COMMONWEALTH OF PUERTO RICO
PUERTO RICO ENERGY COMMISSION

IN RE: AGUIRRE SITE ECONOMIC ANALYSIS	NO. CEPR-AP-2017-0001 SUBJECT: ORDER INITIATING PROCEEDING ON AGUIRRE SITE ECONOMIC ANALYSIS

NOTIFICATION OF INSTITUTO DE COMPETITIVIDAD Y SOSTENIBILIDAD ECONOMICA DE PUERTO RICO (ISCE-PR) TESTIMONY CONCERNING AGUIRRE SITE ECONOMIC ANALYSIS SUBMITTED BY PREPA

TO THE HONORABLE ENERGY COMMISSION OF PUERTO RICO:

COMES NOW, INSTITUTO DE COMPETITIVIDAD Y SOSTENIBILIDAD ECONOMICA DE PUERTO RICO (ISCE-PR), through the undersigned legal counsel, and respectfully STATES and PRAYS:

1. On February 10, 2017, this Honorable Energy Commission notified an Order for Initiating Proceeding on Aguirre Site Economic Analysis (hereinafter, the "February 10 Order"), in which it established the requirements for the economic analysis to be filed by the Puerto Rico Electric Power Authority ("PREPA"), as well as the procedural calendar to be followed by the intervening parties.
2. PREPA has filed its report, and the testimonies of the parties have to be filed, the latest today.
3. Enclose please find ICSE's testimony by Mr. Philip Q. Hanser of the Brattle Group, in Cambridge, Massachusetts.

WHEREFORE, respectfully request that the Honorable Energy Commission to receive ICSE's testimony.

I HERE BY CERTIFY, that this Motion was notified on this date via the emails of record to the following:

j-morales@aeepr.com; n-vazquez@aeepr.com; c-aquino@aeepr.com; codiot@oipc.pr.gov; jperez@oipc.pr.gov; Francisco.rullan@aae.pr.gov; acc@amgprlaw.com; epo@amgprlaw.com; rstgo2@gmail.com; ladrian@gasnaturalfenosa.com; carlos.reyes@ecoelectrica.com; ccf@tcmrslaw.com; lfortuno@steptoe.com; mgrpcorp@gmail.com; sierra@arctas.com; molinilawoffices@gmail.com; Richard.houston@na.engie.com; serdar.tufecki@ma.engie.com; cfl@mcvpr.com; hmc@mcvpr.com; victorluisgonzalez@yahoo.com; acasellas@amgprlaw.com; Wilma.lopez@aae.pr.gov; lmorera@estrellallc.com; pbarcelo@estrellallc.com; equinones@qaclaw.com; vcandelario@qaclaw.com; gmartinez@qaclaw.com; tonytorres2366@gmail.com

RESPECTFULLY SUBMITTED in San Juan, Puerto Rico, this 2 day of June, 2017.

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TESTIMONY OF PHILIP HANSER

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Philip Q Hanser. My business address is One Beacon Street, Suite 2600, Boston, Massachusetts, 02108.

Q. By whom are you employed and in what capacity?

A. I am a Principal of The Brattle Group, an economic consulting firm with offices in Boston, Massachusetts; Washington, DC; San Francisco, California; New York, New York; Toronto, Canada; London, England; Madrid, Spain, Rome, Italy; and Sydney, Australia.

Q. Please describe your background and employment experience.

A. I have been involved in energy related matters for over 35 years and a Principal at The Brattle Group in its Cambridge office for the last 20 years. My practice has included issues such as market economics, transmission pricing, resource planning, environmental issues, forecasting, rate design, demand-side management, distributed resources and financial analysis.

I have appeared as an expert witness before the U.S. Federal Energy Regulatory Commission ("FERC"), and numerous state public utility commissions, environmental agencies, Canadian utility boards, as well as arbitration panels, and in federal and state courts. Since 2009, I have taught industry professionals about the principles and practices of cost of service calculations and rate design on behalf of the Edison Electric Institute in its Advanced Rates Course. I served for six years on the American Statistical Association's Advisory Committee to the U.S. Department of Energy's Energy Information Administration ("EIA"), and am a member of IEEE (Institute of Electronics and Electrical Engineers) and CIGRE (Conseil International des Grands Reseaux Electriques), where I served on its Working Group C5-16, Distribution Rate Designs.

Prior to joining The Brattle Group, I held teaching positions at the University of the Pacific, University of California at Davis, and Columbia University, and have served as a guest lecturer at the Massachusetts Institute of Technology, Stanford University, and the University of Chicago. I am currently a Senior Associate in the Mossavar-Rahmani Center for Business and Government at the Harvard Kennedy School and lead a seminar in public policy analysis. I have also served as the manager of the Demand-Side Management Program at the Electric Power Research Institute ("EPRI").

While at EPRI I was the final project manager for the Electric Utility Rate Design Study, the industry-sponsored multi-volume study to support utilities and commissions in implementing the Public Utilities Regulatory Policies Act of 1978 ("PURPA"). I also supervised EPRI's biennial surveys of innovative rates as well as reports addressing the measurement and evaluation of interruptible and curtailable rates, the impacts of residential time-of-use rates, the design of innovative and traditional rates, and the use of activity-based costing as a supplement to traditional utility accounting. I served five years with the Sacramento Utility District as an economist where I performed the load research design to support both embedded and marginal cost based rates and performed or assisted in the development of the District's embedded and marginal costs of service studies. My background, publications, and prior testimony are further described in my CV, which is included as Exhibit 1 to my Affidavit.

Q. What is the purpose of your testimony?

A. I was retained by the Puerto Rico Institute for Competitiveness and Sustainable Economy ("ICSE-PR") to evaluate the reasonableness of the Puerto Rico Electric Power Authority ("PREPA") proposal to build the Aguirre Offshore Gas Port ("AOGP").

Q. Can you summarize your conclusions?

A. After reviewing PREPA's economic analysis and its responses to Requirements of Information ("ROIs"), I found that PREPA had not established that moving forward with AOGP is in the best interest of Puerto Rico's ratepayers at this time. In particular,

PREPA needs to compare the expected costs and benefits of AOGP to alternative natural gas supplies. Until they have conducted that comparison, and refined some of their modeling assumptions, PREPA's analysis is inadequate and incomplete and it would be inappropriate to conclude that construction of AOGP will be in the best interest of Puerto Rico's rate payers. Thus, the approval of AOGP should be postponed until further analysis is performed.

Q. Please describe how the rest of your testimony is organized.

A. The remainder of my testimony is organized as follows. First, I discuss potential alternatives to AOGP. In this section, I explore the potential for EcoElectrica to provide natural gas to Aguirre. These alternatives serve as examples of alternatives incompletely considered by PREPA. Second, I discuss issues with the PREPA economic analysis of the benefits of AOGP. In the final section of my testimony, I discuss reasons why a delay in construction of AOGP is unlikely to harm Puerto Rico's ratepayers.

II. EXAMPLE OF ALTERNATIVES TO AOGP

Q. Should PREPA have considered any alternative sources of natural gas supply in its economic analysis?

A. Yes. PREPA based its economic analysis of the benefits of AOGP by comparing PROMOD IV scenarios that included AOGP with PROMOD IV scenarios based on the assumption that Puerto Rico would have no expansion in its natural gas supply.[1] However, PREPA did not consider alternative sources of natural gas supply. Potentially alternative natural gas sources could provide even greater net benefits than AOGP.

Q. Can you identify specific scenarios that you believe PREPA should analyze?

A. Arctas Capital identified two possible alternative ways that PREPA could increase its access to natural gas. The first alternative involves constructing a 42 mile pipeline from

[1] PREPA Economic Analysis, page 1-3.

EcoElectrica to Aguirre. Arctas estimates this would allow transportation of 93 million standard cubic feet per day ("MMSCFD") of natural gas to Aguirre. The second alternative involves constructing a 42 mile pipeline from EcoElectrica to Aguirre and also chartering a Floating Storage Regasification Unit ("FSRU") to increase natural gas import capacity at the EcoElectrica liquefied natural gas ("LNG") terminal. Arctas estimates this alternative could provide Aguirre with as much as 500 MMSCFD of natural gas.[2] Because these alternatives involve expanding capacity at the existing EcoElectrica LNG terminal rather than building an entirely new LNG terminal, they may have lower costs than AOGP. At a minimum, PREPA should analyze both these alternatives.

Q. Have pipelines been considered in Puerto Rico previously?

A. Yes. A gas pipeline intended to run from Costa Sur to Aguirre was previously considered, but it was canceled by the governor in 2009. Additionally, a natural gas pipe line traversing the island intended to run from EcoElectrica/Costa Sur to Palo Seco and San Juan was canceled after widespread civic and political opposition in 2012. While neither of these projects was ultimately completed, they demonstrate that pipeline alternatives have been considered in the past.

Q. In this case, are there other potential alternatives besides those of EcoElectrica?

A. Although I have only cited those of EcoElectrica, there may be other alternatives of which I have no current knowledge.

III. ISSUES WITH PREPA ECONOMIC ANALYSIS

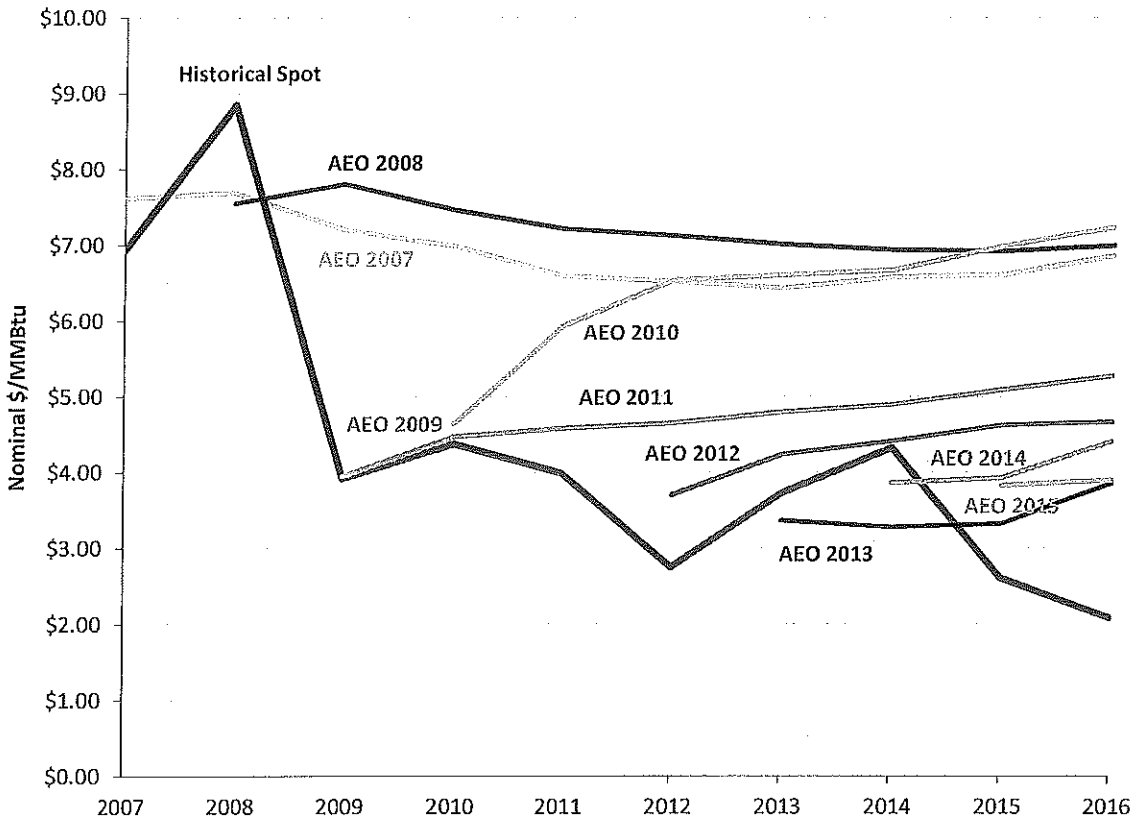
Q. Do you have any general comments about relying on the PREPA economic analysis of AOGP to make investment decisions?

A. PREPA's estimates of the net benefits of AOGP are highly dependent on the accuracy of the natural gas and oil price forecasts used in the PREPA economic analysis. Those

[2] Arctas Proposal for Evaluation of Alternatives to AOGP, page 9.

105 forecasts come from the Energy Information Administration's Annual Energy Outlook
106 ("AEO"). As shown in Figure 1 and Figure 2, historical AEO forecasts have differed
107 substantially from realized spot prices. The historical inaccuracy of the AEO forecasts
108 suggests that the net benefits of AOGP are highly speculative. Indeed, PREPA's own
109 analysis concludes that net benefits could vary from a benefit of $11.1 billion dollars
110 with high oil prices to a net cost of $1.7 billion dollars with low oil prices.[3]

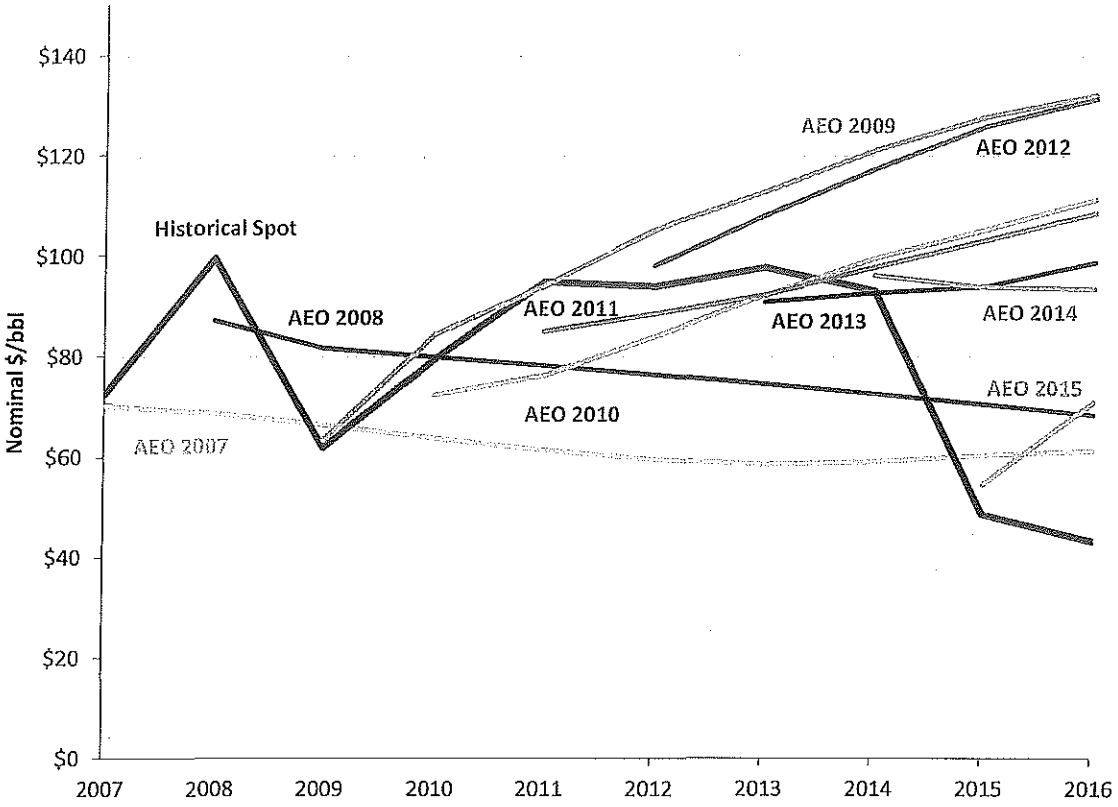
Figure 1: Henry Hub Spot Prices vs. AEO forecasts ($/MMBtu)[4]



[3] PREPA Economic Analysis, page 1-5.

[4] Although AEO 2016 and AEO 2017 are available, we have not included those forecasts in this graph because 2016 is the last full year for which historical spot prices are available.

Figure 2: West Texas Intermediate Prices vs. AEO forecasts ($/MMBtu)[5]



111 **Q. Do you have comments about PREPA's assumptions underlying its economic**
112 **analysis?**

113 A. In its analysis, PREPA makes a number of speculative assumptions that impact the net
114 benefits associated with AOGP. First, PREPA assumes that the U.S. Environmental
115 Protection Agency ("EPA") will impose the maximum fines for violations of the
116 Mercury and Air Toxics Standards ("MATS"). Second, even though AOGP will not
117 provide natural gas to Costa Sur, PREPA assumes that construction of AOGP will
118 lower natural gas prices at Costa Sur. Third, PREPA assumes that engineering,
119 procurement, and construction ("EPC") at AOGP will take only 19 months. .[6] Fourth,
120 PREPA applies a real discount rate of 6.86% to forecast nominal cash flows to

[5] Although AEO 2016 and AEO 2017 are available, we have not included those forecasts in this graph because 2016 is the last full year for which historical spot prices are available.

[6] PREPA Economic Analysis, page 8-2.

calculate the present value of future costs. Finally, PREPA assumes that an accelerated roll-out of distributed generation and renewables would not change its thermal capacity expansion plan. Without access to PREPA's underlying PROMOD analysis, I am not able to calculate the precise impact these assumptions have on the net benefits estimate, but I expect the effects are significant.

Q. Can you discuss the impact that the assumption about MATS fines has on the analysis?

A. Table 1 shows assumed penalties for MATS violations in the scenarios in PREPA's economic analysis. For the AG scenarios, PREPA assumes AOGP is operational by 2019, while for the One-Year AOGP delay scenario PREPA assumes AOGP is operation by 2020. For the NO scenarios, PREPA assumes that no new sources of natural gas are constructed. In all of the scenarios, PREPA assumes that all violations will result in the payment of the maximum statutory penalty.

Table 1: PREPA Estimated MATS Fines By Scenario

Generating Unit	AG Scenarios	One-Year AOGP Delay	NO Scenarios
San Juan 9&10	$336,098,000	$336,098,000	$269,625,000
Palo Seco 3&4	$326,156,000	$326,156,000	$384,281,000
Aguirre 1&2	$83,156,000	$148,969,000	$408,563,000
Total	$745,410,000	$811,223,000	$1,062,469,000

Source: Aguirre Site Economic Analysis (p. 61)

EPA fines are greater in the NO and One-Year delay scenarios largely due to non-compliance at the Aguirre steam units. While in the AG scenarios, PREPA assumes the Aguirre steam units will achieve MATS compliance by converting to natural gas in 2019, in the NO scenario PREPA assumes that Aguirre steam units will be non-compliant until the end of 2023, when PREPA assumes the units will retire. Over 6.5 years, PREPA estimates the fines at Aguirre will total $408 million in the NO scenarios. Potentially, those fines could be reduced – either by achieving MATS

compliance through alternate means or by retiring one or both of the steam units prior to 2024. However, PREPA does not analyze these possibilities.

Additionally, PREPA assumes the EPA will impose MATS penalties at the maximum statutory rate of $93,750 per violation per day. In reality, penalties may not be incurred at the maximum statutory rate considering: (i) new EPA oversight; and (ii) Congress's recognition of Puerto Rico's current economic situation. Penalties could be significantly less. PREPA should account for this possibility in its analysis.

Q. Can you discuss the impact that the assumption about Costa Sur natural gas costs has on the analysis?

A. Gas Natural is the sole provider of natural gas to PREPA for consumption at the Costa Sur plant.[7] With new supply at Aguirre from the completion of AOGP, however, PREPA assumes "that the delivered gas pricing at Costa Sur and Aguirre plants will converge due to expected gas-on-gas competition."[8] PREPA makes this assumption although it has no plans to build a pipeline connecting Costa Sur to Aguirre.

PREPA's assumption about falling natural gas prices at Costa Sur accounts for a significant share of estimated AOGP benefits. PREPA's economic analysis assumes price convergence in four of its scenarios: AG reference, AG high oil, AG+RE reference, and AG+RE high oil scenarios.[9] Figure 3: Total Fuel Costs at Costa Sur (2017-2037) shows for each scenario: (i) total fuel costs at Costa Sur as calculated by PREPA; and (ii) total fuel costs at Costa Sur calculated assuming the same fuel consumption at Costa Sur as in the AG scenarios but without the assumption that prices converge across Costa Sur and Aguirre.

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7 Response to Request No. PREPA 03-04, part a.

8 *Id.*

9 AG reference: AOGP constructed; reference oil prices

AG high oil: AOGP constructed; high oil prices

AG+RE reference: AOGP constructed, w/ full RPS compliance and demand response; reference oil prices

AG+RE high oil: AOGP constructed, w/ full RPS compliance and demand response; high oil prices

Figure 3: Total Fuel Costs at Costa Sur (2017-2037)

	Costa Sur NG Price Assumption		
	w/ PREPA assumption [1]	w/o PREPA assumption [2]	Difference [3]
AG_Base	$4,051,930,163	$5,041,736,809	$989,806,647
AG_High_Oil	$4,759,147,046	$7,689,590,934	$2,930,443,888
AG+RE_Base	$4,014,359,441	$4,902,725,273	$888,365,832
AG+RE_High_Oil	$4,479,761,841	$7,091,897,800	$2,612,135,959

Sources and Notes: "PREPA Aguirre Site Economic Analysis" (April 2017), Brattle analysis
Fuel consumption found in Excel backup to "PREPA Aguirre Site Economic Analysis" files "PREPA-P3MF1M-Final-Reference-Case-rev-17-apr-2017-3.xlsx", "PREPA-P3MF1M-Final-High-Case-rev-17-abr-2017-1.xlsx", "PREPA-P3MF1M_S4_-Final-Reference-Case-rev-17-abr-2017-6.xlsx", and "PREPA-P3MF1M_S4_-Final-HighCase-rev-17-abr-2017-2-4.xlsx".
Fuel prices found in "PREPA Aguirre Site Economic Analysis, Appendices".
The Costa Sur site consists of existing units Costa Sur 5 and Costa Sur 6 (which PREPA assumes will retire in 2026 for its AG scenarios), and a new H-class CC unit (which PREPA assumes will begin operation in 2027 for its AG scenarios). Note PREPA's assumed retirement and online dates may not be consistent with the Commission approved IRP.
[1]: Sum of fuel costs at Costa Sur 5, Costa Sur 6, and Costa Sur H; Costa Sur NG prices converge to Aguirre prices starting in April 2019 (i.e. fuel prices and consumption are the same as in the AG scenarios).
[2]: Sum of fuel costs at Costa Sur 5, Costa Sur 6, and Costa Sur H; Costa Sur NG prices do not converge with Aguirre prices (i.e. fuel prices are the same as in the NO scenarios, but fuel consumption is the same as in the AG scenarios).
[3]: [2] – [1]

Q. Can you discuss the impact that AOGP construction timeline has on the analysis?

A. PREPA's analysis assumes AOGP can be fully operational by April 2019. By PREPA's own admission this is the earliest reasonable online date for the facility.[10] PREPA did conduct an analysis of the impact of delaying AOGP by one year in its AG_Base case and found that it reduced net benefits by $186 million.[11] While PREPA did not analyze longer delays, a longer delay would almost certainly reduce the benefits and increase the costs of the project.

[10] "For AG scenarios, PREPA assumed that the Project will be completed by April 1, 2019, which reflects the earliest expected online date." PREPA Economic Analysis, page 7-2.

[11] PREPA Economic Analysis, page 8-11.

Q. Can you discuss the impact that PREPA's assumed discount rate has on the analysis?

A. PREPA calculated a real discount rate of 6.86% based on a 9.00% nominal cost of debt and assumed 2.00% inflation.[12] PREPA has confirmed that it applied this real discount rate to nominal cash flows as part of its economic analysis of Aguirre.[13] Real discount rates should only be used to discount real cash flows, while nominal discount rates should only be used to discount nominal cash flows. Done correctly, applying a real discount rate to real cash flows will produce the same present value as applying a nominal discount rate to nominal cash flows.[14] However, by applying the 6.86% real discount rate to nominal cash flows, PREPA incorrectly inflates its estimate of the total present value of system costs. Because PREPA's estimate of the net benefits of AOGP is calculated as the change in the total present value of system costs that PREPA attributes to AOGP. Our review of PREPA's spreadsheets suggests that had PREPA correctly used a nominal discount rate, such as 9.00%, net benefits could be billions lower in some of the scenarios analyzed.

Q. Can you discuss the issues with the thermal capacity expansion and retirement assumptions?

A. PREPA assumes that thermal capacity expansion and retirements will be the same in the AG and AG+RE scenarios. PREPA also assumes that thermal capacity expansion and retirements will be the same in the NO and NO+RE scenarios. In reality, a faster adoption of renewables would likely decrease the need for thermal capacity in the near term. Without a detailed analysis, I cannot precisely evaluate the impact these assumptions had on net benefits at AOGP. However, if increased renewable generation delays any of the proposed new natural gas fired generation, the expected benefits of

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[12] Puerto Rico Electric Power Authority's Response to the Requirement of Information No. 4, response to request no. PREPA 04-05.

[13] Puerto Rico Electric Power Authority's Response to the Requirement of Information No. 4, response to request no. PREPA 04-02.

[14] Brealey, Richard A., Stewart C. Myers, and Franklin Allen. "Chapter 6." *Principles of Corporate Finance.* 10th ed. New York, NY: McGraw-Hill Education, 2011. 131. Print.

AOGP will fall. I also note the sales forecast provided in PREPA's economic analysis of Aguirre appears higher than the sales forecast provided in its fiscal plan.[15] The fiscal plan is dated on April 28, 2017 while the economic analysis is dated April 25, 2017. Given that the two analyses were prepared at approximately the same time, I am confused by the differences in the two load forecasts.

Q. Do you have other comments about the assumptions made in PREPA's economic analysis?

A. Yes. Based on my review of the most recent Integrated Resource Plan submitted by PREPA, the economic analysis is not consistent with the Modified Action Plan. In particular, the installed generation resources assumed for the economic analysis differ from what the Commission has approved. PREPA's economic analysis should be consistent with an approved resource plan.

IV. CONSTRUCTION DELAY UNLIKELY TO HARM RATEPAYERS

Q. Is delaying AOGP likely to increase fuel costs for Puerto Rico's ratepayers?

A. Even if the Commission ultimately decides to approve development of AOGP, a delay of one to two years is unlikely to increase fuels costs dramatically. PREPA expects AOGP to be operational by April 2019. However, PREPA's modeled resource plan does not include new natural gas-fired capacity at Aguirre until July 2022. Between April 2019 and July 2022, PREPA's analysis assumes that only the Aguirre steam units will burn natural gas from AOGP. Thus, even if AOGP came online 3 years later than PREPA assumes for its economic analysis, it should not affect the operations of a new H-Class combined cycle at Aguirre.

Q. Is delaying AOGP likely to increase MATS fines for Puerto Rico's ratepayers?

A. Delaying AOGP is not likely to increase MATS fines for Puerto Rico's ratepayers. Based on PREPA's analysis, a delay at AOGP would only affect MATS compliance at

[15] PREPA Economic Analysis, page 3-9.
PREPA Fiscal Plan, page 28.

Aguirre steam units 1 & 2. PREPA estimated that a 1 year delay would increase MATS fines by $66 million.[16] However, as I discussed earlier in my testimony, PREPA did not consider MATS compliance alternatives at the Aguirre steam units besides natural gas fuel conversion. Moreover, PREPA assumed that the EPA would impose the maximum statutory civil penalties for MATS non-compliance. Given the new EPA oversight and Congress's recognition of Puerto Rico's current economic situation penalties could be significantly less than the statutory maximum.

Q. Are there other factors that impact the cost of delaying AOGP to conduct further analysis of alternatives?

A. Two other factors suggest that a delay would not impose significant costs on ratepayers. First, Puerto Rico's installed capacity substantially exceeds its peak load.[17] Second, Puerto Rico's load is expected to fall steadily over the next decade (and beyond).[18] These two factors suggest there is no pressing reliability need for new natural gas fired capacity in the immediate future.

V. CONCLUSION

Q. Should PREPA conduct further analysis before the Commission approves AOGP?

A. Yes it should. PREPA's analysis has not demonstrated that constructing AOGP provides greater benefits to Puerto Rico's ratepayers than alternative sources of natural gas. PREPA has simply not evaluated the relative costs and benefits of alternative sources, such as a pipeline from EcoElectrica or an expansion of import capacity at the EcoElectrica LNG terminal. Moreover, the economic analysis PREPA prepared relies on speculative assumptions. Assumptions about MATS fines, natural gas costs at Costa Sur, the AOGP construction timeline, the discount rate, and the capacity expansion plan all have an important impact on the estimated net benefits. Taken in aggregate, they

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[16] PREPA Economic Analysis, page 7-4.

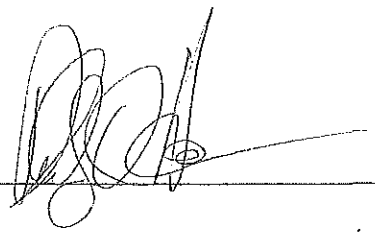
[17] "PREPA currently has 5100 MW of thermal capacity to serve a peak load of 3600 MW." Arctas Proposal for Evaluation of Alternatives to AOGP, page 11.

[18] PREPA Economic Analysis, page 3-9.

may inflate the net benefits expected at AOGP. For all of these reasons, further analysis is merited and the approval of AOGP should be postponed.

Q. Does this conclude your testimony?

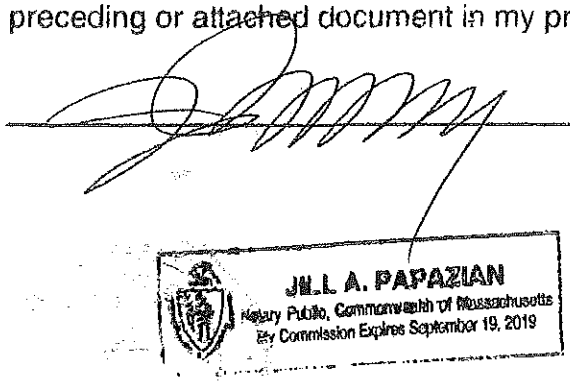
A. Yes.



2 June 2017

(Signature) Date

On this 2 day of June, 2017, before me, the undersigned notary public, personally appeared Philip Harber (name of document signer), proved to me through satisfactory evidence of identification, which were MA Drivers license, to be the person whose name is signed on the preceding or attached document in my presence.



(official signature and seal of notary)

JILL A. PAPAZIAN
Notary Public, Commonwealth of Massachusetts
My Commission Expires September 19, 2019