. Despite this, the load forecast in this IRP assumes 2% annual EE savings starting in 2020. While laudable and exceedingly benefitical for ratepayers, these savings will take time to develop and procure.

Furthermore, energy efficiency programs typically require upfront savings to yield benefits over time, and can be vulnerable to political pressure particularly early in their implementation. Solutions to reconcile the need for initial funding, such as pay for performance or energy savings contracts can help overcome these barriers. Given the time needed to initiate programmatic energy efficiency, it is therefore critical to choose a plan that is able to adjust to a higher than anticipated load scenario especially in the early years while also pursuing energy efficiency expeditiously (see Appendix 1) given the important value the resource can provide.

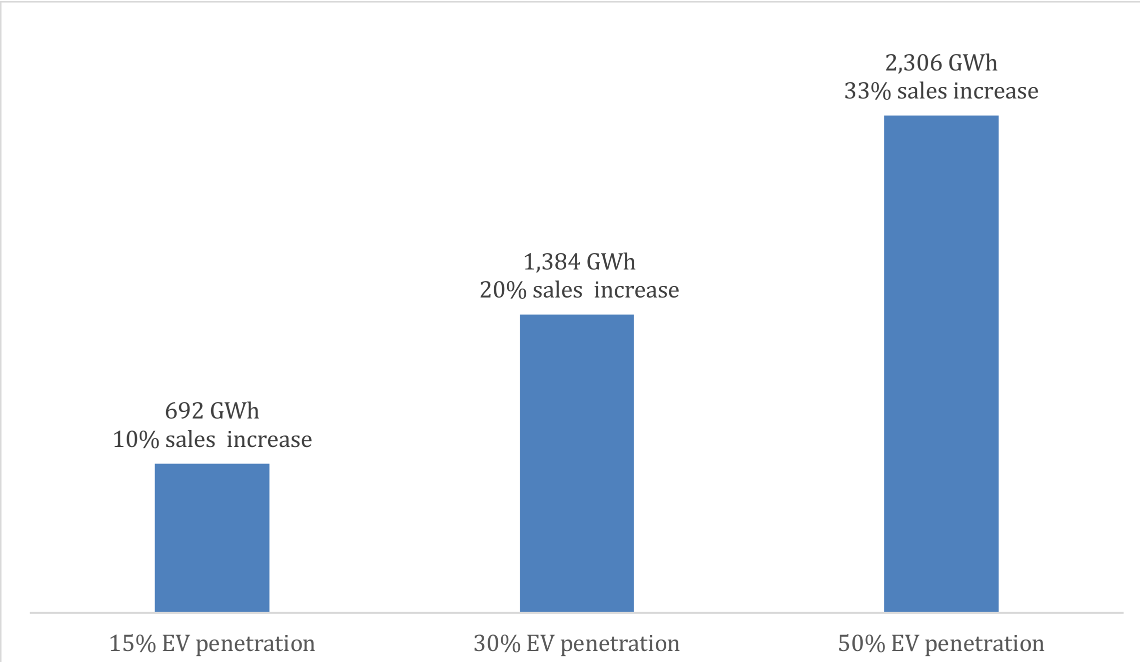
Second, the potential impact of the RSA on load is not considered. The proposed RSA would impose a transition charge on customer bills applied to all energy consumption at a rate of 2.8 cents per kWh in years 1-3 and increasing gradually to over 4.5 cents per kWh.[7] Researchers have estimated the long-run price elasticity of electricity demand near -1, meaning that for every one percent increase in cost, electricity sales will fall roughly one percent.[8] With an RSA transition charge representing a roughly 20 percent price increase, it is feasible this could depress electricity sales by 20 percent.

Third, electric vehicles are not considered in the demand forecast. Siemens consultants have stated they estimated potential EV adoption in Puerto Rico and concluded "it doesn't really make a difference" on demand.[9] Our analysis disagrees with this conclusion. We conclude that at EV adoption levels of 15%, 30%, and 50%, the increase in PREPA sales would be 10%, 20%, and 33%, respectively, as shown in figure 5 below. This analysis assumes a 2038 Puerto Rico population of 2.4 million and assumes driving behavior is comparable to that reported for

[5] http://energia.pr.gov/wp-content/uploads/2019/09/Resolution-NEPR-MI-2019-0015-2.pdf
[6] Best Practices for Energy Efficiency Programs, EPA: https://www.epa.gov/sites/production/files/2015-08/documents/napee_chap6.pdf
[7] https://grupocne.org/2019/05/23/prepa-debt-restructuring-agreement-3-0/
[8] Burke, Paul, and Ashani Abayasekara, *The price elasticity of electricity demand In the United States: A three-dimensional analysis,* August 2017, https://cama.crawford.anu.edu.au/sites/default/files/publication/cama_crawford_anu_edu_au/2017-08/50_2017_burke_abayasekara_0.pdf
[9] Initial technical hearing, https://youtu.be/spMJQLhv6rQ?t=12924

Hawaii, i.e., that there are 0.93 vehicles per capita and that 8,231 miles are driven annually per vehicle.[10]

Figure 5: Potential impacts of electric vehicle adoption on 2038 PREPA sales



These load uncertainties may result in total electricity needs that are higher or lower than forecasted. The IRP addresses this by evaluating the performance of different plans under higher or lower load cases. Given the extent of uncertainty, it is critical that the plan resulting from this IRP be robust to deviations in load, including that it complies with the energy policy objectives established by Puerto Rico law, and that it maintains low cost regardless of load. The ESM fails to satisfy this need for robustness on two counts – it does not comply with the RPS in high or low load cases, and its costs become much less attractive than alternative plans.

If the ESM plan is pursued and demand deviates, which current circumstances already indicate may be likely, Puerto Rican customers may be burdened by an additional billion dollars in cost that could have been avoided through different scenarios. The IRP, as considered, does not properly assess this risk.

1.b The ESM plan risks noncompliance with the RPS established in Act 17-2019

The IRP asserts that the ESM plan complies with the RPS, incorrectly stating,

[10] "Hawaii Transportation by the Numbers," 2017, https://www.bts.dot.gov/sites/bts.dot.gov/files/legacy/Hawaii.pdf

"The renewable portfolio standard targets of 15% by 2021, 20% by 2022, and 40% by 2055 are all met in the ESM Plan under all load cases. The levels of renewable penetration exceed a linear trend towards the 60% renewable target by 2040, with the plan meeting or exceeding the target by 2038 in all load cases."[11]

This is incorrect on two counts – first, it misrepresents the RPS requirements established in Act 17-2019, which include 40% by 2025 and 60% by 2040. Second, the ESM plan actually only meets the required RPS target in the base demand scenario. A linear trend toward 60% by 2040 would require 57.3% RPS in 2038. The ESM Low Demand case only provides 53.9%, and the ESM High Demand case provides 53.4% in 2038, both falling short of target.[12]

1c. The ESM plan is not cost-competitive in high or low demand cases

In high or low demand, ESM becomes less cost-competitive compared to other plans. Table 3 below depicts the cost comparison between ESM and S4S2 under base, low, and high demand cases. ESM is more costly in each case, and in fact its cost disadvantage to S4S2 only increases when demand is high or low, indicating the ESM plan's cost is less robust than S4S2 to demand uncertainty.

Table 3: Cost comparison across demand levels

NPV of Scenarios Across Different Demand Levels ($ million)			
	ESM	S4S2	S4S2 cost advantage vs. ESM
Base	14,431	14,350	81
Low	13,952	12,866	1,086
High	15,255	15,155	99

1d. The scorecards PREPA and Siemens have used to select the ESM plan are arbitrary and incorrectly consider key factors

Section 8 of the IRP describes the development of the various resource plans and exhibit 8-7 presents a "balanced score card", used to compare scenarios across several factors. This scorecard is central to PREPA's conclusion that S4S2 and ESM are the two most attractive plans, and that ESM is the preferred plan. Below we have recreated the image of the scorecard with the weightings and values more clearly depicted, and focused on just three plans – S3S2, S4S2, and ESM.

[11] Errata IRP, section 8.3.8.1
[12] Workpaper "Summary PREPA IRP Cases-06032019_v9", worksheet "2ndFiling" accessed at http://energia.pr.gov/wp-content/uploads/2019/07/Summary-PREPA-IRP-Cases-06032019_v9.xlsx

Figure 6: Scorecard used to evaluate scenarios in proposed IRP

Weight		S3S2B	S4S2B	ESM
20	NPV @ 9% 2019-2038 k$	10.0	9.6	9.6
20	Average 2019-2028 2018$/MWh	10.0	9.7	9.7
5	Capital Investment Costs ($ Millions)	6.5	8.4	10.0
15	NPV Deemed Energy Not Served	9.9	8.2	7.6
5	RPS 2038	10.0	7.8	7.7
5	Emissions Reductions	10.0	8.9	9.1
20	Technology Risk (PV / Max Demand)	6.1	8.9	9.8
5	High Fuel Price Sensitivity on NPV	9.7	9.8	9.6
5	High Renewable Cost Sensitivity on NPV	5.0	9.9	10.0
	Overall	8.8	9.1	9.3

Several aspects of this scorecard are problematic and lead to a flawed conclusion that the ESM plan is most attractive. First, the scoring matrix gives substantial weight to "technology risk," giving it 20 out of 100 points in the weighting. Technology risk here is defined as the ratio of solar PV capacity to the maximum expected system demand. This metric is far too simplistic to be meaningful and does not account for mitigating circumstances such as deployment of storage and implementation of demand response programs. It also does not fairly address risks across different technologies and presents a clear bias against solar technology. For example, this metric does not account for the technology risk associated with LNG investments that could result in stranded assets if high loads do not materialize simplistic.

Additionally, such a high weighting is not clearly justified – in fact this risk is given the same weight as the NPV of total costs (tied for the highest weighting in the scorecard). This high weighting is unmerited because the technology risk of solar is already accounted for in three separate analytical elements of the IRP:
1. Baseline costs of solar as modeled in all scenarios,
2. Price sensitivity analysis performed for solar resources, and;
3. In the procurement timeline limitations as determined by PREPA.

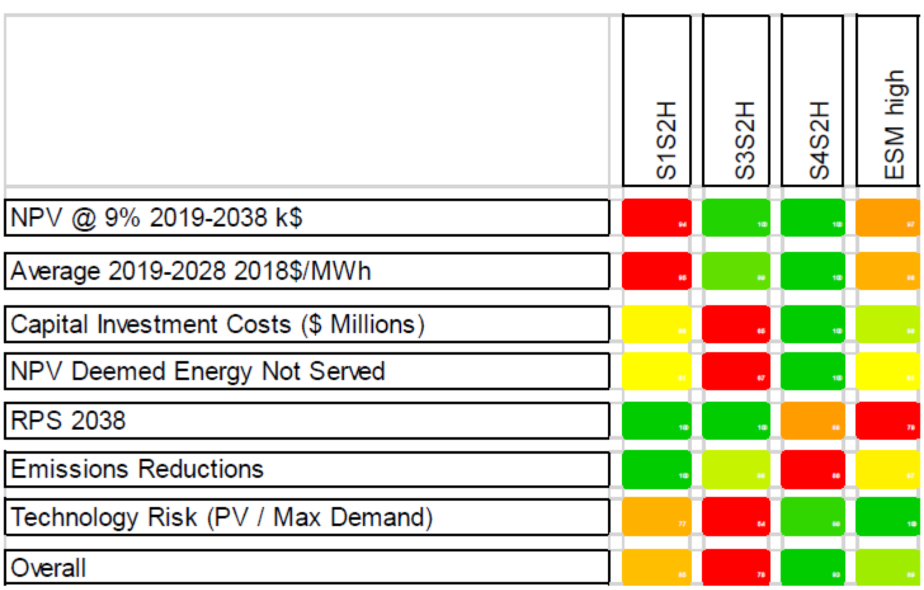
Furthermore, while a transition to a system with large amounts of solar PV does represent a major transformation, requiring learning and new operational practices, PREPA does not make the case that this transition would pose material risks to system reliability. What's more, to the extent this risk is substantial, it raises the question why the resource mix in the planning scenarios did not account for it in the first place. For instance, the highly renewable scenarios such as scenario 3 are dominated by solar PV (rather than wind), which PREPA explains as the result of a cost optimization. If in fact it was highly important to avoid a high reliance on solar PV as the unique new renewable resource, then the IRP should evaluate a high renewables scenario presenting a mix of solar and wind resources that mitigate this technical risk.

Second, S3S2 is given a very low score on "high renewable cost sensitivity on NPV" despite the fact this sensitivity does not appeared to be calculated for S3S2 anywhere in the IRP. In fact, Exhibit 8-6 describes that "in the case of Scenario 3 the sensitivity was made going from Low Renewable Prices to Base."[13] However, the NPV cost differential for S3S2 going from low renewables price to base is an increase of only $514M, while the high renewables price sensitivity applies to ESM and S4S2 show NPV cost increases of roughly $1.2B each. No justification is provided for giving S3S2 such a disadvantageous score on this metric, which contributes significantly to its lower overall score.

Third, the scorecards for high and low load growth cases give a red color to the ESM scenario for RPS compliance in 2038 – in fact the ESM fails to comply with the legal requirements established in Act 17 in these cases, as described above. Despite this lack of legal compliance, the ESM scenario still shows up as green in the "overall" rating for high and low demand. Exhibits 8-8 and 8-9 from the IRP are pasted below to illustrate this point

Figure 7: Scorecard for High Load Case (copied directly from proposed IRP)

Exhibit 8-8: Scorecard for Scenario 1, ESM, and Scenario 4 and Scenario 5 for the High Load Growth Case.



[13] Errata IRP page 8-13

Figure 8: Scorecard for Low Load Case (copied directly from proposed IRP)

Exhibit 8-9: Scorecard for Scenario 1, ESM, and Scenario 4 and Scenario 5 for the Low Load Growth Case.

	S1S2L	S3S2L	S4S2L	ESM Low
NPV @ 9% 2019-2038 k$	[illegible]	97	100	[illegible]
Average 2019-2028 2018$/MWh	[illegible]	97	100	[illegible]
Capital Investment Costs ($ Millions)	100	[illegible]	[illegible]	[illegible]
NPV Deemed Energy Not Served	75	[illegible]	100	[illegible]
RPS 2038	[illegible]	[illegible]	100	70
Emissions Reductions	100	97	[illegible]	[illegible]
Technology Risk (PV / Max Demand)	[illegible]	49	[illegible]	100
Overall	[illegible]	74	[illegible]	[illegible]

Different weighting choices – and correcting the treatment of S3S2 cost sensitivity – could easily produce different results. For example, as shown in the image below, it may be reasonable to disqualify the ESM plan on the grounds that in the high or low demand scenarios it fails to comply with the RPS requirements. Shifting more weighting out of the perceived "technology risk" and into the NPV metric (a primary standard metric used in integrated resource planning) would result in higher scores for S3S2 and S4S2, compared to ESM. Applying this same logic to the high or low demand cases would have a particularly negative impact on the ESM plan, since its NPV suffers disproportionately in those cases. As this example illustrates, the justification for selecting the ESM over other scenarios is arbitrary and dependent on flawed logic.

Figure 9: Hypothetical scorecard comparing scenarios with alternate weighting

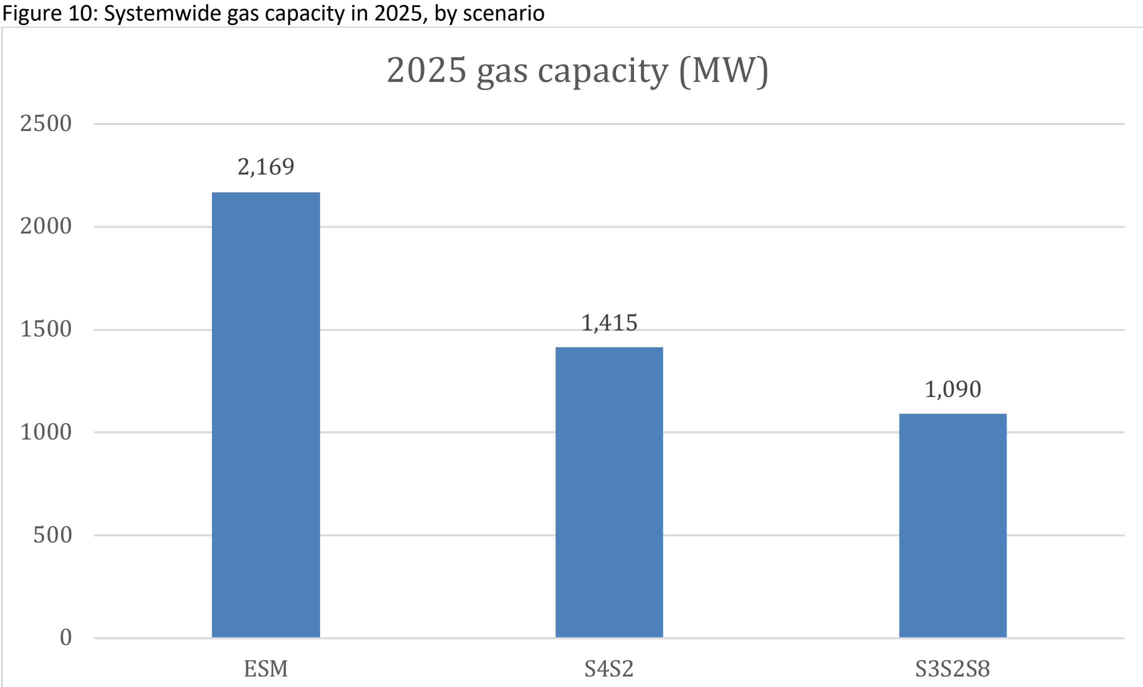
Weight		S3S2B	S4S2B	ESM
30	NPV @ 9% 2019-2038 k$	10.0	9.6	9.6
10	Average 2019-2028 2018$/MWh	10.0	9.7	9.7
5	Capital Investment Costs ($ Millions)	6.5	8.4	10.0
15	NPV Deemed Energy Not Served	9.9	8.2	7.6
5	RPS 2038	10.0	7.8	DISQUALIFIED
5	Emissions Reductions	10.0	8.9	9.1
10	Technology Risk (PV / Max Demand)	6.1	8.9	9.8
5	High Fuel Price Sensitivity on NPV	9.7	9.8	9.6
5	High Renewable Cost Sensitivity on NPV	10.0	9.5	9.7
	Overall	9.3	9.1	8.8

2. The proposed plan is overly reliant on natural gas, and does not fully account for the risks of gas infrastructure

2a. PREPA's actions indicate a bias toward natural gas

The scenarios modeled in the IRP largely represent transition to a mix of gas and renewable power generation. Among the three scenarios we highlight above, ESM is most heavily invested in gas with over 2.1 GW of gas capacity by 2025. S4S2 has roughly 1.4 GW of gas capacity, and S3S2S8 has roughly 1.1 GW, as depicted in figure 10 below.

Figure 10: Systemwide gas capacity in 2025, by scenario



Many of PREPA's actions, within and outside this IRP, indicate a bias toward gas as a preferred resource. The insertion of Yabucoa and Mayagüez gas infrastructure in the ESM scenario is one such action, taken despite the fact that the capacity expansion model does not select these resources economically.

Outside the IRP docket, PREPA's approved fiscal plan, dated June 27, 2019, depicts a "future state vision for generation system"[14] which includes the gas generation at both Mayagüez and Yabucoa included in the ESM plan. The depiction of these generators within "the latest vision for the power system's generation state in 2025" implies a clear preference for these facilities to be built, despite the fact the IRP action plan proposes proceeding "only with the preliminary permitting and engineering" and treating these projects as "a hedge against uncertainties."[15]

[14] "2019 Fiscal Plan for the Puerto Rico Electric Power Authority," page 20, https://drive.google.com/file/d/18wh7W-dch5LNr-gKJZMtxoP-DJ1NYBQw/view
[15] Errata IRP section 10.1.7

Lastly, PREPA's recent history reinforces the view that expansion of gas generation is a predetermined outcome PREPA is pursuing outside the IRP process. In 2018, PREPA contracted New Fortress Energy for the conversion of San Juan units 5 and 6 from diesel to natural gas as part of a contract that includes fuel supply of natural gas. To justify pursuing such a contract outside the IRP process, PREPA claimed anticipated fuel savings around $150M per year resulting from the switch from diesel fuel to natural gas.[16] This calculation was based on an assumed capacity factor of 90% for these plants.[17] And yet the subsequent resource plan filed by PREPA in February 2019 indicated these units would only operate at an average capacity factor of 46% in the years 2020-2024, and lower in later years.[18] These actions – developing a fuel conversion project outside the IRP process, overstating the savings that would result – reinforce the perception of bias toward gas investments at PREPA and indicate close scrutiny of gas plans is required to protect ratepayers from imprudent investments.

Furthermore, based on the experience of RMI and other experts, the Federal Energy Regulatory Commission (FERC) serves as the regulatory body overseeing all LNG import and export terminals. This jurisdiction includes the facilities to store LNG vessels and their berthing platforms. Among many other duties, FERC is empowered to protect the public and energy customers and ensure all LNG facilities are safe and appropriately permitted. The EcoElectrica regasification facility petitioned for and successfully secured FERC permitting to operate, and when seeking permits to expand the facility – also proceeded through FERC. The proposed Aguirre regasification facility initiated FERC permit processes but filed to vacate the initial authorization in 2018. All relevant documents related to these two projects are available in the public FERC database.

As of December 19th, 2019, New Fortress Energy has not filed any petitions with FERC related to the under-construction San Juan regasification facility. Questions arise as to whether all proper administrative steps have been followed. In addition to secured temporary permits by the Coast Guard to transmit LNG in San Juan harbor, the regasification activities, including more permanent construction occurring on land, would typically require FERC oversight and permits. If exceptions to FERC jurisdiction, including waivers or special circumstances exist – these should be made clear to the public. Expediting these projects could offer a reduction in operating costs (as cited above), but avoiding proper FERC permitting creates pervasive risks to customers and residents of San Juan.

In response to the argument that these expedited activities are necessary to move investments along in a slow-moving regulatory environment; RMI's experience working with utilities and regulators in many different markets suggests that these sorts of pre-determined outcomes lead to more harm to the consumer than good. Pre-determined outcomes in an IRP process can lead to stranded assets, unnecessary exposure to volatile expenses, and a perceived lack of regulatory certainty, all of which can result in higher costs for the consumer. For these very

[16] http://energia.pr.gov/wp-content/uploads/2018/09/Escrito-en-cumplimiento-AEE-CEPR-AI-2018-0001.pdf
[17] Statements by PREPA representatives in PREB technical hearing, https://youtu.be/yOaZu1xpbIg?t=5794
[18] RMI analysis of generation data included in the work paper "ESM_Base_Metrics_V5.0" at http://energia.pr.gov/wp-content/uploads/2019/02/ESM_Base_Metrics_V5.0.xlsx

reason's IRPs are required to asses all options fairly, something that this IRP fails to do through the ultimate and unjustified recommendation of the ESM plan.

2b. The proposed investments in gas infrastructure at Mayagüez Yabucoa and Palo Seco are not justified by the IRP analysis.

The action plan proposes preliminary permitting and engineering activities for LNG terminals and gas generation in Mayagüez and Yabucoa, despite the fact that the LTCE analysis did not select these options when offered. The only reason these investments show up in the planning scenarios is because they were fixed in the modeling software as a predetermined outcome. The Mayagüez and Yabucoa gas investments increase cost overall (ESM is more expensive than S4S2 or S3S2S8) while substantially increasing Puerto Rico's commitment to fossil fuels. This comes despite the recent passage of landmark energy policy in Puerto Rico that commits to a transition to 100% renewable energy and establishes a policy goal "to aggressively reduce the use of fossil fuels."[19] Furthermore, as described above, these investments do not provide a valuable hedge as the IRP claims, given the ESM's cost becomes even less attractive in the high and low demand cases.

PREPA's plan to pursue preliminary permitting and engineering activities is particularly questionable given limits on PREPA's internal capabilities are cited as justification for limiting the pace of solar PV acquisition.[20] Recognizing that constraints on engineering, procurement, and project management staff capacity are real, directing such resources toward preliminary work for facilities that may never be built represents a significant opportunity cost in limiting the major work that will be needed to integrate solar and storage onto the energy system. Conducting preliminary activities for these gas facilities, while the underlying demand forecast is so uncertain, creates the real possibility that within a few years PREPA or its successor will turn to the gas infrastructure even if demand reductions do not materialize as forecast. PREPA's language supports this premise, describing the Yabucoa and Mayagüez gas investments as "additions to preserve options and hedge uncertainties … should the customer load or generation projects at other sites indicate an adjustment is warranted."[21]

The risk is that establishing constraints on solar and storage resource development, that PREPA proceeds with extensive preparatory work for alternative gas facilities, and then in the coming years, gas expansion is the most readily available option when demand reductions do not materialize (a risk established earlier in this document). However the economic analysis contained in the IRP make clear today that these gas facilities are not the least cost option to meet demand, or appropriate to respond to deviations from the demand forecast, high or low, and that pursuing greater solar and storage investment is preferable. In light of this, PREB should approve neither the LNG import terminals in Yabucoa and Mayagüez, nor the generation infrastructure that would use its supply, and should restrict PREPA's ability to expend limited staff resources in development of such projects.

[19] Act 17-2019
[20] Errata IRP section 10.1.1
[21] Errata IRP section 10.1.7

In its analysis, PREPA also assumes the construction of an import terminal and generator at Palo Seco site in the two recommended scenarios – ESM and S2S4. Even though this investment is still subject to regulatory approval, PREPA has included this investment as pre-determined in its analysis of its recommended scenarios and has collaborated with other government agencies to initiate a procurement process for a contractor to build it.

PREPA's confidence in the development of Palo Seco is not merited by the IRP analysis. When comparing S4S2, which includes Palo Seco, to S3S2S8, the high renewable option that does not include Palo Seco, PREPA's analysis shows their aggregate costs are comparable, even without considering the benefits from lower pollution, better participation, and a more flexible system. These two scenarios are comparable even with PREPA's assumption of a future in which solar costs are rising in Puerto Rico, in part due to the planned expiration of the federal investment tax credit for solar PV. This contrasts sharply to decades of solar cost reduction and recent projects in the rest of the world, where competitive (and increasingly fully unsubsidized) solar prices in Mexico, Chile, Jordan, Jamaica, and solar and storage prices in Colorado and California are all coming in less than a third of the cost PREPA projects. The IRP analysis does not provide enough evidence to suggest that Palo Seco should be built, much less does it indicate that PREPA should begin negotiation with contractors on its construction. The regulator should scrutinize the justification for Palo Seco investment to ensure that a clean and flexible pathway is still secure in the coming decades.

2c. The IRP overlooks the case offered by S3S2S8, which is a viable option for a highly renewable pathway, at lower cost than PREPA's preferred ESM plan

This IRP presents ESM and S4S2 as the two leading plans for consideration, so if PREB rejects the ESM plan as recommended above, it should then consider whether to pursue S4S2 or some other scenario that has been overlooked. We have highlighted above that S3S2S8 represents a higher renewable plan with the same underlying cost assumptions as S4S2, with almost identical cost results (S3S2S8 has an NPV of $14.36 billion, compared to S4S2 at $14.35 billion). Comparing these two plans, S3S2S8 offers the benefits of more aggressively reducing fossil fuels and transitioning toward 100% renewable electricity, limiting the stranded asset risk of major gas infrastructure investments, and avoiding additional environmental risk associated with expanded LNG import operations in San Juan harbor.

To date, PREPA's rationale for excluding S3S2S8 from serious consideration has been flawed. PREB questioned the exclusion of S3S2S8 from the preferred plan through an ROI, and PREPA has responded with both economic and technical claims, including:

The main practical reason for this plan not to be selected as the preferred plan was its high reliance on low cost of renewable as mentioned above and the associated risk of this not being the case. Other practical problem is the dependence on PV and over the long term the entire installed thermal capacity in this plan would only cover 44% of the expected peak demand versus 62% in the S4S2B.[22]

[22] ROI response PREB_PREPA-01-54 c

This answer misrepresents an economic argument by claiming S3S2S8 relies on low cost of renewables, when in fact it uses the base cost assumptions for renewables. Additionally, it asserts that low thermal capacity is inherently a disadvantage of this plan, citing the long-term result that thermal power plants can only provide 44% of peak demand. While the transition to an energy system with low thermal generation capacity is a major change from the status quo, and will require new learning and operational practices, it is not justified as a reason for discarding the S3 plan, given that the IRP modeling does in fact conclude that it satisfies demand, and that the public policy of Puerto Rico will eventually require retirement of all non-renewably based thermal generation.

And even the low renewables pricing that informs the main S3S2 case is not unrealistic. Recent procurements of solar plus storage systems in Hawaii have shown pricing as low as $0.08 cents/kWh, including 4-hour duration storage, down 42 percent over the last three years.[23] The Hawaii comparison is useful for Puerto Rico, because Hawaii also faces cost increases compared to the mainland U.S., due to its remote geography and high labor and shipping costs. This pricing compares to the IRP's low- and base-cost assumptions for solar alone which range from 5.6 to 6.3 cents per kWh for 2020 and could well exceed the Hawaii pricing when storage costs are added. The cost analysis presented in the IRP does not include LCOE figures for solar plus storage installations, making a complete comparison to observed market pricing difficult – a thorough comparison will likely require PREPA to provide LCOE results for solar plus storage installations include four-hour storage duration.

2d. The assumption that solar PV will be unavailable after a natural disaster is overly conservative and drives increased gas investment

Within the regional minigrids, the IRP assumes no solar resources will be available in the first week following a natural disaster, instead relying on gas generation for local resource adequacy. In fact, solar energy facilities can be engineered and constructed to withstand hurricane conditions. Rocky Mountain Institute sent expert structural engineering teams to the Caribbean region (including to Puerto Rico) in the months after the 2017 hurricane season to investigate why some PV systems survived virtually unscathed while others suffered extensive damage. After a comprehensive investigation of the observed and potential failure modes, our experts determined a set of recommended best practices for ground mount systems that can lead to projects that are rated for category 5 hurricanes. Furthermore, our team determined that implementing these recommendations would lead to only a 5-8% increase in engineering, procurement, and construction (EPC) costs. These additional costs come in the form of labor for the extra time needed to through-bolt the modules and install more foundation and racking supports. There are also additional costs in material (racking supports, dual post piers, and fasteners) as well as minor costs for additional engineering and construction oversight. These recommendations can be implemented with existing technology. Based on RMI's Islands Energy Program's most recent solar PV procurement for a ground mount system in the Caribbean,

[23] Foehringer Merchant, Emma, "Hawaiian Electric Announces 'Mind-Blowing' Solar-Plus-Storage Contracts," January 4, 2019, https://www.greentechmedia.com/articles/read/hawaiian-electric-industries-announces-mind-blowing-solar-plus-storage-cont#gs.4qsx0j

implementing the best resilience practices would add approximately $90,000 per MW in EPC costs (or 9 cents per watt). This overall project price increase was roughly equivalent to the reduction in module pricing from 2017 to 2018.[24]

2e. Natural gas infrastructure – both for power generation and LNG supply and regasification – poses substantial financial risk to Puerto Rico ratepayers in the form of stranded asset risk

The IRP envisions a contractual structure in which PREPA or its successor procures energy, capacity, and other grid services from an independent power provider who owns and operates CCGTs at Mayagüez and Yabucoa. The independent power provider could also own and operate the LNG import terminals, or contract with an additional party to do so. To secure such an arrangement, PREPA or its successor would commit to a long-term contract. Meanwhile, the energy policy of Puerto Rico, established in Act 17-2019, includes the policy "to ensure that power purchase agreements do not hinder the development of a modern system that integrates renewable resources and power from distributed generation sources."

Recent research[25] from RMI concludes that across the US, up to 90% of proposed new gas power plants are at risk of becoming stranded assets by 2035. That is, by 2035 it is likely to become more cost-effective to create new clean resource portfolios – consisting of solar, wind, storage, demand response, and energy efficiency – than to continue *operating* gas power plants, regardless of whether those plants have paid off their financing or are considered fully depreciated. The consequence is the risk that any gas plant operating on that time frame (i.e., after 2035) risks being uneconomic to operate. If Puerto Rico ratepayers are still contractually obligated to pay for operation of such plants at that time, these contractual obligations may preclude the opportunity to adopt lower cost solutions at that time.

Additional research from EY[26] shows that "a high percentage of [oil and gas megaprojects] fail to deliver on time or meet approved budgets." Among LNG liquefaction projects studied, 67% faced cost overruns, and those overruns averaged 70% above budget. While PREPA's proposed IRP includes sensitivity analysis for high cost of renewables and high commodity cost of natural gas, it does not directly address the risk of capital cost overruns associated with large-scale LNG projects. The IRP also does not account for the risk of a carbon price being applied by the U.S. or Puerto Rico governments in the future.

Options to limit these risks include limiting the amount and pace of new gas infrastructure investment, and requiring short, flexible contract terms for any gas infrastructure that is constructed. Siemens staff have stated that the IRP was conducted with the assumption that all gas infrastructure is fully depreciated by 2050. In response to ROI 01-22, PREPA stated that LNG supply contracts as short as 5-15 years "have become more prevalent in recent years." For any

[24] *Solar Under Storm: Select Best Practices for Resilient Ground-Mount PV Systems with Hurricane Exposure,* 2018, https://rmi.org/wp-content/uploads/2018/06/Islands_SolarUnderStorm_Report_digitalJune122018.pdf
[25] *The Growing Market for Clean Energy Portfolios.* Rocky Mountain Institute, 2019, https://rmi.org/cep-reports
[26] *Spotlight on Oil and Gas Megaprojects.* EY, https://www.ey.com/Publication/vwLUAssets/EY-spotlight-on-oil-and-gas-megaprojects/$FILE/EY-spotlight-on-oil-and-gas-megaprojects.pdf

new gas infrastructure that is approved, PREB should consider guidelines for maximum contract duration that limit ratepayers' exposure to stranded cost risks.

3. The proposed IRP does not fully capture the value available from distributed energy resources

Puerto Rico has an opportunity to be a global leader in tackling some of the most pervasive issues in the energy transition while also tackling its own issues of reliability, resilience, and enabling a vision for the growth of Puerto Rican "prosumer." The proposed IRP, while not ruling out distributed energy resources, also does not pursue them as a valuable class of resources and does not recognize the unique value they can provide over utility-scale resources, most specifically for solar PV and battery energy storage. Implementation of this IRP without additional emphasis on distributed resources risks missing an opportunity to capture greater value in the transformation of Puerto Rico's energy system and presents an opportunity cost if customers are unable to fully integrate their private solar plus storage systems with PREPA's grid.

3a. The IRP does not emphasize distributed generation and storage as valuable resources to meet its system needs.

The IRP document asserts alignment with the five pillars of PREPA's "Vision for the Future of Power in Puerto Rico," including the principle titled "System is Customer-Centric." Exhibit 2-2 of the IRP describes this pillar with language including, "Customers are engaged by innovative products and value-added services that provide choice among rate plan and risk management options … Customers are empowered with behind-the-meter alternatives for energy efficiency, demand management, and distributed generation, with the ability to become prosumers if they so choose."

Furthermore, Act 17-2019 establishes policies and goals to:

- "establish and Electrical System model that maximizes the use of the energy resources available and that empowers the consumer to be part of the energy resources portfolio;" and
- "encourage the use of energy storage technology for consumers at all levels to facilitate and accelerate the integration of renewable energy sources and capitalize on their capacity as a distributed generation mechanism."

These strategic principles and policy statements support a vision in which customers provide critical resources to the energy system, including distributed generation and distributed storage, among others. And while PREPA's IRP forecasts that customers will adopt over 1,100 MW of customer-owned generation (regardless of IRP scenario),[27] it only considers this as a resource

[27] Exhibit 1-7: Summary of Investment Decisions by Scenario, Strategy and Load Growth

which customers adopt organically, and which PREPA integrates for its electricity generation. Customer-owned storage is not mentioned at all in the IRP. Neither customer-owned solar PV nor customer-owned storage is treated as a resource which can be encouraged or procured by PREPA in order to meet system needs.

The results of this IRP include large amounts of solar and storage, and IRP text indicates they would be procured in blocks of 200 to 250 MW, but does not explicitly provide recommendations that would allow for the procurement of both utility-scale or distributed. During the initial technical hearing, Siemens representatives described how the IRP does not predetermine whether resources are large scale or distributed, and in fact aggregations of smaller resources (i.e., virtual power plants) may compete alongside utility-scale projects in response to future RFPs.[28]

In practice, the design and implementation of future procurement practices will be critical to ensuring distributed resources can in fact participate fully. The IRP describes RFPs issued in blocks of approximately 250 MW or solar PV[29] and 150 to 200 MW of battery energy storage.[30] In order to enable participation by aggregated distributed resources, PREPA must avoid restrictive requirements that could rule out such resources, such as excessive minimum aggregation sizes, burdensome telemetry or metering requirements at the individual resource level, or other technical requirements that are not essential to the performance of solar and storage resources.

3b. Distributed generation and storage can in fact be valuable resources, and incorporating them can be more cost effective than focusing exclusively on utility-scale resources.

Leading utilities elsewhere have begun to embrace aggregations of solar and storage in their resource portfolios:

- Green Mountain Power, a Vermont utility, runs a program called "Resilient Home" in which the utility provides a customer with two Powerwall batteries. During normal grid operations, the utility dispatches these batteries just as it would large utility resources, saving expense in power system operations and land costs. During periods of power outage, customers rely on the energy stored in these batteries for backup power. In return for the grid value that the batteries provide, customers access a pricing structure that effectively reduces the cost of battery ownership.[31]
- Sonnen is equipping a new residential community in Utah with more than 600 batteries totaling 5 MW / 12.6 MWh. The utility Rocky Mountain Power has contracted with sonnen to use these batteries in support of the power grid. The batteries also provide backup power for residents during times of outage.[32]
- Hawaiian Electric, the utility serving the island of Oahu, has contracted with OATI and Sunrun to use up to 1,000 distributed batteries to provide up to 4.3 MW worth of grid

[28] Initial Technical Hearing, September 4, 2019, at 2:12:45, https://youtu.be/spMJQLhv6rQ?t=7965
[29] IRP Action Plan section 10.1.1
[30] IRP section 1.2.1
[31] https://greenmountainpower.com/product/powerwall/
[32] https://www.greentechmedia.com/articles/read/sonnen-delivers-long-promised-goal#gs.47deu3

services. These batteries will provide a mix of technical services, including fast frequency response, needed as Oahu's island grid transitions away from traditional fossil fuel power plants toward a 100% renewable system. Participating customers are compensated through the aggregator (Sunrun) in return for the value their batteries provide to the grid.[33]

These types of programs and business models can be lower cost to utilities than utility-scale solar and storage, despite their smaller size. This is possible because resources located on a customer's premise and within communities that value their services can provide multiple value streams, and their costs can be shared among those who benefit from them. For instance, in the case of the Green Mountain Power program described above, customers pay for the battery installation because they value the resilience it provides their home in case of grid outage. The utility contributes to the battery cost because it benefits from peak reduction, load shifting, and other grid values the battery provides. In this way, customers and the utility effectively "split the cost" of distributed resources.

In Puerto Rico, people and businesses have already installed large amounts of solar and storage, especially following the extended power outages caused by Hurricanes Irma and Maria. Over 170 MW of distributed solar are already connected to PREPA's grid, up from only 88 MW in June 2017.[34] We have seen no firm estimates of distributed storage capacity installed in Puerto Rico but anecdotally hear from solar companies that the large majority (i.e., roughly 90 percent) of installations since Hurricane Maria have included battery storage. To date, the vast majority of these batteries installed as part of local solar plus storage systems are only providing one value stream – resilience. Despite the presence of these resources already interconnected to Puerto Rico's electric grid, few if any are being used to balance the grid today, even while PREPA prepares plans to procure roughly 1-2 GW of new battery storage. Failing to enlist distributed battery storage in support of grid needs represents a major opportunity cost, both for PREPA in additional battery procurement requirements, and for the individual customers who have acquired or would acquire storage for resilience and could benefit from additional revenue by using their batteries to benefit the grid.

Distributed solar and storage resources could also help accomplish other major policy objectives. For instance, the critical facilities Puerto Ricans depend on for essential services could install solar and storage on-site at each premise for resilience in the face of future natural disasters. Initial RMI analysis shows that equipping over 20,000 critical facilities – including hospitals, clinics, airports, elderly care facilities, shelters, water treatment plants, and more – across Puerto Rico with solar and storage microgrid systems to power their critical loads in the event of grid outage could total 650-700 MW solar and 900-1,000 MWh of battery storage. Incorporating a significant portion of such resources into PREPA's system as aggregated virtual power plant resources could not only help meet PREPA's needs for dispatchable power, but also provide critical public service resilience in the face of future natural disasters. To the extent additional funding (public, private, and philanthropic) can be used to help fund critical facility

[33] https://www.greentechmedia.com/articles/read/sunrun-lands-1000-home-solar-and-battery-grid-services-contract-in-hawaii#gs.47dkqx
[34] http://energia.pr.gov/wp-content/uploads/2019/07/MI-2019-00010.pdf

energy resilience, the cost to PREPA ratepayers may be lower in incorporating such microgrids than it would be in procuring standalone utility-scale solar and storage.

Embracing distributed, customer-owned resources also offer many intangible values that may provide benefit to customers and communities, but which are not discussed in this IRP. These include such values as preservation of natural and agricultural lands, greater community and individual choice and control over energy resources, and local economic empowerment. While it is difficult to attribute monetary value to such traits or to account for them in the type of NPV analysis that guides IRPs, they do offer meaningful social value which should be recognized within the major decisions involved in this plan.

3c. In practice, PREB has options to ensure the unique values of distributed generation and storage are not excluded.

Ultimately, there is great opportunity for synergy between customers' demand for solar, storage, and other energy technologies, and PREPA's need for the same energy resources. Utilities and system operators generally have three options for enlisting distributed energy resources in support of grid needs: procurement, pricing, and programs. PREPA's presentation within this IRP and comments from PREPA and Siemens in the technical hearings suggest procurement of solar and storage could proceed in a manner that is neutral to the distinction between utility-scale and distributed resources. In practice, PREB may consider establishing procurement guidelines that ensure distributed resources can participate in such procurements, or even encourage them with targeted procurement practices. First, PREB can recognize that excessive minimum procurement sizes can exclude distributed resource participation – for instance, a 10 MW minimum bid size would exclude projects like the 4-5 MW contracts secured by the Hawaii and Utah utilities described above. Second, improper technical requirements could provide excessive burdens for aggregated resource portfolios without adding substantial value to the energy system. For instance, requirements for sophisticated metering or communications equipment located at each individual resource may add excessive cost to resource aggregations when portfolio-wide communication and measurement may provide sufficient technical capability.

Regardless of which scenario is selected in the final approved IRP, it will be critical for PREB to establish clear procurement guidelines so that resource aggregations are not unduly excluded from Puerto Rico's future energy system. Alternatively, if PREB determines that the policy goals of Act 17-2019, and the many additional values of distributed resources warrant additional action to build a stronger market for distributed resources and to ensure those resources support a resilient energy system, it may choose to explicitly encourage their development, for instance by requiring some portion of new resource procurements be restricted to distributed resources.

Pricing can also enable distributed resources to provide value to the energy system. Net metering is one pricing structure that already enables customers to provide energy to the electric grid and to receive compensation. Today in Puerto Rico, no pricing structure offers customers value for utilizing their battery energy storage in support of the grid. The most prominent option to expand pricing structures is with time-varying pricing, which may include such elements as time of use (TOU) rates, critical peak pricing (CPP), and dynamic pricing. These rates provide customers with incentives to shift the timing of their energy use, and customers equipped with batteries may be able to store energy during low-cost times and dispatch energy during high-cost times. Through the IRP or other proceedings, PREB can advance the using of innovative pricing structures to encourage greater participation of distributed energy resources.

Finally, utility programs are another mechanism to utilize distributed resources. In these programs utilities typically directly manage resources like small batteries or flexible loads, based on system needs. Within docket NEPR-MI-2019-0015, PREB has issued a draft regulation[35] outlining the role for a third-party administrator to implement such programs, rather than PREPA. This may prove to be an effective structure but requires further clarification. The role of the third-party administrator in that docket is described as implementing energy efficiency and demand response. The role of distributed storage is not clearly stated, and thus the boundaries between roles of PREPA and the third-party administrator in directly managing distributed storage programs is uncertain. PREB could provide greater clarity by establishing both clear lines of responsibility and clear goals and direction for distributed storage programs, whether in this IRP or in the Energy Efficiency and Demand Response docket.

Conclusion and recommendations

In this brief we have made three main points

1. The justification for ESM as the preferred plan is incomplete and flawed.
2. The proposed plan is overly reliant on natural gas, and does not fully account for the risks of gas infrastructure
3. The proposed IRP does not fully capture the value available from distributed energy resources

Overall, we have described three scenarios – ESM, S4S2, and S3S2S8 – that are each technically viable and have similar cost under the base demand and cost assumptions. ESM relies most heavily on new gas, while S3S2S8 relies most heavily on new renewables, and S4S2 lies in between. PREPA's IRP evaluates these plans through a lens that heavily weights high solar penetration as a "technology risk" and arbitrarily prefers operations and fuel expense to capital expense. Ultimately, PREB must determine which factors are most important in evaluating the options presented in this IRP. If those emphasize a rapid transition to renewable energy, avoiding stranded asset risks posed by major gas investments, and robustness to uncertainties in demand, the highly renewable scenarios become more attractive than a gas-dominant plan.

In conclusion, we emphasize specific recommendations for PREB:

- Do not approve investment in LNG terminals or large-scale gas generation at Yabucoa or Mayagüez, or any preliminary permitting and engineering activities related to these facilities. These gas investments cost more than renewable alternatives, are less robust to demand uncertainties, run counter to Puerto Rico's energy policy, and consume limited PREPA staff capacity that would be better directed to the renewable transition.
- Start quickly in implementing the "no regrets" solar and battery storage procurement, recognizing all scenarios incorporate substantial amounts of these resources quickly.

[35] http://energia.pr.gov/wp-content/uploads/2019/09/Resolution-NEPR-MI-2019-0015-2.pdf

- Scrutinize the justification for the Palo Seco CCGT and the land-based San Juan LNG import terminal before approving such projects. Ensure the San Juan LNG terminal and all other considered LNG projects comply with FERC guidelines and have followed all proper administrative steps.
- Evaluate the higher renewables pathway offered by scenario 3 as an alternative to these gas investments that more closely aligns with Puerto Rico's energy policy and reduces stranded asset risk for customers.
- Issue clear guidelines for the procurement of solar and storage resources that encourages distributed, customer-owned resources to participate fully, including customer-owned battery storage. Clarify the roles and responsibilities of PREPA and the demand response third party administrator for managing distributed storage aggregations.
- Reconsider in supplementary analysis the role of wind power to provide resource diversity and mitigate the technical integration challenges of solar PV.

Appendix 1: The Important Role of Energy Efficiency

In the fall of 2019, the Puerto Rican legislature has turned increased scrutiny on initial charges to provide for an energy efficiency fund, driven largely by constituent backlash against any new charges on customer bills. Some initial attempts to weaken the energy efficiency goals established by Act 17 ensued from this scrutiny. For more than 38 years, Rocky Mountain Institute has been working on the topic of energy efficiency and assessing progress across utility jurisdictions as well as varied industries and customer classes. In the filed PREPA Integrated Resource Plan, and many other utility assessments, we note an assumption that energy efficiency —generally and repeatedly shown to be the most cost-effective energy system resource —is a limited and dwindling resource whose price- and policy-driven adoption will inevitably deplete its potential and raise its cost. However, in a recent peer-reviewed scientific paper[36] Amory Lovins, the co-founder and Chief Scientist of Rocky Mountain Institute explains that modern energy efficiency "shows every sign of durably remaining, an expanding-quantity, declining-cost resource." Even though energy efficiency programs take time to stand up, we consistently observe that it is the most cost-effective energy resource with durable benefit to customers and supporting sustainble economic activity over many decades.

Most utilities across the U.S. run energy efficiency programs for their customers to meet targets established by legislatures or regulators. In some states, a separate "energy efficiency utility" is responsible for efficiency programs. In accordance with the American Council for an Energy Efficient Economy (ACEEE), as of January 2017, twenty-six states have fully funded policies in place that establish specific energy savings targets that utilities or non-utility program administrators must meet through customer energy efficiency programs. Energy Efficiency Resource Standard (EERS) in those states mostly range from below 0.5% (Texas) to over 2.5% annual savings (Massachusetts and Rhode Island)[37]. These programs have led to sizable savings for their customers. In Hawaii, for example, a 2.1 cent per kWh investment in energy efficiency has yielded, "bill savings of $37 million annually, more than $488 million over the life of the measures installed."[38]

Similarly to other jurisdictions, Puerto Rico can benefit from an energy efficiency program. In PREPA's 9th response to IRP Request for Information, PREPA illustrated the additional cost of not implementing energy efficiency. The table below illustrates for the two scenarios that PREPA recommends (ESM and S4S2) the increased cost (in Net Present Value and vale of energy not served) of *not* implementing the mandated energy efficiency target.

[36] https://rmi.org/insight/how-big-is-the-energy-efficiency-resource/
[37] https://aceee.org/topics/energy-efficiency-resource-standard-eers
[38] https://aceee.org/blog/2019/11/puerto-rico-poised-benefit-energy

Table A: Net present value and value of energy not served of ESM and S2S2 across different energy efficiency scenarios

Scenario	Mandated EE Target (2%)	Low EE	No EE
ESM: Net Present Value + Energy Not Served in 1,000 USD	$ 14,698,161	$ 16,802,158	$ 17,521,981
S4S2: Net Present Value + Energy Not Served in 1,000 USD	$ 14,597,640	$ 17,055,430	$ 18,127,482

As shown by PREPA's own analysis, not implementing an energy efficiency program in Puerto Rico would be a billion-dollar mistake for electricity consumers. **Clearly, energy efficiency should be prioritized and pursued, including with financing mechanisms that defray or avoid the need for up-front customer charges and instead allow for savings and costs to be spread across the life of the program.** We believe the ongoing regulatory proceedings led by PREB are the appropriate venue to explore these options, and the integrated resource planning process can be refined in coming years to reflect specific program design and timing.

Declarations required by Regulation No. 8543

Regulation No. 8543, Section 7.01 establishes guidelines for the contents of briefs files by *amicus curiae* parties. These contents are provided here:

1) A description of the petitioner and its interest in the controversy(s) pending adjudication

Rocky Mountain Institute – an independent nonprofit founded in 1982 – transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; Oakland, California, and Beijing.

Since 2012, RMI's Islands Energy program has been accelerating the transition of island economies from a heavy dependence on fossil fuels to a diverse platform of clean energy and energy efficiency while establishing a blueprint for other island economies. Since Hurricanes Irma and Maria struck in 2017, RMI has been supporting the energy transition in Puerto Rico by: (1) convening and facilitating collaborative workshops to enable stakeholders to contribute to the transformation of energy policy and infrastructure; (2) providing direct, independent, expert input to technical advisory groups, including those convened by the Puerto Rico Senate, the Resilient Puerto Rico Advisory Commission, and the Southern States Energy Board; and (3) managing philanthropically backed solar and storage project deployment.

2) An explanation of the reasons for which its participation in the case is justified

The Puerto Rico Energy Public Policy Act (17-2019) states "The electric power system should be reliable and accessible, promote industrial, commercial, and community development, improve the quality of life at just and reasonable cost, and promote the economic development of the Island." The law further declares as the public policy of the Government of Puerto Rico "to promote the necessary changes in order to transform the Electric Power System into one that satisfies the energy needs of the 21st century Puerto Rico."

Rocky Mountain Institute is well suited to provide independent expert input in support of this policy vision. In recent years we have served as direct advisors to energy regulators pursuing their own energy system transformations – including advising the Hawaii Public Utilities Commission on implementation of demand response and performance-based regulation, and aiding the New York Public Service Commission's Reforming the Energy Vision process – and to leading U.S. utilities such as Green Mountain Power and Consolidated Edison in their own energy innovation programs. RMI has supported utilities and governments (in Saint Lucia, Saint Vincent and the Grenadines, Belize, the Turks and Caicos Islands, and other island grids) to develop integrated resource plans by providing analytical support, project management, and advisory input. RMI led integrated resource planning in Malawi, with coordination among the generation and supply utilities, government, and key development partners. RMI believes strongly in the importance of analytically rigorous, participatory, and properly overseen integrated resource plans that consider all available options to pursue ratepayer benefit.

3) An introductory explanation of the contributions that it will make to assist the Commission to be better informed or in a better position to adjudicate the case properly

RMI will act as an independent expert contributor to the PREPA IRP proceeding. We will conduct thorough review and analysis of the proposed IRP and identify both its strengths in supporting the goals of Puerto Rico's energy public policy, and the opportunities to improve how it delivers on these goals. Our input to this process will build on extensive engagement in utility and energy sector transformation across both the United States and the Caribbean region. Through our participation in the 2018 Public Collaborative for Puerto Rico's Energy Transformation, several technical advisory groups described above, and in the Puerto Rico renewable energy market supporting philanthropic projects, we have a thorough understanding of the challenges and opportunities facing the island's energy system.

4) A declaration indicating:
4a) If any of the parties or lawyers in the complaint has helped draft the petitioner's brief

No party or lawyer in the complaint has helped draft this brief.

4b) If any of the parties or lawyers in the complaint has contributed funds or any other type of resource for the preparation or submission of the petitioner's brief

No party or lawyer in the complaint has contributed funds for the preparation of this brief. RMI staff have met with several parties, both in person and by teleconference, to discuss the substance of the IRP. On September 13, 2019, RMI staff attended a working session hosted by Sierra Club Puerto Rico, where breakfast and lunch were provided by Sierra Club.

4c) If any other person, not a party in the complaint, the petitioner or its lawyer, has contributed funds or any other type of resource for the preparation or submission of the petitioner's brief, and the name of said persons(s)

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- Builders Initiative
- Eldred Foundation
- Energy Foundation
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- Open Society Foundations
- The Prudential Foundation
- The Rockefeller Foundation
- Sally Mead Hands Foundation
- Save the Children
- Schwab Charities
- Virginia G. Piper Charitable Trust

Certification

This updated document is respectfully submitted to the Puerto Rico Energy Bureau on December 20th, 2019. We have electronically filed this document via https://radicacion.energia.pr.gov/ and a copy of this document is being sent via email to: N-vazquez@aeepr.com; astrid.rodriguez@prepa.com; jorge.ruiz@prepa.com; c-aquino@prepa.com; mvazquez@diazvaz.law; kbolanos@diazvaz.law; acarbo@edf.org; javier.ruajovet@sunrun.com; pedrosaade5@gmail.com; rmurthy@earthjustice.org; carlos.reyes@ecoelectrica.com; ccf@tcmrslaw.com; victorluisgonzalez@yahoo.com; mgrpcorp@gmail.com; hrivera@oipc.pr.gov; jrivera@cnslpr.com; manuelgabrielfernandez@gmail.com; acasellas@amgprlaw.com; corey.brady@weil.com; maortiz@lvprlaw.com; rnegron@dnlawpr.com; paul.demoudt@shell.com; escott@ferraiuoli.com; agraitfe@agraitlawpr.com; castrodieppalaw@gmail.com; voxpopulix@gmail.com; cfl@mcvpr.com; info@liga.coop; amaneser2020@gmail.com; sierra@arctas.com; tonytorres2366@gmail.com;

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