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

IN RE: REVIEW OF THE PUERTO RICO ELECTRIC POWER AUTHORITY INTEGRATED RESOURCE PLAN	NO. CEPR-AP-2018-0001 **SUBJECT:** PREPA'S INFORMATIVE MOTION AND MOTION TO EXTEND DUE DATE FOR REVISED IRP

PREPA'S INFORMATIVE MOTION AND MOTION TO EXTEND DUE DATE FOR REVISED IRP

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES NOW the Puerto Rico Electric Power Authority ("PREPA") and respectfully submits, to the honorable Puerto Rico Energy Bureau (the "Energy Bureau"), PREPA's Informative Motion and Motion to Extend the Due Date for the Revised IRP (Integrated Resource Plan) by three weeks, to May 31, 2019.

1. PREPA has attached hereto a Memorandum prepared by its independent expert IRP consultants, Siemens. The Memorandum serves two purposes:

   a. the Memorandum provides the Energy Bureau with interim information regarding work done by PREPA and Siemens on certain cases for purposes of the revised IRP and the interim results of those cases, as well as associated difficulties and complications due to compliance with Energy Bureau directives and the changes in the renewable portfolio standard under Act 17-2019, and

   b. the Memorandum explains the reasons that have compelled PREPA to request a minimum three-week extension for the revised IRP.

2. In brief, the reasons more time is needed are as follows:

   a. The Energy Bureau's directive to model wind turbines as a separate resource option is making the Long-Term Capacity Expansion ("LTCE") plan model runs take significantly longer (meaning the actual amount of time it takes the supercomputer to run the models). PREPA respectfully requests that the Energy Bureau consider revising that directive to limit it to those LTCEs that consider the low case for renewables costs. The past LTCE runs indicate that the

wind resources are not selected in the middle case for renewables costs. Siemens also believes that there is no reason to believe that the wind resources will be selected in additional middle case runs.

b. The Siemens team also has encountered several model issues with the Aurora LCTE which have caused significant delays in running LTCE plan cases and getting meaningful results. First, Siemens is having difficulties, in particular with the build out of battery storage for most Scenarios, and in particular the ones with high development of solar, such as Scenarios 1 and 3. The model is building substantially less battery storage in comparison with the renewables, resulting in high levels of curtailment. This situation was not seen before and, while working with Energy Exemplar, the developers of Aurora, Siemens believes they may have found a solution, there was significant time lost to this point.

c. Second, the models have yielded inconsistent results in terms of EcoEléctrica retirement decisions, in particular for Scenario 1. This point is still under investigation.

d. Finally, the Energy Bureau's April 26th order, although it might not have been intended, in effect requires the re-running of all LTCE plan cases. The Siemens team, to date, modeled energy efficiency (EE) gains of 2% per year as necessary to reach 30% by 2030, reaching compliance based on the net load by 2031, considering future programs and measured over the final load. However, the April 26th order measured the 30% compliance based on gross load instead of net load, and it directed PREPA to extend the 2% EE reduction to 2037. Those changes would require re-running all of the cases, including the two presented in the Memorandum.

3. Please note that the Memorandum also explains and urges the Energy Bureau to consider withdrawing the requirement to re-run Scenario 2 for those cases that the solution of Scenario 4 does not build new generation at the proposed LNG terminals at Yabucoa and Mayaguez, collapsing into the restrictions of Scenario 2. Please note, however, that if the Energy Bureau were to approve this change, that would reduce the number of LTCE runs, but it would not reduce the need for a minimum three-week extension.

4. Please also note that the completion of the revised IRP may require PREPA to update some of the testimony submitted on February 13, 2019. However, it is not practically possible to prepare the testimony updates until the final revised IRP is available. Because completing the final revised IRP is expected to take right up until the new proposed deadline of May 31st, PREPA will not be able simultaneously to file updated testimony if and as needed. PREPA will seek to do so as soon as possible.

WHEREFORE, the Puerto Rico Electric Power Authority respectfully requests that the Honorable Puerto Rico Energy Bureau accept this Informative Motion and extend the due date for the revised IRP for at least three weeks, to May 31, 2019.

RESPECTFULLY SUBMITTED,

IN SAN JUAN, PUERTO RICO, THIS 3rd DAY OF MAY, 2019

PUERTO RICO ELECTRIC POWER AUTHORITY

I HEREBY CERTIFY that on this day I have filed the above filing with the Puerto Rico Energy Bureau at the office of the Clerk of the Puerto Rico Energy Bureau; and, that courtesy copies of the filing were sent via email to the Puerto Rico Energy Bureau via email to secretaria@energia.pr.gov and to the office of the Energy Bureau's internal legal counsel via email to legal@energia.pr.gov and sugarte@energia.pr.gov.

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MEMO TO: PREPA CEO and IRP Team

FROM: Siemens PTI/EBA

DATE: May 2nd, 2019

SUBJECT: New Results for ESM and Scenario 4, Strategy 2, Base Plans

This memo summaries the assumption changes and preliminary results for the ESM Plan and Scenario 4, Strategy 2 Base Case, in response to the Bureau's April 5th Resolution and Order. The results discussed in this document do not incorporate any of the assumption changes from the April 26th Order, provided by the Bureau to PREPA in response to the PREPA's April 17th informative Motion, Proposal regarding compliance schedule and updated question, in particular, regarding the change in Energy Efficiency assumptions.

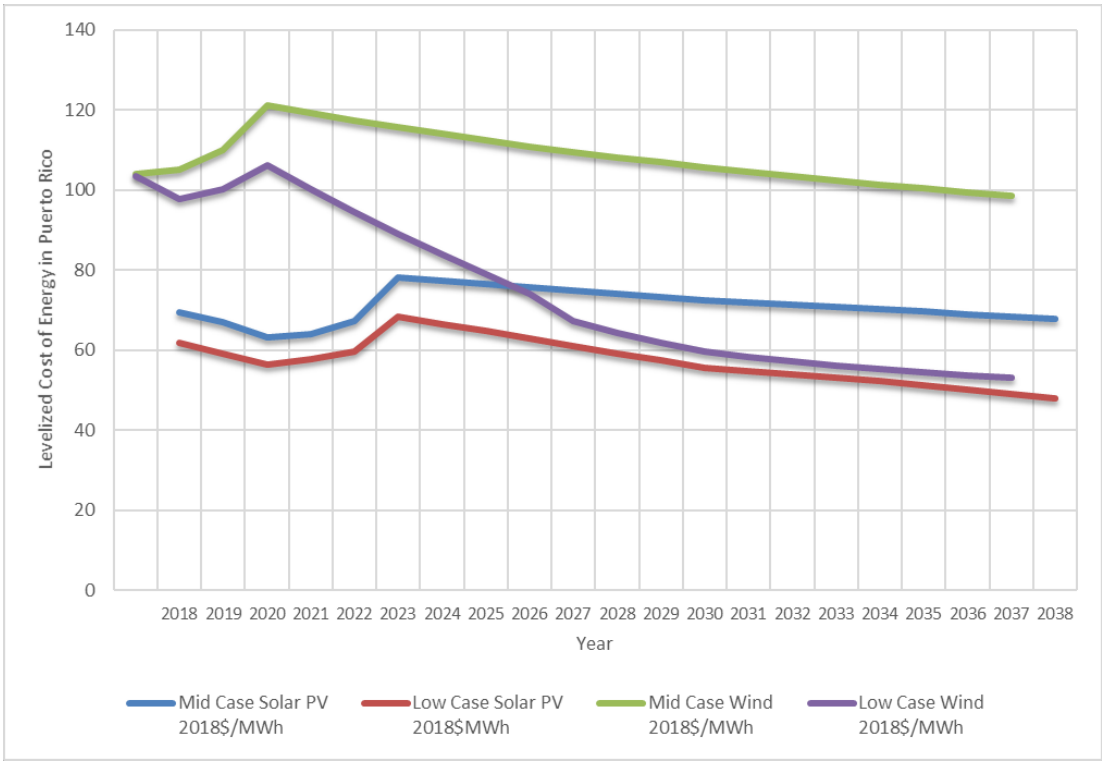
The results presented here are preliminary in nature and subject to change, perhaps materially, due to the issues discussed at the end of this memo in relation with the Aurora models that arouse due to a combination of; more resources offered (namely wind turbine generation), further drop in the demand (due to extension of the Energy Efficiency gains) and increased levels of renewable generation as required by Act 17-2019. Siemens PTI made every effort to confirm the accuracy of the results presented here and we believe that they are reasonable, but as indicated earlier, they may have material changes as we resolve the issues with the Aurora models.

1. Updated Assumptions

The ESM, Scenario 4 and other core cases have common assumption changes listed below in response to the April 5th order.

1 - Improve capacity factors for Wind based on NREL ATB TRG-8, mid case and add this as an option to the LTCE selection and offered as a resource to the Aurora LTCE calculations. As can be observe in the exhibit below we don't expect wind turbine generation to be selected under the "mid" case renewable price projections, despite the fact that these resources do have some contribution to the nigh peak (about 20%). On the other hand, based on the wind profiles considered, we do expect to find some level of contribution towards the end of the forecast under the 'low" case.

Exhibit 1: Renewable Resources LCOE 2018$/MWh



2 - Implementation of Act 17-2019 with new RPS targets of 20% by 2022, 40% by 2025 and 60% by 2040. In addition, the new simulations meet the November's Bureau's resolution of 15% RPS by the end of 2021. This is a material change with respect of the assumptions on the previous filing as the amounts of solar generation installed in the earlier years went up significantly.

3 - Modeled EE gains of 2% per year as necessary to reach 30% by 2030, reaching compliance based on the net load by 2031, considering future programs. The Energy Bureau in its Order of April 26 measures the 30% compliance on the gross load instead of net load and ordered to extent the 2% per year reduction to 2037. This change needs to be processed. This change is also important considering for example that by the end of the forecast the peak demand drops more than 350 MW (one large CCGT).

4 - Any non-renewable generator is modeled as fully depreciated by 2050 and ready for retirement by then.

5 - High Efficiency Requirement Fossil Generation - For demonstration of compliance, PREPA check compliance using two requirements: 1) The real levelized costs in $/MWh for new and existing CCGTs staying online meet the 100$/MWh requirement in real 2018 dollars. As indicated, it is generally the expectation that when new or existing CCGTs (namely EcoEléctrica and San Juan 5 & 6 gas conversions) dispatching at capacity factors higher than 60%, the levelized costs of energy is at or below $100/MWh. Also, in reference to the April 26th Order, PREPA is confirming that at least 60% of the total energy from fossil generation comes from highly efficient units.

6 – Land based LNG Cost at San Juan sized to the new CCGT F class built in the North at Palo Seco (Bayamon). Siemens evaluated the potential maximum fuel used at the terminal from the new combined cycle plus the San Juan 5&6 conversions to gas. As such, the CapEx required is slightly lower compared to previous simulations. Exhibit 2 shows the new capital costs assumptions for all terminals. Exhibit 2 illustrates the potential maximum volume at the

terminal based on the maximum generation from the new F Class unit and the San Juan conversions. The LPG option is not considered in the total, as is optional in the simulation.

Exhibit 2: Capital Costs Assumptions LNG Terminals

Infrastructure Option	CAPEX $MM (2018$)	Annual OPEX $MM (2018$)	Max Daily Gas Volume (MMcf/d)	Max Gas Volume (MMBtu/month)	Max Capacity MW	CAPEX $/kW (2018$)	Annual OPEX $/kW (2018$)	CAPEX + Annual OPEX $/kW (2018$)
Land-based LNG at San Juan Port (w/o pipeline)	$ 471.62	$ 24.52	125.9	3,924,711	702	68	35	103
Ship-based LNG at Mayaguez (west)	$ 185.00	$ 9.62	53.4	1,642,116	302	62	32	94
Ship-based LNG at Yabucoa (east)	$ 185.00	$ 9.62	53.4	1,642,116	302	62	32	94
Ship-based LNG (FSRU) at San Juan Port (supply to San Juan only)	$ 185.00	$ 9.62	50.4	1,549,815	350	54	27	81

Exhibit 3: Maximum Fuel Usage

	San Juan 5 Peak Fuel Consumption	San Juan 6 Peak Fuel Consumption	F-Class Consumption	Total
Capacity	200	200	302	702
Capacity Factor (used to determine peak consumption)	100%	100%	100%	100%
Heat Rate BTU/kWh	7625	7853	7552	
Fuel MMCf/day	35.7	36.8	53.4	125.9
Max Gas Volume (MMBtu/month)	1,113,250	1,146,538	1,664,923	3,924,711

7 - PREPA can buy RECs to meet the RPS requirements from DG. Modeled with compliance 100% from utility scale solar only. Provide the shadow price as the fair value of RECs.

8 – EcoEléctrica was modeled from 2022 onwards with a reduction of 53% on the fixed costs (47% multipliers) as this value was estimated to make it competitive with an F-Class CCGT, using the results of the prior ESM .

9 – The CCGT offered as an option to the LTCE at Costa Sur was assumed to burn natural gas priced under the same conditions from a new ship-based LNG terminal. This consideration makes the selection of this CCGT independent of any assumptions with respect of the costs of the gas to be delivered from Costa Sur LNG terminal.

10 – The LPG unit of 114 MW modeled in the ESM case, is provided as optional for selection by the Aurora model in the LTCE.

2. ESM Results

2.1.1 Capacity Expansion Plan

- 2,340 MW of solar built over the study period, mostly in 2020-2024, as shown in Exhibit 4. This is an increase of 160% over the original ESM that had a total of 900 MW of new solar and 18% higher than the sensitivity where we required the ESM to reach 50% (1980 MW). It should also be noted that this later plan had most of the supplementary additions towards the end of the forecast period and comparing the 2020-2024 period in the new ESM we have 2,220 MW of new solar added while in the ESM 50% case this value was 1,140 MW about 48%.
- 1,100 MW of storage built to support renewables and provide reserves; a 28% increase over the original ESM that had 800 MW of batteries.
- No wind turbine generation was built by the plan.
- The LPG unit is not selected by the model or any other gas unit besides the input new CCGTs at Bayamon and Yabucoa (Caguas).

- San Juan gas conversions are retired economically. San Juan 5 converted retires in 2032 and San Juan 6, earlier in 2027 (see Exhibit 5).
- EcoEléctrica is not retired by design, dispatching at 53-93% capacity factor range. The lowest dispatch capacity factors happen in 2025-2027 prior to AES retirement. In contrast, the highest capacity factors happen early in the forecast.

Exhibit 4: Capacity Additions by Technology and Region

Capacity Additions

600

Type: New Unit

Sum of Capacity		Year																				
REM_Fuel_BESS	Zone Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Grand Total
Battery_2hr	SAN JUAN										20					60						80
Battery_2hr Total											20					60						80
Battery_4hr	ARECIBO			60																		60
	CAGUAS			120	100																	220
	CAROLINA			120	100																	220
	CAYMG	20	60																			80
	MAYAGUEZ NTH		40	60	20																	120
	SAN JUAN			40	40					40	60				60	60						300
Battery_4hr Total		20	100	400	260					40	60				60	60						1,000
Battery_6hr	SAN JUAN															20						20
Battery_6hr Total																20						20
Large CCGT_gas	BAYAMON							302														302
	CAGUAS							302														302
Large CCGT_gas Total								604														604
New Solar	ARECIBO				60	60																120
	BAYAMON			120	120	120	120															480
	CAGUAS		60	120	120	120			60													480
	CAROLINA		120	120	120	120														60		540
	CAYMG		60	60	60	60	60															300
	MAYAGUEZ NTH		60	60	60	60	60															300
	SAN JUAN				60	60																120
New Solar Total			300	480	600	600	240		60											60		2,340
Peaker_gas	CAGUAS			116																		116
	CAROLINA			116																		116
	CAYMG			46																		46
	MAYAGUEZ NTH			93																		93
	MAYAGUEZ STH				200																	200
	PONCE ES			46																		46
Peaker_gas Total				418	200																	618
(blank)	(blank)																					
(blank) Total																						
Grand Total		20	400	1,298	1,060	600	240	604	60	40	80				60	140				60		4,662

Exhibit 5: Capacity Retirements by Unit *

Sum of Capacity	Year																				
Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038

AGUIRRE 1 CC							257													
AGUIRRE 2 CC							249													
AGUIRRE STEAM_1		432																		
AGUIRRE STEAM_2	429																			
CAMBALACHE CT_2					82															
COSTA SUR 5		388																		
COSTA SUR 6	393																			
DAGUAO GT11 & GT12	42																			
Jobos GT11 & GT12	42																			
MAYAGUEZ GT 1			50																	
MAYAGUEZ GT 2			50																	
MAYAGUEZ GT 3			50																	
MAYAGUEZ GT 4			50																	
PALO SECO 3							206													
PALO SECO 4					206															
PALO SECO CT11	42																			
PALO SECO CT31	42																			
SAN JUAN 07					94															
SAN JUAN 08					95															
SAN JUAN 5 CC_Conversion														200						
SAN JUAN 6 CC_Conversion									200											
Vega Baja GT11 & GT12	42																			
Grand Total	**1,033**	**821**	**200**		**478**		**712**		**200**					**200**						

* Last year in service year shown in table

2.1.2 Results and Metrics

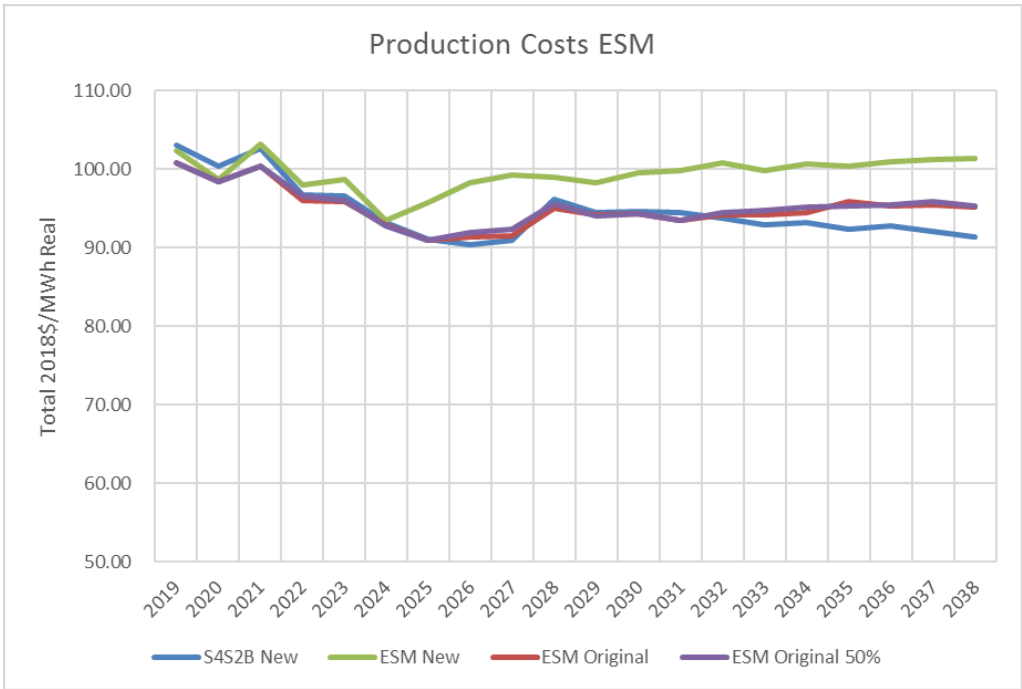
- The NPV of the system cost is slightly higher at $14.46 billion compared to the previous results for the ESM, mostly driven by higher fixed costs partially offset by lower fuel and variable O&M costs with more solar capacity additions; note however that part of the reduction in the NPV is due to the fact that in these runs we are supplying a smaller load over the planning period due to the increased EE gains. The average cost in $/MWh in the first ten years increase by nearly $4/MWh, compared to previous results as can be observed in Exhibit 7.

Exhibit 6: NPV System Costs ($000)

	New ESM	Original ESM
NPV @ 9% Nominal 2019 - 2038	14,460,033	14,500,639
NPV @ 9% Nominal 2019 - 2028	10,399,728	10,367,066
Average $/MWh (2019-2028)	98.6	95.3
RPS 2038	53%	23%

	New ESM	Original ESM	Difference
NPV fuel	6,143,899	7,998,923	(1,855,023)
NPV Var O&M	370,348	400,021	(29,673)
NPV Fixed Costs	7,945,786	6,101,695	1,844,091

Exhibit 7



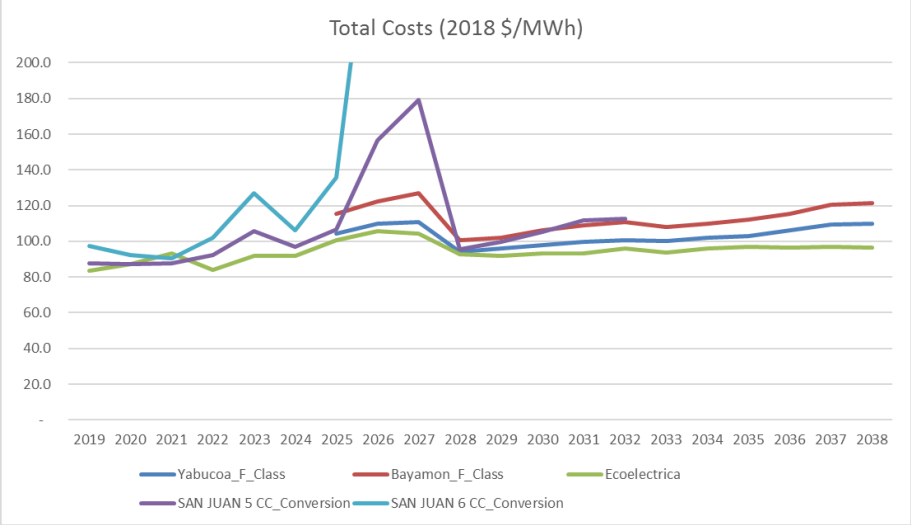
- New CCGTs dispatch at 40-70% capacity factors, with Yabucoa's CCGT dispatching at 58% capacity factor on average for the study period, and Bayamon CCGT dispatching at 52% average capacity factor, below the factors that would allow compliance with the high efficiency requirement (see Exhibit 8).

- The total costs in $/MWh are at or below the $100/MWh efficiency mark for EcoEléctrica during most of the study period and for Yabucoa CCGT in 2028-2033. In contrast, the new CCGT at Palo Seco CCGT has total costs at or above the $100/MWh efficiency mark for most of the forecast period, as shown in Exhibit 9. The San Juan 5&6 conversions have costs that are below the efficiency mark in the early part of the forecast but lose competitiveness after 2023 with the new solar generation, Aero-Mayaguez conversions and the new CCGTs after 2025.

Exhibit 8: Capacity Factors Large Fossil Units

Average Capacity_Factor	Column Labels																			
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
AES_1	93%	95%	96%	97%	96%	95%	95%	94%	94%											
AES_2	95%	96%	97%	97%	96%	96%	96%	95%	95%											
AGUIRRE 1 CC	1%	2%	1%	0%	0%	1%	1%													
AGUIRRE 2 CC	1%	1%	2%	0%	0%	1%	1%													
AGUIRRE STEAM_1	35%	33%																		
AGUIRRE STEAM_2	33%																			
COSTA SUR 5	20%	52%																		
COSTA SUR 6	65%																			
EcoElectrica	93%	89%	90%	87%	71%	74%	58%	53%	54%	72%	72%	70%	68%	65%	68%	66%	64%	65%	64%	63%
PALO SECO 3	40%	37%	47%	38%	38%	38%														
PALO SECO 4	39%	36%	44%	37%	36%															
SAN JUAN 07	58%	60%	62%	61%	60%															
SAN JUAN 08	56%	60%	65%	61%	60%															
SAN JUAN 5 CC	1%																			
SAN JUAN 6 CC	1%																			
SAN JUAN 5 CC_Conversion	53%	62%	76%	43%	21%	34%	37%	16%	13%	44%	38%	33%	29%	29%						
SAN JUAN 6 CC_Conversion	27%	46%	65%	28%	12%	24%	23%	6%	7%											
MAYAGUEZ GT 1_Conversion				59%	41%	50%	14%	0%	1%	20%	9%	9%	8%	6%	13%	11%	11%	7%	10%	3%
MAYAGUEZ GT 2_Conversion				58%	38%	47%	12%	0%	1%	16%	9%	4%	4%	5%	12%	9%	8%	7%	7%	1%
MAYAGUEZ GT 3_conversion				51%	32%	43%	11%	0%	1%	15%	6%	3%	4%	4%	10%	9%	9%	6%	4%	1%
MAYAGUEZ GT 4_Conversion				48%	30%	35%	11%	0%	0%	11%	4%	3%	2%	5%	8%	8%	6%	3%	5%	2%
Yabucoa_F_Class							54%	49%	48%	71%	66%	63%	60%	60%	61%	59%	59%	56%	54%	54%
Bayamon_F_Class							47%	43%	39%	64%	62%	57%	53%	52%	56%	55%	53%	51%	47%	47%

Exhibit 9: Total Costs CCGT Units



2.1.3 Other Metrics

- RPS targets are met in 2021, 2022 and 2040 as can be seen in the exhibit below.

- Renewable curtailments are low reaching a maximum of 2.2% in 2027 and 2038 (Exhibit 11).

Exhibit 10: RPS Compliance

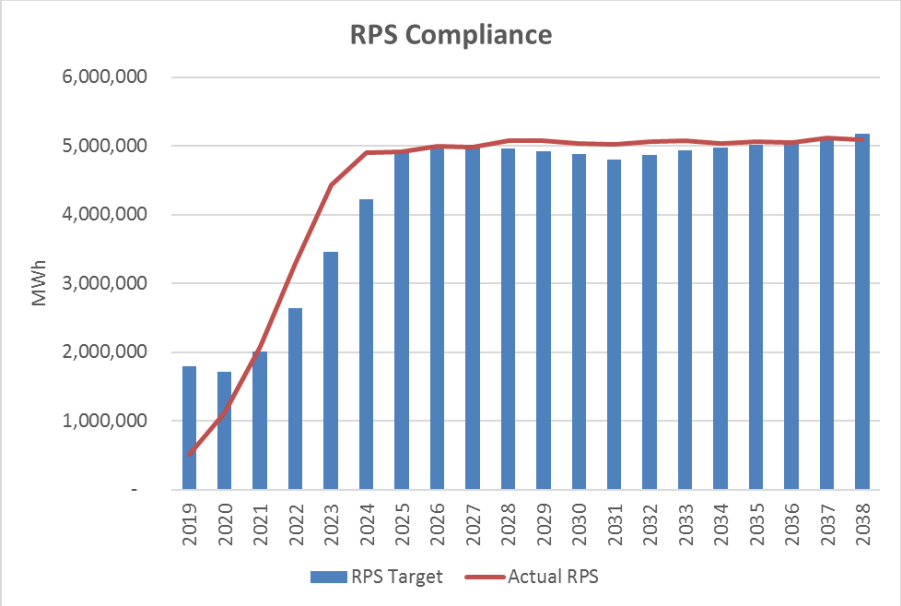
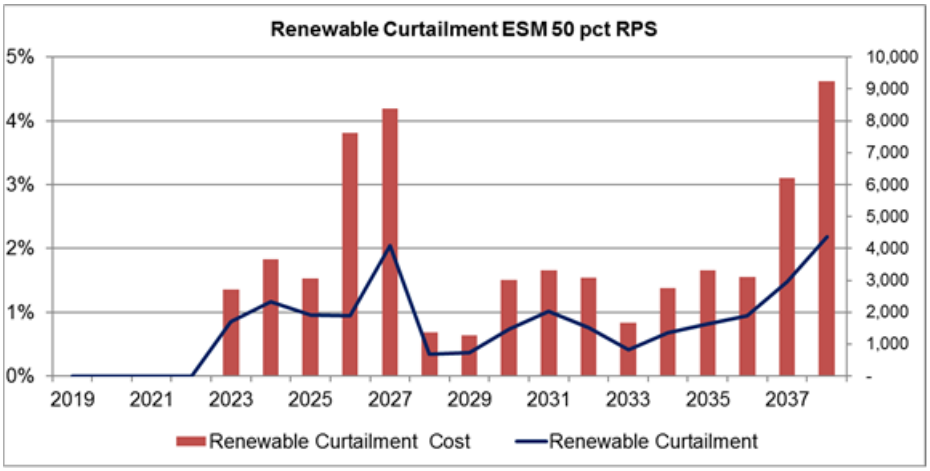


Exhibit 11: Renewable Curtailments



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3. Scenario 4, Strategy 2 Results

3.1.1 Capacity Expansion Plan

- 2,760 MW of solar built over the planning period, with most of the capacity built in 2020-2025, as shown in **Error! Reference source not found.**. This value is 24% higher than the original S4S2B case 2,220 MW.
- 1,200 MW of storage built to support solar PV additions and provide reserves, this value is 11% higher than the original S4S2B case 1,080 MW.
- No wind turbine generation was built by the plan.
- The Aurora model built two combined cycle units, one in Palo Seco (Bayamon) and the other in Ponce at Costa Sur, both in 2025. In addition, there is 371 MW of new gas peaker capacity, mostly mobile peakers included in the scenario by design. Only one peaker of 23 MW was built economically by the model.
- San Juan gas conversions are not retired by the model. Both continued operation through 2038 after being converted in 2019.
- EcoEléctrica is retired in 2024, as shown in, **Error! Reference source not found.** which is consistent with the previous results for Scenario 4. EcoEléctrica is driven to economic retirement with the addition of the new more efficient CCGT at Costa Sur, despite having the fixed cost reduced by 53% (47% multiplier). EcoEléctrica dispatches at 82% capacity factor prior to retirement.

Exhibit 12: Capacity Additions by Technology and Region S4S2B

Capacity MW		Year																				
Unit type	Zone Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Grand Total
BESS	ARECIBO	40	20																			60
	BAYAMON												20	20								40
	CAGUAS		60	200						20		20										300
	CAROLINA	40	100	80								20		40			20					300
	CAYMG	40	40					20	20													120
	MAYAGUEZ NTH	40	40		40	20	20	20	20	20	20											240
	PONCE ES											20		20								40
	SAN JUAN	20	40	40																		100
BESS Total		**180**	**300**	**320**	**40**	**20**	**20**	**40**	**40**	**40**	**20**	**60**	**20**	**80**			**20**					**1,200**
Large CCGT_gas	BAYAMON							302														302
	PONCE OE							302														302
Large CCGT_gas Total								**604**														**604**
New Solar	ARECIBO			60	60			60														180
	BAYAMON		120		120		60		60		120											480
	CAGUAS		60	120	120	120		60			120											600
	CAROLINA			120	120	60	60	120			120											600
	CAYMG		60	60	60	60	60				60											360
	MAYAGUEZ NTH		60	60	60		60	60			60											360
	SAN JUAN			60	60	60																180
New Solar Total			**300**	**480**	**600**	**300**	**240**	**300**	**60**		**480**											**2,760**
Peaker_gas	CAGUAS			93																		93
	CAROLINA			116																		116
	CAYMG			23																		23
	MAYAGUEZ NTH			93																		93
	PONCE ES			46																		46
Peaker_gas Total				**371**																		**371**
Grand Total		**180**	**600**	**1,171**	**640**	**320**	**260**	**944**	**100**	**40**	**500**	**60**	**20**	**80**			**20**					**4,935**

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Exhibit 13: Capacity Retirements by Unit S4S2B *

Sum of Capacity	Year																				
Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Grand To
----																					
AGUIRRE 1 CC							257														257
Aguirre GT21 & GT22	42																				42
AGUIRRE STEAM_1	432																				432
AGUIRRE STEAM_2		429																			429
CAMBALACHE CT_2					82																82
COSTA SUR 5		388																			388
COSTA SUR 6	393																				393
EcoElectrica						507															507
Jobos GT11 & GT12	42																				42
MAYAGUEZ GT 2										50											50
MAYAGUEZ GT 4												50									50
PALO SECO 3							206														206
PALO SECO 4							206														206
PALO SECO CT11	42																				42
PALO SECO CT12		42																			42
PALO SECO CT31		42																			42
SAN JUAN 07					94																94
SAN JUAN 08					95																95
Vega Baja GT11 & GT12	42																				42
YABUCOA GT11 & GT12	42																				42
Grand Total	**1,036**	**902**			**271**	**507**	**670**			**50**		**50**									**3,485**

* Last year in service shown in table

3.1.2 Results and Metrics

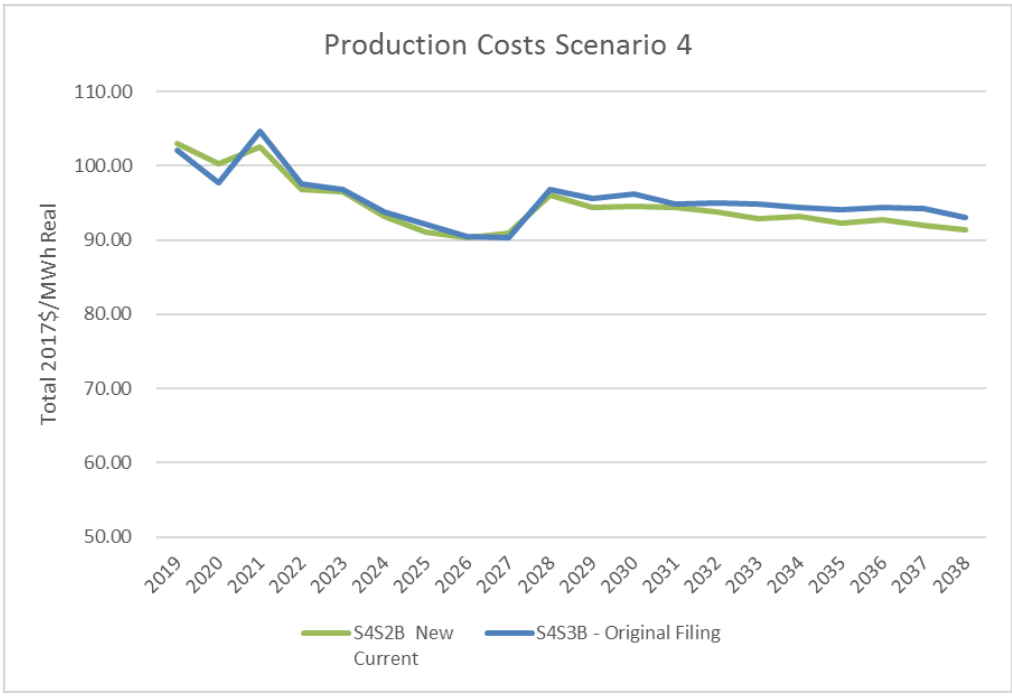
- The NPV of the system cost is 3.8% lower compared to the previous results for the S4S2B at $13.9 billion, mostly driven by lower fuel costs, due to the higher penetration of renewable and lower overall supplied load. The average cost in $/MWh in the first ten years is about the same, compared to previous results and there is a decline towards the end of the planning period, as shown in Exhibit 15.

Exhibit 14: NPV System Costs ($000)

	S4S2B Current	S4S2 Original Filing
NPV @ 9% Nominal 2019 - 2038	13,963,988	14,509,386
NPV @ 9% Nominal 2019 - 2028	10,187,652	10,402,276
Average $/MWh (2019-2028)	96.07	96.27
RPS	60.53%	48.98%

	S4S2B Current	S4S2 Original Filing	Difference
NPV fuel	6,032,476	6,984,736	(952,260)
NPV Var O&M	408,341	416,185	(7,844)
NPV Fixed Costs	7,523,171	7,108,465	414,706

Exhibit 15

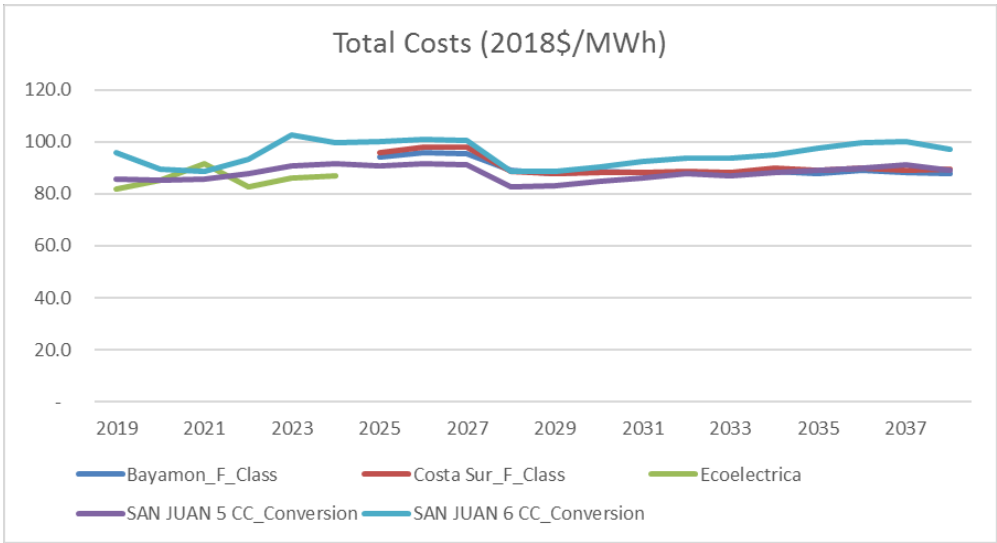


- New CCGTs at Bayamon dispatches at 73% average capacity factor on average over the study period, while the CCGT at Costa Sur dispatches at 65% average capacity factor, both above the 60% that is expected to be needed to meet the high efficiency requirement (see Exhibit 16).
- Under the Scenario 4, new and existing CCGTs comply with the high efficiency requirement of $100/MWh levelized costs, as shown in Exhibit 17. The new CCGTs at Palo Seco (Bayamon) and Costa Sur are below the $100/MWh mark through the forecast. For the existing units, San Juan conversion unit 5 has an overall lower cost compared to San Juan 6, due to slightly better heat rate. EcoEléctrica maintains a low competitive cost for all years prior to retirement.

Exhibit 16: Capacity Factors Large Fossil Units

Sum of Capacity_Factor	Column Labels																			
Row Labels	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
AES_1	94%	96%	97%	97%	97%	97%	96%	95%	95%											
AES_2	96%	97%	97%	97%	97%	97%	96%	96%	96%											
AGUIRRE 1 CC	0%	0%	0%	0%	0%	0%	1%													
AGUIRRE 2 CC	0%	0%	0%	0%	0%	0%	1%	1%	1%	2%	1%	1%	1%	1%	1%	0%	0%	1%	1%	1%
AGUIRRE STEAM_1	35%																			
AGUIRRE STEAM_2	33%	33%																		
COSTA SUR 5	20%	51%																		
COSTA SUR 6	64%																			
EcoElectrica	94%	89%	90%	86%	81%	82%														
New Resource 4239 from RMT102 Generic CC_F.04_gas							74%	70%	68%	82%	81%	78%	75%	75%	73%	70%	71%	67%	67%	66%
New Resource 5419 from RMT104_1 Generic CC_F.04_gas							64%	60%	58%	76%	75%	71%	68%	67%	65%	62%	62%	59%	59%	57%
PALO SECO 3	39%	37%	49%	40%	38%	39%														
PALO SECO 4	39%	36%	46%	37%	36%	37%														
SAN JUAN 07	58%	60%	63%	61%	60%															
SAN JUAN 08	56%	60%	67%	61%	60%															
SAN JUAN 5 CC	0%																			
SAN JUAN 5 CC_Conversion	54%	64%	76%	57%	43%	44%	53%	48%	48%	66%	62%	58%	54%	51%	52%	51%	49%	48%	46%	48%
SAN JUAN 6 CC	0%																			
SAN JUAN 6 CC_Conversion	26%	50%	67%	43%	24%	29%	43%	39%	38%	56%	55%	52%	46%	45%	45%	44%	40%	39%	38%	40%

Exhibit 17: Total Costs CCGT Units S4S2B



3.1.3 Other Metrics

- RPS targets are met in 2021, 2022 and 2025 with 40% penetration. Renewable penetration reaches 60.5% by 2038, reaching the long-term target of 60% by 2040. Renewable generation stays relatively flat in the long-term due to solar curtailments.
- Solar curtailments are relatively low, rising through the study period, and reaching a peak of 3.9% by 2038, as shown in Exhibit 19.

Exhibit 18: RPS Compliance

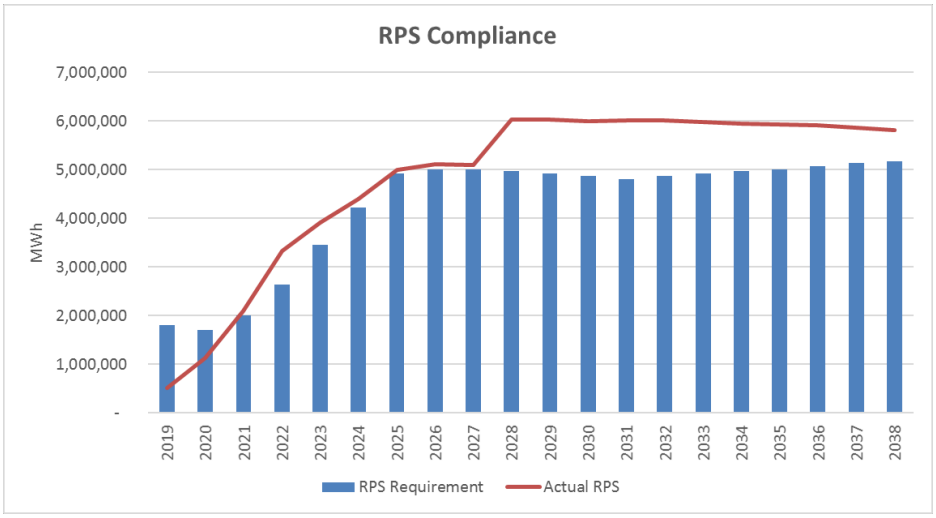
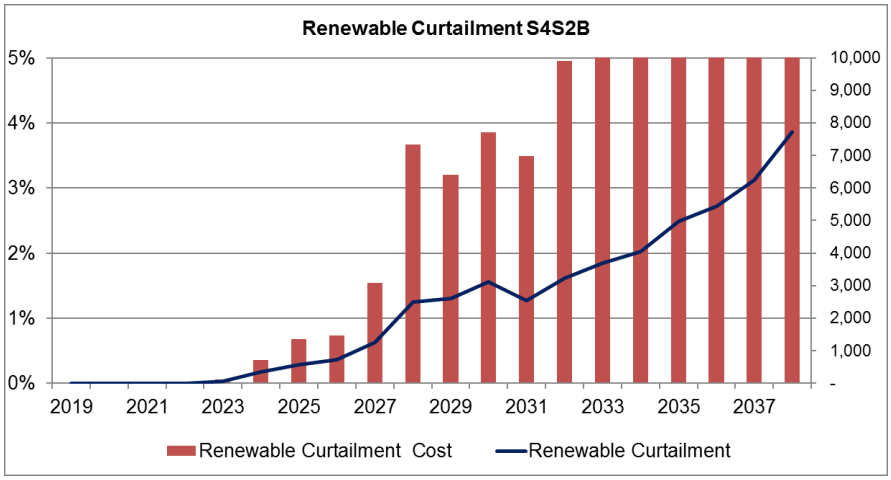


Exhibit 19: Renewable Curtailments



4. Considerations and Issues

4.1.1 Scenario 2 may not be needed

The LTCE results from Scenario 4 now are identical to those that Scenario 2 would have produced be with new gas fired-capacity developed only in Palo Seco (Bayamon) and Costa Sur. The model does not select to build a new CCGT at either Yabucoa (east) or Mayaguez (west), in spite of having gas availability via ship-based LNG at both locations. Thus, in absence of gas availability at these two locations under Scenario 2 is expected to produce identical results as Scenario 4, in terms of gas-fired generation. There is no reason to think that solar or storage builds would be substantially different.

As such, PREPA would like to respectfully request to the Energy Bureau not running Scenario 2, at least for those cases like this Strategy 2, where Scenario 4 did not build the CCGT's at Yabucoa or Mayaguez.

4.1.2 Wind Turbine Generation is making the model slower

The consideration of wind turbine as an option to the LTCE is making the runs take much longer, however as shown earlier these resources are not selected and there is no reason to believe that in any of the scenarios that consider the mid case prices for renewable, they will be selected. Siemens would like PREPA to request to the Energy Bureau that these resources be offered only to those LTCE's considering the low case for renewable costs (e.g. Scenario 3), but not be offered for those scenarios and sensitivities that consider the mid case costs.

4.1.3 Modeling Issues

The Siemens team have encountered several model issues with the Aurora LCTE solution which have caused significant delays in running the cases and getting meaningful results. We are having difficulties, in particular with the build out of battery storage as selected by Aurora for most scenarios, in particular de ones with high development of solar, such as Scenario 1 and 3. The model is building substantially less batteries in comparison with the renewable resulting in high levels of curtailment. This situation was not evident before. Working with the developers of Aurora, we think we may have identified solutions, but this there was significant time lost to this moment in testing and re-runs.

It should be noted that ESM case presented above did not have this issue and for the S4S2B we did a correction; added batteries to address curtailment based on prior runs ratios and confirmed that this resulted in a reduction of the NPV ($14.02 billion down to $13.96 billion).

In addition, we have gotten inconsistent results in terms of EcoEléctrica retirement decisions, in particular for Scenario 1. This is still under investigation by the Siemens team.

Finally, the running times increased dramatically with the inclusion of wind as a resource option, as presented earlier. The LTCE extended its time from 9-18 hours of run time (depending on the case) to 24-40 hours. The Siemens team have been working with the developer of the software Energy Exemplar to reduce the run times, but the improvements were not seen until the last week of April, but time requirements are still substantial (over 16 hours).

4.1.4 Rerun of all cases with the EE revision

The Siemens team modeled EE gains of 2% per year as necessary to reach 30% by 2030, reaching compliance based on the net load by 2031, considering future programs and measured over the final load. The Energy Bureau, in its April 26th Order, measures the 30% compliance based on gross load instead of net load, and ordered to extent the 2% EE reduction to 2037. This change would require re-running all the cases, including the two presented in this memo, the ESM and Scenario 4.

5. Request for Additional Time to Re-File the IRP

Due to the issues and delay indicated under numeral 4, it is practically impossible to meet the May 10th deadline and Siemens would like to respectfully request to have an extension of at least three weeks to submit the results and file a new IRP. We will continue providing memos like this one as results are identified and request to have the deadline moved to May 31th.