COMMONWEALTH OF PUERTO RICO

PUERTO RICO ENERGY COMMISSION

IN RE: REVIEW OF RATES OF THE PUERTO RICO ELECTRIC POWER AUTHORITY	**MATTER NO.:** CEPR-AP-2015-0001 **SUBJECT:** EXPERT REPORT: STATE OF PREPA'S SYSTEM, LOAD FORECAST, CAPITAL BUDGET, FUEL BUDGET, PURCHASED POWER BUDGET, OPERATIONS EXPENSE BUDGET.

EXPERT REPORT

OF

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I. INTRODUCTION

A. Purpose of report

Synapse Energy Economics, Inc. ("Synapse") staff were retained by the Puerto Rico Energy Commission ("CEPR" or the "Commission") to review elements of the Puerto Rico Electric Power Authority's ("PREPA" or the "Company") first rate case, as initially filed May 27, 2016, and to make recommendations to the Commission with respect to PREPA's revenue requirements. We were tasked with assessing PREPA's capital budget requirement, operational and maintenance expenses, fuel cost estimates, and power purchase agreement costs, as well as PREPA's estimated sales forecast for the fiscal year 2017.

This report has two primary purposes. First, it fulfills our obligation to assess, to the best of our ability, PREPA's fundamental revenue requirements, the prudence of PREPA's decisions, the basis of PREPA's costs and cost estimates, and the execution of projects as incurred in rates. Secondly, and to some extent more importantly, it seeks to provide a detailed background on the genesis of the costs incurred by PREPA, the process used by PREPA to make budgetary decisions, and the mechanisms by which PREPA estimates costs.

As a first rate case filing, the Commission has no established record of capital or operational requirements, performance, or cost containment. The Commission and public have little knowledge of PREPA's spending and prioritization, and remarkably little information about PREPA's generators, transmission system, or reliability. PREPA as an entity has operated for decades without either transparency or oversight, and is in a deep financial crisis. This rate case provided one of the first opportunities to understand the state of the system and how PREPA operates both day-to-day and on a strategic basis.

As a newly regulated utility, PREPA was seemingly unaware of its obligation to provide records to the Commission and staff, as well as intervenors. As a result, the organization was ill-prepared to provide clean, auditable records. PREPA's testimony in this rate case provided the barest of insight into a struggling utility. It is the intent of this report to consolidate disparate records, files, discussions and testimony into a description of the utility the Commission regulates today.

At the end of the day, the Commission must decide if PREPA's estimated costs in this rate case are prudently incurred, if the costs are reasonable, and what conditions—if any—are placed on the provision of rates to PREPA. It is the author's intent that this report provides the Commission confidence in setting rates for FY2017, and guidance towards an improved process in future cases.

B. Qualifications of authors

Dr. Jeremy Fisher is a Principal Associate at Synapse. He has been employed at Synapse since 2007 working on electricity system energy planning and currently leads its resource planning group, which engages in the assessment of planning processes across a wide cohort

of states and regions. Dr. Fisher has provided consulting services for a wide range of public sector and public interest clients, including the U.S. Environmental Protection Agency ("EPA"), the National Association of Regulatory Utility Commissioners ("NARUC"), the National Association of State Utility Consumer Advocates ("NASUCA"), National Rural Electric Cooperative Association ("NRECA"), the states of Alaska, Arkansas, Michigan, and Utah, the Commonwealth of Puerto Rico, Tennessee Valley Authority Office of Inspector General ("TVA OIG"), the California Office of Ratepayer Advocates ("CAORA"), the California Energy Commission ("CEC"), the Regulatory Assistance Project ("RAP"), the Western Grid Group, the Union of Concerned Scientists ("UCS"), Sierra Club, Earthjustice, Natural Resources Defense Council ("NRDC"), and other organizations.

Dr. Fisher holds a masters and doctorate in Geological Sciences from Brown University, and received his bachelor degrees from University of Maryland in Geology and Geography. His full curriculum vitae is attached as Exhibit Fisher and Horowitz Exhibit 01.

Dr. Ariel Horowitz is a Senior Associate at Synapse. Dr. Horowitz is an expert in data analysis and energy systems and technologies. At Synapse, Dr. Horowitz conducts in-depth research on specialized electric system issues, including electric system modeling, engineering, and data science. During her tenure at Synapse, Dr. Horowitz has led the modeling of the impacts of clean air regulations for the State of Michigan, worked on multiple litigated resource planning dockets, and co-authored the Commission's expert report on PREPA's integrated resource plan (IRP).

Dr. Horowitz holds a doctorate in Chemical Engineering from Tufts University, where her research focused on cutting-edge electrochemical energy storage technologies. She received her bachelor degree from Swarthmore College in Engineering. Her full curriculum vitae is attached as Exhibit Fisher and Horowitz Exhibit 02.

C. Organization of report

This report covers numerous detailed topics and describes, in depth, areas of PREPA's budgeting and operational processes. There are a multitude of areas in which our ability to assess PREPA's budget required an assessment of process, extrapolation from related records, and comparison of incomplete datasets. Each section of this report attempts to draw independent conclusions based on the collected evidence.

The report is organized as follows:

Section II: Summary of Findings and Recommendations is a summary of our findings and recommendations to the Commission. It details our findings with respect to overarching topics, and provides a summary of specific recommendations with respect to the load forecast, capital budget, fuel and purchased power expenses, and operating expenses.

Section III: State of PREPA's System provides critical background on the state of PREPA's system as portrayed through responses to Commission inquiries, data, conversations with

PREPA staff, and testimony. This section details PREPA's current generation reliability crisis, the rising level of interruptions experienced by customers, and PREPA's strategy to comply with an important federal environmental regulation. This section provides context for the remainder of PREPA's decisions.

Section IV: Load Forecast examines the validity of PREPA's load forecast both in the short term (FY2017) and over the extended period contemplated in PREPA's rate case filing. We review PREPA's methodology and proposed load forecast for this rate case.

Section V: Capital Budget reviews PREPA's $280 million FY2017 capital budget request. This section examines PREPA's capital projects in the areas of production and generation, the Aguirre Offshore GasPort (AOGP), transmission and distribution, and other capital projects, including vehicle procurement. This chapter reviews PREPA's historical spending patterns in Directorates and Departments, and assesses high-cost individual projects. This section also provides extensive detail on the state of PREPA's generation, transmission and distribution system as background to PREPA's expected spending.

Section VI: Fuel and Purchased Power assesses PREPA's estimated $1.47 billion fuel and purchased power budget for FY2017. This chapter reviews the fuel price forecast used to support PREPA's estimated fuel procurement budget, the modeling conducted by PREPA to prepare a monthly budget for fuel and purchased power, and a comparison of PREPA's forecasts against current pricing and market forwards.

Section VII: Operating Expense reviews the $560 million operational and maintenance ("O&M") budget assessed by PREPA. This chapter reviews PREPA's historical spending patterns and PREPA's portrayal of its budget requirements on a going-forward basis. It assesses how PREPA's O&M budgets are used by Directorate, and are likely to be used going forward.

II. SUMMARY OF FINDINGS AND RECOMMENDATIONS

A. Information reviewed for this report

Our review of PREPA's planned spending and revenue requirement is based on information provided by PREPA in its rate case petition, as well as a significant and lengthy record of discovery. We reviewed many elements of PREPA's filing, including several key schedules (A-1, A-2, A-6, E-6, F-3, and F-4 primary among them);[1] the direct and rebuttal testimony of PREPA's revenue requirement panel[2] and the direct testimony of the panel of Miranda, Sales, and Sosa;[3] PREPA's business plan;[4] the Fortieth Annual Report from PREPA's Consulting Engineers;[5] and the financial model submitted by PREPA in support of its rate case filing.[6]

We submitted and reviewed responses to several hundred Requirements of Information, as well as reviewing many of PREPA's responses to other of the Commission's advisors.[7] We reviewed historical records relating to much of PREPA's capital spending and all of PREPA's operational spending over the past five fiscal years. We also participated in two technical conference calls with PREPA. During these calls, we spoke to over a dozen of PREPA's engineering, planning, finance, and forecasting staff, as well as several of PREPA's advisors.

In addition to information provided by PREPA in this case, we reviewed the testimony submitted by intervenors. Finally, we also relied upon PREPA's filed IRP and the Commission's review thereof in Docket CEPR-AP-2015-002.

B. Major findings regarding PREPA's present and future spending needs

Below, we summarize the key findings of our research into and analysis of PREPA's petition for rate review.

1. PREPA's reliability has suffered since FY2014

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[1] PREPA's Petition for Rate Review. A Schedules, E Schedules, F Schedules, and revisions thereof.

[2] PREPA's Petition for Rate Review, Exhibit 5, Direct Testimony of Francis X. Pampush, Lucas D. Porter, and Dan T. Stathos.

[3] PREPA's Petition for Rate Review, Exhibit 3, Direct Testimony of Sonia Miranda, Antonio Perez Sales, and Virgilio Sosa.

[4] PREPA's Petition for Rate Review, Exhibit 3.02, PREPA Business Plan.

[5] PREPA's Petition for Rate Review, Schedule I-1.

[6] PREPA's Petition for Rate Review, Exhibit 14.02.

[7] We submitted ROIs as part of the Commission's Fourth, Sixth, Seventh, Eighth, 11th, 14th, and 17th rounds of ROIs.

A review of reliability metrics for PREPA indicates that the utility's ability to provide safe and reliable service has declined substantially since FY2014, a fact underplayed by the Company's presentation of this case and generally not featured as an issue in intervenor testimony. And while reliability is not the only metric by which a utility measures its performance, it is a fundamental and key component of society's expectations for electric service.

Ms. Miranda's panel makes passing reference to PREPA's "ailing grid;"[8] Mr. Quintana states that "insufficient revenues ha[ve] led to degradations of PREPA's infrastructure," noting that "PREPA's transmission system is deteriorated, and this has led to reduced reliability."[9] But neither witness describes the state of PREPA's system and the extent of the crisis faced by the utility today.

As part of the pre-filing of this case, PREPA submitted a 2013 report from the consultancy URS ("URS 2013 Report") that showed PREPA consistently achieving its reliability goals.[10] A casual review of PREPA's filing might give the impression that while the utility is concerned about potential degradation and staff shortages, the system is relatively robust. A careful review of PREPA's records provided in response to probing discovery reveal a drastically different story. PREPA's generation, transmission, and distribution systems are falling apart and reliability is suffering.

As of the last records provided by the Company, PREPA has an extraordinary amount of baseload generation offline. Extended forced outages, starting in FY2015 and FY2016, have led PREPA to rely on more expensive units, and forced the utility to use environmentally non-compliant generators that it pledged would not get used. The severe outages, deferred maintenance, and a lack of experienced staff have resulted in an increasingly brittle transmission system—as witnessed by the three-day outage just two months ago in September 2016. PREPA's customer outage rate is far higher than other U.S. utilities, and this rate has been increasing over the last two years. PREPA's own records show that the number of service interruptions experienced by PREPA customers in the past few months of 2016 have been four to five times higher than the average U.S. customer.

PREPA's mid-level managers have been frank in their discovery responses and discussions on conference calls. PREPA's fundamental infrastructure is in jeopardy due to a lack of funding and significant workforce reductions.[11] The utility has shifted from performing

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[8] PREPA Exhibit 3.0 at 211-213

[9] PREPA Exhibit 1.0 at 80 to 84

[10] URS June 2013 Annual Report ("URS 2013 Report"). PREPA Exhibit 3.02(D), Schedule I-1. Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Pages 44-46.

[11] CEPR-RS-03-03, CEPR-AH-02-01, discussions with generation and transmission staff during October 20 Clarification Call.

preventative maintenance to triaging outages as they occur through reactive maintenance. PREPA's internal documentation on outages is even starker: a lack of experienced staff, deferred maintenance, failures to pay vendors, and problems with procurement have severely impacted the PREPA generation fleet.[12]

We find that PREPA is in dire need of a capital infusion: monetary capital to pay for maintenance and ensure the system is operational; human capital to adequately staff generation and transmission equipment, and intellectual capital to strategically deploy PREPA's limited resources to break out of a cycle of disrepair and transition the fleet to a cleaner, more reliable system.

2. PREPA operates in a cost-constrained environment

PREPA, by every measure, operates in a deeply cost-constrained environment. Limited access to capital markets, political pressure to sustain low rates, and a constrained economy have led to PREPA having relatively sparse working funds. In light of these constraints, PREPA has extended maintenance outage cycles, moved to reactive maintenance, deferred some initiatives, and shed staff.

We recognize the extent of PREPA's limited budgets and financial distress. The fact that the utility has succeeded in maintaining generators and an extensive transmission and distribution system under these circumstances is a testament to the ability of PREPA's mid-level managers to operate under highly constrained circumstances.

3. PREPA's capital and labor budgets may not support a safe and reliable system

PREPA's budgets presented in this rate case seem to envision a modest increase in operational and maintenance ("O&M") budgets since the last budget cycle, but our review indicates that PREPA's operational spending has not been consistent with operation of a safe and reliable system since at least FY2014. Both the generation and transmission directorate have indicated that reduced staffing and ability to access maintenance dollars have severely hampered their ability to maintain reliability and prevent the degradation of key resources.

PREPA's capital budgets for the basic upkeep of the generation fleet and transmission system are consistent with prior year spending, despite the current state of the system. While it is difficult to tell on a generator-by-generator system if PREPA has allocated appropriate funds, we are concerned that the causes of recent extended outages are not necessary addressed by PREPA's near-term capital budgets. In addition, PREPA's reliance on a marginal generation fleet that it otherwise expected to retire, or at least sideline, is not supported by the capital budget put in place in this case. For example, PREPA seeks to run some of its steam units in a "limited use" framework to meet environmental regulatory requirements.

[12] CEPR-JF-01-16 Attach 01 (Public Version).

However, some of those "limited use" units have operated more than generators in PREPA's primary fleet, indicating that they are critical for reliability. PREPA makes no capital investments in these units, despite its reliance on them.

PREPA's budgets for O&M in FY2015–016 declined substantially from FY2010–2014 levels, and that decline tracked PREPA's reduced reliability almost in lock step. In this rate case, PREPA requests an O&M budget consistent with FY2015–2016. We are concerned that this budget is inadequate to meet PREPA's burgeoning maintenance requirements—particularly in the areas of generation, transmission, and distribution.

4. PREPA's non-labor operations budgets are poorly allocated

A major component of PREPA's operational spending lands in Administrative and General (A&G) functional area, and that spending in this area has increased in recent years for unexplained causes. A review of PREPA's records shows that PREPA spent the astonishing figure of $165 million in A&G in FY2016, of which $134 million fell into an undescribed discretionary fund. To give this figure context, PREPA spent the equivalent of *more than a third of its entire capital budget* on discretionary A&G spending.

Problematically, PREPA describes that it is "an inefficient bureaucracy" that is "overly staffed with non-value added administrative personnel," and that "the executive directorate and executive team is oversized."[13] It is difficult for us to overstate how concerning this is. Moreover, we have absolutely no further information about what, exactly, PREPA spent these funds on, although we can make inferences. A separate discovery response indicates that they were likely spent by the "Corporate Responsibilities" directorate[14] but we do not find this to be particularly informative as to the nature of the expenses.

5. PREPA's record keeping is sub-par

Across several areas, PREPA was unable to provide the basis or justification for budget items or spending. For example, we requested that PREPA identify which capital projects had work orders or contracts for engineering, procurement, and construction (EPC). PREPA denied the request in full, stating that their records were not sufficient to provide such justifications. PREPA explained that it does not have an electronic system for tracking capital projects, and that most information was maintained on paper records, distributed across regional offices. PREPA explained that details and budgets for projects were managed at a local scale and budgets (but not justifications) were filtered up through a central budgeting process.

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[13] PREPA Exhibit 3.0 at 659-662.

[14] CEPR-JF-01-24_Attach 05.xlsx. All spending in "Gen misc exp controlled by resp" expenses occurred under the directorate labeled "A14 - Responsabilidades Corporativas".

PREPA's budget is allocated from a central office, but managed across a wide range of directorates and many local offices. It is not clear that PREPA has the infrastructure to manage a strategic budget allocation process.

PREPA's lack of reasonable documentation also renders it difficult to provide oversight. PREPA's "detailed" explanation for multi-million dollar capital projects were often limited to two to three sentences, and in no case did PREPA provide an explanation of the basis of its cost estimates. For all intents and purposes, PREPA's capital budget—for the vast majority of items listed—could have simply been a rough estimate based loosely on manager experience. PREPA provided few requests for proposals, proposals or bids, or engineering estimates.

6. PREPA's budget allocation process is opaque and distortionary

PREPA provides for an approximate $300 million capital budget, but gives no basis for this precise figure. In discussions with PREPA's financial director, we learned that PREPA creates a capital budget, but the utility could provide no clear explanation why the value was set at $300 million versus any other value.

A hard cap budget can, in some circumstances, be a reasonable mechanism of incentivizing a strategic allocation of budgets—but we learned from PREPA that the organization sets budgets in a much more rudimentary fashion, and has little infrastructure for making strategic allocations. The financial director of PREPA informed us that budgets are allocated on prior years' spending or budget, whichever is lower. This budgeting process decouples the utility's strategic needs from the budget creation process at the directorate level, and creates a distortionary effect where directorates seek to spend budgets—even if they're not required—for fear of losing future year budgets.

On a project-by-project basis, PREPA provided no cost-benefit analyses, no economic assessments, and no alternative analyses. These types of analyses, as well as engineering estimates, establish baseline confidence in local budgeting processes. We have none of that confidence in this case, and instead must rely on our own external assessments of PREPA's needs and the value of PREPA's projects.

7. Fundamental needs should drive revenue requirements; PREPA's budgets constrained by a perception of revenues

PREPA's hard cap budgets are driven by its perception that its revenue stream is necessarily fixed. This stands in stark contrast to other utilities where revenue requirements are driven by needs, tempered by political realities (i.e. the avoidance of rate shock). In PREPA's case, the political reality of avoiding cost increases appears to lead, with system requirements taking a back seat.

To keep its budgets under the cap, PREPA has engaged in what appear to be self-defeating practices, such as deferring maintenance,[15] extending outages to avoid overtime,[16] and allocating budget away from critical, but low-utilization units.[17]

In the meantime, PREPA's generation, transmission, and distribution system clearly require substantial maintenance, overhauls, and repairs. As a newly rate-regulated utility, a rational pathway would have been for PREPA to establish its needs before the Commission, and then work with this Commission to set a reasonable budget to ensure safe and reliable operation, rather than through an artificial budget cap.

8. Significant investment and development of core competencies are needed to improve the condition and performance of PREPA's system

Quite simply, PREPA has dug itself into a hole of disrepair, and suffers from shortages of both resources and skills. This Commission[18] and the legislature of Puerto Rico[19] have both set forth ambitious visions for PREPA's future. These visions describe a new PREPA, focusing on the goal of a future PREPA that relies on clean energy generated from resources that are abundantly available in Puerto Rico rather than requiring constant imports of fossil fuels and exposing the people of Puerto Rico to the vagaries of the global oil market.[20] In these visions, empowered customers interact on equal footing with a flexible, transparent, and responsive PREPA;[21] demand-side solutions contribute equitably to supply-side resources on a modernized grid;[22] and every part of PREPA's organization operates efficiently to deliver better environmental outcomes and customer experiences at lower costs.[23]

We share these visions for PREPA's future. However, the current reality is stark: many of PREPA's existing units are in such a poor state of repair that PREPA must consider itself lucky

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[15] PREPA Exhibit 3.0 at 367-368

[16] URS 2013 Report. Page 57. "The Authority has adopted the policy of avoiding overtime for scheduled outages to reduce their costs. This work practice has extended the duration of these outages and negatively impacted availability."

[17] For example, PREPA did not identify any capital dollars spent on maintenance at Palo Seco 1 & 2 over the last six years despite the significant use of these units. See CEPR-AH-6-12 Attach 01

[18] *Notice of Investigation to Identify Opportunities to Improve Performance of the Puerto Rico Electric Power Authority*, CEPR-IN-2016-0002 (November 15, 2016). Hereafter "Performance Case NOI."

[19] Act 57-2014.

[20] Act 57-2014, Statement of Motives; Performance Case NOI, Section II.

[21] *Id.*

[22] *Id.*

[23] *Id.*

if they remain operational for more than several months at a time.[24] PREPA's transmission and distribution systems are falling apart quite literally: they are cracking, corroding, and collapsing.[25] PREPA is failing at the basic mandate of an electric utility, which is to safely and reliably supply electricity to its customers. Neither the Commission, other governmental authorities, nor the public should be misled about PREPA's current state, which is unambiguously one of crisis.

9. PREPA's current state will require time, effort, and funds to repair

PREPA cannot escape from this crisis through application of a band-aid or a coat of paint. Nor can PREPA and the people of Puerto Rico afford to wait for the intervention of a third-party savior. PREPA's situation is an emergency in the present day, and PREPA and the Commission must both take immediate steps to address it. One of those steps must be the recognition on the part of PREPA, the Commission, and the public of the level of investment that will be required to improve PREPA's condition. PREPA has "deferred" maintenance so often and for so long that required maintenance has become required repairs, and required repairs have become required replacements—all with a bigger price tag than the maintenance PREPA pushed off for the sake of constraining its spending.[26] We recognize that the ratepayers of Puerto Rico can ill abide increases in already high costs for electricity. However, we emphasize that there is simply no way for PREPA to achieve a safe and reliable electricity system without a significant outlay of funds.

The investments that PREPA requires are not solely financial, however. PREPA suffers from a severe lack of adequately trained staff and sound internal policies, protocols, and tools. PREPA's recordkeeping is archaic and unreliable. Its approaches to problem-solving are often improvised, with results that are disastrous as often as they are admirable. It has repeatedly shown itself to be penny-wise and pound-foolish. PREPA needs guidance, training, and talent to be able to take advantage of the opportunities for improvement afforded to it by this Commission. The Commission therefore finds itself in the position of having to both regulate and teach—and, equally, PREPA must find or develop in itself a commitment to cooperation and a willingness to learn.

10. Role of energy efficiency, renewable energy, and distributed energy resources

We share and strongly endorse a vision of PREPA's future that rests primarily on energy efficiency and demand-side management, renewable energy, distributed energy resources. We agree absolutely and without qualifications that increased utilization of these resources will result in lower costs and greater reliability over time. However, the fact is that safety

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[24] PREPA's response to CEPR-JF-01-16(b) of the Commission's Sixth ROI (PUBLIC; August 23, 2016).

[25] PREPA's response to CEPR-AH-02-01 of the Commission's Sixth ROI (PUBLIC; August 29, 2016).

[26] CAPITAL BUDGET, Chapter V, Page 65

and reliability *must* be PREPA's first priorities, above all other considerations. Energy efficiency and renewable energy take time to implement; PREPA's system is in a desperate state *today*. Integration of very high levels of renewable energy can present technical challenges even for mainland utilities with abundant resources and extensive available interconnections. Meanwhile, PREPA is barely able to provide electric service with its present fleet and dispatches its units with software that was developed in 1985[27]—well before the possibility of high reliance on variable renewable energy was contemplated by electric utilities as a realistic possibility.

We recognize the strong desire on the part of many stakeholders for a sign from PREPA that it is willing and eager to move towards greater reliance on renewables. We share this concern. We recommend that, over the medium and long terms, the Commission should require PREPA to develop and implement a strategic plan that allows it to improve reliability and safety without closing doors to cost-effective adoption of energy efficiency and renewable energy. In its long-term planning, PREPA should orient itself towards the possibility that adoption of renewable energy and energy efficiency can allow PREPA to avoid costly investments in traditional generating infrastructure and continued high levels of spending on fuel. PREPA's strategic investments should be directed at increasing its ability to integrate renewables as quickly as possible, rather than closing off avenues for doing so cost-effectively.

We emphasize, however, that this rate case focuses on PREPA's costs and revenues for fiscal year 2017. Realistically, PREPA can accomplish very little in terms of implementation of energy efficiency and renewable energy over the next seven months. Today, PREPA and the Commission must focus on addressing PREPA's immediate crisis by establishing sufficient revenue for PREPA to begin to ameliorate its system's state of utter disrepair.

11. PREPA must begin to think in terms of its actual needs for operation of a safe and reliable system

One of the goals of this rate case is for PREPA to establish its true needs for staffing, capital, and operational spending. PREPA needed to demonstrate that it can plot a viable path forwards out of its current crisis. We have seen some evidence of this in PREPA's internal communications, including a clear recognition that PREPA requires improvements in staff training and core competencies related to preventative maintenance and safety. However, PREPA also needed to present and justify an accurate accounting of what it actually requires to operate its system safety and effectively.

Unfortunately, PREPA did not take this opportunity to do so. Repeatedly in our review of PREPA's planned spending, we found artificial and arbitrary budget caps. PREPA restricted its operational spending to a nominal increase over FY2016 levels (except in the area of

[27] PREPA's response to CEPR-JF-01-12(a) of the Commission's Sixth ROI (PUBLIC; August 23, 2016).

restructuring fees).[28] PREPA continues to shed employees even given a labor shortage that it repeatedly cited as a contributory factor in its decreased reliability.[29] PREPA restricted its capital budget to the point where any significant cuts would lead to yet-greater impairments of system stability.[30] We conclude that PREPA's "revenue requirement" bears very little, if any, relationship to the revenue actually required by PREPA to operate its system safely and reliably. We find this extremely problematic, for reasons expressed by PREPA itself in rebuttal testimony:

> PREPA needs rates that cover its costs. That is reflected in Acts 57-2014 and 4-2016 and in basic principles of utility regulation. If a utility cannot cover its costs, then that can jeopardize service adequacy, reliability, and safety, and drive up the utility's costs of obtaining capital, lead to financial failure and bankruptcy. PREPA has been operating for a long time with rates that do not cover its costs, and we have seen that this has led to a system that not only needs modernization but needs major work to maintain and improve reliability.[31]

We are not concerned that PREPA will vastly overspend its budgets; rather, our worry is that PREPA is so entrenched in a restricted cash flow-based mindset that it was either unwilling or unable to present an estimate of its actual costs for repairing and maintaining its system. We recognize that PREPA, today, may not have the capacity to repair itself even if the Commission were to allocate it unlimited funding. However, in order to effectively regulate, the Commission must have a sound understanding of the gap between where PREPA is and where it should be, and what path PREPA must traverse on the way to improvement. By artificially depressing its revenue requirement for the sake of appearances, PREPA has not assisted with this goal in the present rate case.

C. Role of the Commission

This Commission is the entity best positioned, by its jurisdiction and mission under Act 57 and by its expertise in electricity systems and the regulation thereof, to guide PREPA through a path to improvement. This rate case has been extraordinarily comprehensive as it is the onus of the Commission to gain intimate familiarity with every aspect of PREPA's operations. PREPA is an extraordinarily complex organization in an extraordinarily complex situation. The Commission must foster a full and nuanced understanding of PREPA, its history, and its current state in order to regulate effectively.

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[28] OPERATING EXPENSE BUDGET, Chapter VII, Page 182

[29] OPERATING EXPENSE BUDGET, Chapter VII, Page 182

[30] PREPA's response to CEPR-RS-02-06(b) of the Commission's Fifth ROI (PUBLIC; August 9, 2016).

[31] PREPA's Petition for Rate Review, Exhibit 20, Rebuttal Testimony of Gregory Rivera, lines 123-129.

In general terms, having an unbiased set of eyes on PREPA's operations is of crucial importance. Act 57 recognizes the necessity of such an external authority, stating that:

> PREPA has been conceived and managed as an independent Government entity that is not accountable to its customers. PREPA's vision is inaccurate and inconsistent with the purposes that prompted its creation, which should be the basis for its operations. Such vision has, at times, led to the proposal and adoption of measures that, in practical terms, adversely affect most of its customers.[32]

The special quality of this Commission, as opposed to other external figures, is that it is tasked with maintaining the best interests of the ratepayers of Puerto Rico above *all* other concerns. While it seeks to consider input from all relevant stakeholders, it is not beholden to any of them. However, through open and transparent regulatory processes under the purview of this Commission, stakeholders have been given an opportunity to impact PREPA's operations for the first time in the utility's history, and have illuminated several issues of public concern. Most importantly, the Commission is not "for" or "against" PREPA: its only motivation is to seek the best outcome for Puerto Rico's ratepayers. Going forward, the role of the Commission must be to monitor (and, if necessary, adjust) the flow of information and funds through PREPA, to assist PREPA in recovering from this current crisis through sound regulatory guidance, and to enable PREPA to best serve its ratepayers as safely and reliably as possible.

D. Summary of budget adjustments

Below we summarize our recommendations for adjustments to PREPA's FY2017 revenue requirement or the calculation or allocation thereof.

1. With respect to fuel, we recommend that the Commission adjust PREPA's FY2017 budget upwards by $461,305,000, for a total FY2017 fuel budget of $1,117,273,289 after savings from performance improvements. We calculate and justify this adjustment in FUEL AND PURCHASED POWER BUDGETS, Chapter VI (Page 155).
2. With respect to PREPA's capital budget, we recommend the following, as calculated and justified in CAPITAL BUDGET, Chapter V (Page 65)
    a. The Commission approve PREPA's FY2017 full capital spending at Aguirre, Palo Seco, and San Juan Steam Plants.
    b. The maintenance contract at San Juan Combined Cycle be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $12 million in FY2017 from capital to O&M, and that the

[32] Act 57-2014, Statement of Motives: Transformation of PREPA.

Commission approve the other capital expenses at San Juan and Aguirre Combined Cycle Units.

c. The maintenance contract at Cambalache be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $4 million in FY2017 from capital to O&M.

d. The Commission revise PREPA's revenue requirement for FY2017 to reflect a $15 million spending cap at AOGP, reducing FY0217 revenue requirements by $41,339,807. To reflect the Commission's order that PREPA "shall assume, for informational purposes only, that AOGP will become operational at a realistically achievable date," we recommend increasing the FY2018 budget by the same $41.3 million increment to $454,756,927.

e. The Commission approve the full FY2017 transmission system capital budget as requested by PREPA.

f. The Commission approve the full FY2017 distribution system capital budget for all items except secondary line meters (PID 16677).

g. The Commission reduce PREPA's meter budget (PID 16677) from $10.6 to $5.8 million for FY2017 to reflect the anticipated cost of continuing PREPA's normal AMR acquisitions.

h. We recommend that the Commission approve the full FY2017 transportation and computer equipment budget.

3. With respect to operational expenses, we recommend that the Commission apply a series of adjustments to PREPA's FY2017 operations budget, as justified and calculated in OPERATING EXPENSE BUDGET, Chapter VII (Page 181). These adjustments include:

   a. Reallocation of PREPA's proposed budget by functional area to better align with historical spending patterns, resulting in no net change to PREPA's revenue requirement.

   b. Additions to and subtractions of funds from PREPA's proposed budget by functional area to better align with historical spending patterns, resulting in a net addition of $19,414,000 to PREPA's revenue requirement.

   c. Allocation of budgets for new initiatives and costs to specific functional areas, resulting in no net change to PREPA's revenue requirement.

   d. Recategorization of maintenance contracts as operational expenses, rather than capital, resulting in no net change to PREPA's revenue requirement.

E. Summary of other recommendations

Below we summarize our recommendations that do not modify PREPA's FY2017 revenue requirement or the calculation or allocation thereof.

1. With respect to load forecasting:
    a. The Commission should accept PREPA's sales and load forecast for FY2017 only.
    b. The Commission should require PREPA to improve its load forecasting methodology.
    c. The Commission should require PREPA to develop a new sales forecast based on an improved methodology prior to filing another planning or rate case with the Commission.
    d. The Commission should require PREPA to clearly document any changes to its forecasting models and support such changes with appropriate evidence.
    e. The Commission should require PREPA to adequately document its load forecasts with both methodological descriptions and comprehensive workpapers.
    f. The Commission should require PREPA to correct its financial model, cost of service studies, and all other relevant workbooks to rely on its actual by-class forecasts.
2. With respect to the capital budget:
    a. The Commission order that PREPA withhold from signing a Final Notice to Proceed at AOGP until it has submitted, and the Commission has approved, the AOGP Economic Analysis. PREPA should submit, or the Commission should require that PREPA submit, the AOGP economic analysis expediently.
    b. The Commission examine the maintenance contract at San Juan CC and the performance of MHPS-PR to determine if the contractor is meeting performance expectations for maintenance service.
    c. The Commission examine the Camabalache contract and the performance of Alstom to determine if the contractor is meeting performance expectations for maintenance service at Camabalache.
    d. The Commission require PREPA to file notice of any long-term contract with external service providers (i.e. contractors) with a potential net present value of $25 million value or higher.

e. The Commission require PREPA to provide strategic plans for San Juan and Palo Seco steam plants, including the following elements, at a minimum: maintenance plan, MATS compliance plan, an investment plan for maintaining (or not) San Juan 7-10 and Palo Seco 1 & 2, and a reliability study – i.e. what strains are placed on the system in the presence or absence of the San Juan and/or the Palo Seco steam units.

f. The Commission require PREPA to cease further smart meter or advanced meter infrastructure ("AMI") purchases until a strategic plan justifying the need for AMI is produced by PREPA and approved by the Commission.

g. For units designated as "limited use" for compliance with EPA's Mercury and Air Toxics Standard (MATS), we recommend:

    i. The Commission require PREPA to track and report on projects at San Juan 7-10 and Palo Seco Units 1 & 2, regardless of if these units are considered limited use.

    ii. The Commission require that PREPA's next long-term planning exercise evaluate the extent to which the "limited use" units should be maintained and contribute to peak requirements on an economic basis.

    iii. The Commission require PREPA tracks capital dollars spent at each "limited use" facility separately.

    iv. The Commission require that PREPA's long-term modeling consistently assess if these limited use facilities are available for peak purposes, and if not, assess the value of maintaining units that neither contribute to peak purposes or provide energy to the system.

3. With respect to fuel and purchased power:
    a. The Commission should require PREPA to prepare fuel price forecasts, or have forecasts prepared on its behalf, at least biannually.
    b. The Commission should require PREPA to submit for the Commission's review detailed documentation and workpapers regarding its fuel price forecasting methodology as part of PREPA's initial filing in the next major rate- or planning-related case it brings before the Commission.
    c. The Commission should require PREPA to establish and regularly update a database of its renewable energy contracts and the costs, performance, and statuses thereof.
4. With respect to operational expenses:
    a. The Commission should require PREPA to adjust its monthly report format, such that future monthly reports will include greater detail and more useful

information regarding the status of PREPA's operational budgets by functional area.

   b. The Commission should investigate PREPA's "miscellaneous" non-labor spending in the Administrative and General functional area.

5. Generally:
   a. The Commission should exercise increased oversight of PREPA's budgeting process and the status of its budgets and spending throughout the year.

III. THE STATE OF PREPA'S SYSTEM

PREPA's system today is in a state of crisis. Deferred and inadequate investment in infrastructure, a loss of key staff, and a myopic management focus on large risky bets have left PREPA with generation and transmission infrastructure literally falling apart, unnecessarily high costs, a utility operating out of compliance with commonwealth and federal law, and alternative options rapidly disappearing.

Our review of revenue requirement issues ultimately makes relatively few adjustments to PREPA's capital and operating budgets relative to PREPA's requests, but this is not as much an affirmation of PREPA's budgeting process as it is a reluctance to cut PREPA's budgets in a time of crisis, a recognition that PREPA's recent budget reductions have resulted in disastrous outcomes for the utility's infrastructure, and a desire to see PREPA provide reliable and safe service quickly. In assessing PREPA's needs, we've come to the conclusion that PREPA is in dire need of a comprehensive strategic plan, the likes of which were not seen in either the business case supporting this rate case nor the preceding integrated resource plan (IRP). Both PREPA's business plan and the IRP attempt to sugarcoat what is otherwise a dire situation.

Over the course of the last two years, PREPA's generators have failed at an unprecedented rate, straining the utility's system and forcing the utility to rely on higher cost generators. PREPA's customer interruption rates are four to five times higher than other U.S. utilities, and PREPA's costs are higher. PREPA's attempt to meet federal environmental regulations through a massive investment in an offshore gasport and 15-year commitment to gas deliveries have been delayed time and again, are looking increasingly less economically attractive, and doubles down on the utility's reliance on fossil fuels and inability to incorporate renewable energy. Workers suffer injuries and fatalities at an alarming rate. PREPA's management is unable to thoroughly account for the use of capital and operations budgets, and the budget allocation system at the utility is distortionary at best. PREPA's most experienced staff, and those able to make the system work on historically thin budgets, are leaving.

We were not charged with telling the whole story of PREPA's system today, but could not reasonably assess PREPA's budgets and revenue requirements without an eye towards PREPA's performance. Reviewing PREPA's anticipated projects, historic budget use, and flow of information, we felt strongly that we needed to characterize PREPA's situation, and re-emphasize the need for a strategic plan.

This rate case is the first opportunity for the public to understand PREPA's performance and transparency, and the results are grim. PREPA's system today appears to be running on fumes and in our opinion desperately requires an infusion of capital—monetary, human, and intellectual—to restore a functional utility.

A. PREPA's generation system crisis

PREPA's generation and transmission facilities are in a state of crisis. In PREPA's filing, witnesses Miranda, Sales and Sosa describe that the utility suffers from "high forced outage rates caused by deferred maintenance and skilled labor leaving operational roles."[33]

A review of the utility's records shows a rapidly increasing generation outage rate, and customer outage levels four to five times higher than other U.S. utilities. Indeed, given the levels of generation outage reported by the utility, it is fairly astounding that PREPA was able to restore power after only three days in the September 21st 2016 Aguirre outage.

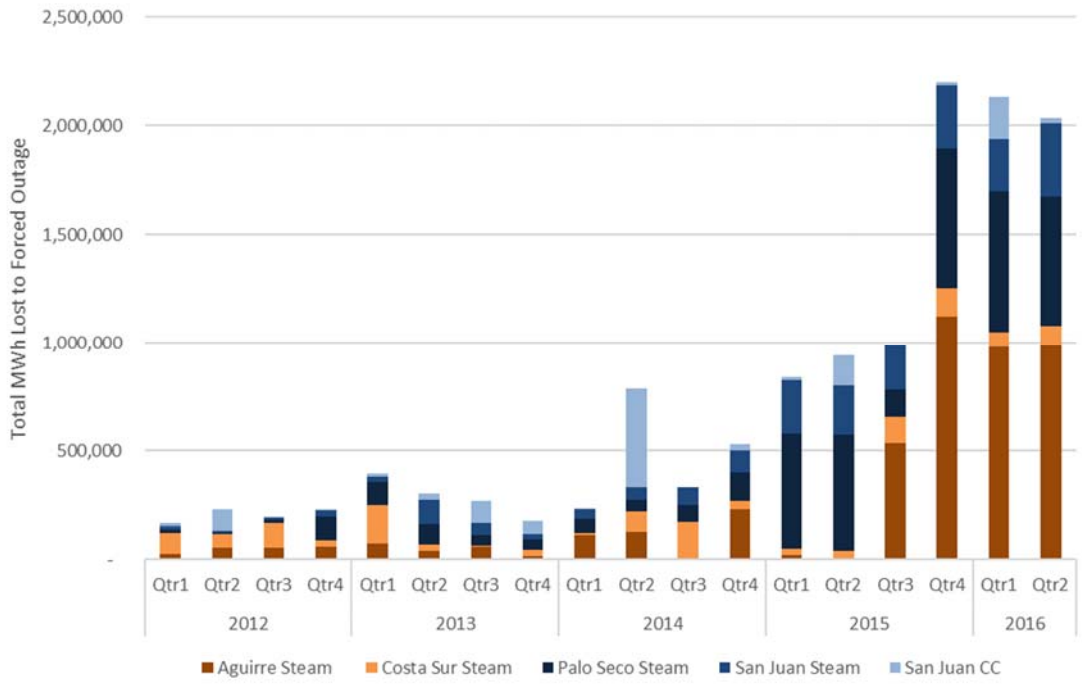
It is difficult to overstate the level of disrepair or operational neglect at PREPA's generation facilities. Numerous reports, both internal and external, talk of multiple cascading events, simple failures that blossom into crises, staff shortages and in some cases, staff incompetence. PREPA's system today appears to be running on fumes and in our opinion desperately requires an infusion of capital –monetary, human, and intellectual – to restore a functional utility.

Figure 1, below, shows how much potential generation has been lost to forced outages at PREPA's steam plants and the San Juan combined cycle ("CC") units by quarter since 2012.[34] The chart shows that, starting in late 2014, PREPA began losing substantial generation across their steam fleet. As of late 2015, chronic and reoccurring outages at Aguirre, Palo Seco and San Juan stations have led to PREPA forgoing more than 2,000,000 MWh each quarter. To give this number some heft, the amount of generation that *hasn't* been provided by these generators because of forced outages exceeds the amount of generation that *could have* been provided by a 2,300 MW generator operating with a modest 50% capacity factor.

[33] PREPA Exhibit 3.0, lines 367-371

[34] From CEPR-JF-01-16 Attach 02. Forced outages from this database include both complete outages as well as de-rating events, where a generator is turned down while a problem persists or is fixed. MWh lost calculated by PREPA.

Figure 1. Total energy (MWh) lost to forced outages by quarter, calendar year.[35]



An extraordinary amount of PREPA's generation is, by all accounts, currently not available. These forced outages appear to be a direct consequence of deferred maintenance, reduced capital spending, and a shortage of expert staff in key positions.

1. PREPA's assessment of the forced outage crisis

Does PREPA recognize the depth of crisis it is in today? From our discussions with PREPA management and review of documentation, it is clear that PREPA's mid-level managers—both for generation and transmission/distribution—are keenly aware of their needs and have demonstrated an ability to work with extremely limited resources spread thinly over PREPA's system. It is not clear, however, that PREPA's top management understands the level of crisis or how to strategically invest, and there are indications that competency is mixed at the plant management level.

An internal management presentation, apparently from mid-2015, shows the start of the upward forced outage trend in Figure 1, above. Already showing persistently high outages relative to historic trends, the slide deck underplays the emerging problem, stating that "while PREPA's units have over time experienced a slight decrease in FO events, there has been a recent increase during 2015."[36] The slide shows a graphic with a month-to-month line

[35] CEPR-JF-01-16 Attach 02.

[36] CEPR-JF-01-16 Attach 01. Forced Outage ("FO") Analysis: Business Case. Public version.

with a "forced outage factor" ("FOF"), which PREPA states is "the probability that a unit will not be available for service." PREPA indicates that it has averaged 6.87% from 2010 to year-to-date 2015—but then shows that the factor sits at an historic high of 27%—an extraordinary level. For any other top managers, this trend, and an examination of the outages already incurred by mid-2015, should have triggered a rapid mitigation process. The generation fleet at PREPA is the backbone of operations.

In testimony, PREPA's Executive Director Javier Quintana states that PREPA has made "improvements [to] generation performance," and "finalizing an integrated process that will reduce the number and severity of forced outage events, further stabilizing the system."[37] Mr. Quintana's testimony implies that, as of May 2016, PREPA's system was improving relative to historic performance. This is not correct. In mid-2016, PREPA was experiencing its historically worst performance since 2012 with massive and chronic failures at Aguirre and Palo Seco plants. In late September 2016, a fire at the Aguirre substation plunged the island into a three-day blackout, demonstrating that PREPA's system was so fragile that it was unable to cope with this first contingency. From the perspective of a utility general manager, mitigating severe generation and transmission outages should be a top-level priority—not a casual side note.

What led to this crisis state? PREPA identifies at least three primary drivers of the increasing forced outages at generators and in the transmission system.

Deferred maintenance: Ms. Miranda's panel discusses that deferred maintenance is in part responsible for forced outages.[38] This is highlighted again in PREPA's internal documentation, where it states a root cause of forced outages are "exceeding OEM recommended equipment overhauls schedule," "budget constraints to perform necessary inspections, maintenance and repairs." Problematically, PREPA states in this report that they are "waiting for gas conversion [at Aguirre] before investing in major repairs. (e.g. AG1 and AG2)." [39] Inevitable delays in that project may have caused far more deferred maintenance than originally anticipated by PREPA. Finally, the 2013 Annual Report by URS (PREPA's consulting engineers) indicates a policy change at PREPA that may have resulted in worse outcomes. "The Authority has adopted the policy of avoiding overtime for scheduled outages to reduce their costs. This work practice has extended the duration of these outages and negatively impacted availability.[40]

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[37] PREPA's Petition for Rate Review, Exhibit 1.0, Direct Testimony of Javier Quintana-Mendez, lines 313-319.

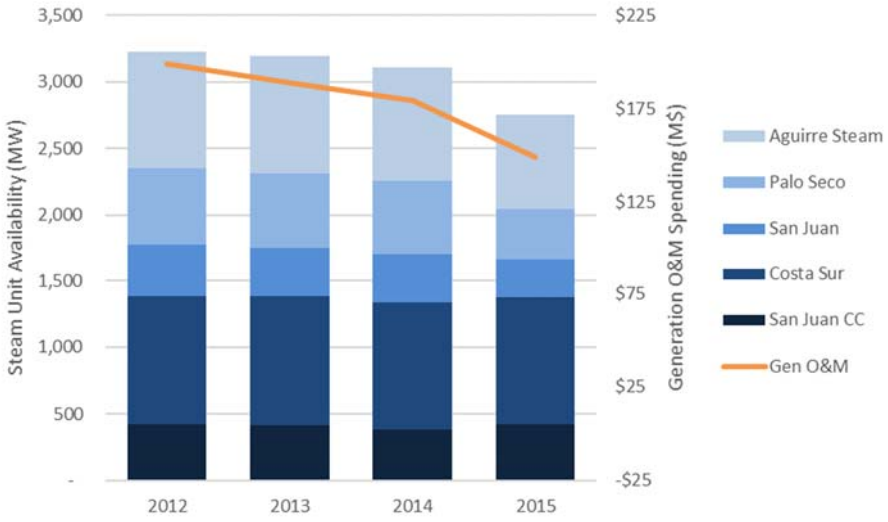
[38] PREPA Exhibit 3.0, lines 367-368.

[39] CEPR-JF-01-16 Attach 01 (Public version).

[40] PREPA's Petition for Rate Review, Exhibit 3.02(D) and Schedule I-1. Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Hereafter "URS 2013 Report" or "Consulting Engineer's report."

Reviewing PREPA's operations and maintenance ("O&M") expenditures in the generation division, we see that the availability of PREPA's generation units, here measured by the power (MW) available in the steam units after forced outages has declined in lock step with spending in O&M. Units become unavailable as different parts fail over time. We conclude that a substantial component of the forced outages in generation and transmission are a failure to invest or maintain at an appropriate time.

Figure 2. Steam unit availability (in MW relative to max capacity) vs. historic generation operations and maintenance, by fiscal year.[41]



The problem is not isolated to the generation system. In response to a query regarding the degradation of the transmission system, Ms. Miranda stated that**:**

> **...**due to limited capital, transmission investments were selected based primarily on the immediate impact upon system reliability of a failure to invest. Thus, PREPA invested in transmission projects that helped to alleviate or mitigate operational congestion problems, system overloads, and voltage regulation problems at the bulk transmission and subtransmission level. When under significant capital constraints, such investments are the most urgent and failure to make them has the most immediate and unavoidable potential consequences.[42]

Staff availability and competence: Ms. Miranda's panel discusses that forced outages are due, in part to "skilled labor leaving operational roles and not being replaced."[43] PREPA's own internal documentation backs up and expands this contention, blaming the outages on

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[41] Derived from CEPR-JF-01-16 Attach 02. Author's calculation.

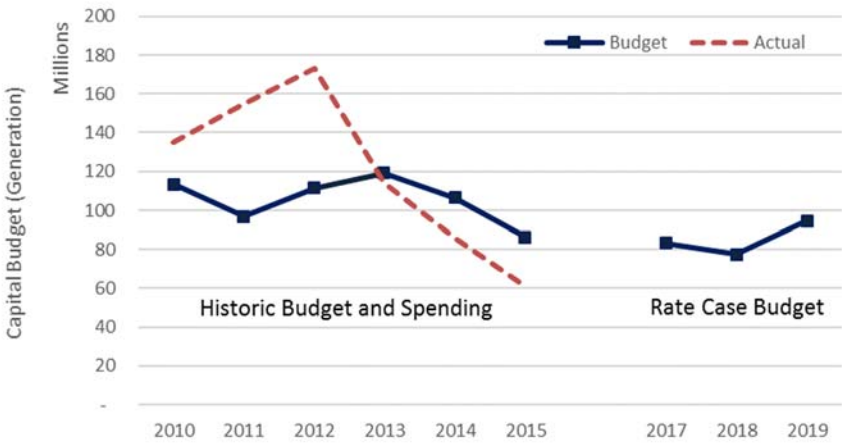
[42] CEPR-JF-01-01(a).

[43] PREPA Exhibit 3.0, lines 367-368.

a "loss of significant number of experienced personnel," and that "new employees do not have the required expertise and knowledge." That staff also fails to document and assess the root cause of problems, resulting in a lack of followup and strategic thinking.[44] However, the problems extend further, into PREPA's contractors, where "technical advisors [are] not always familiar with technology… [such as] stator windings at Aguirre, turbine controls issue at Costa Sur and vibrations problems at San Juan."[45]

Declining capital investments: Both Mr. Quintana and Ms. Miranda's panel testimony both indicate that "PREPA's historically low investment on capital expenditures had led to more than twice the number of forced outages than the U.S. industry standard."[46] PREPA's investments at its generation fleet have declined substantially in recent years – and while PREPA's generation spending was substantially overbudget from 2010 to 2013, the system was maintained more reliably.

Figure 3. PREPA capital budget and spending for generation, historic and rate case, by fiscal year (millions).



2. Forced outages impose costs on system

The state of PREPA's system exacts a steep cost on the system in the short term, and over the long run.

In the *short term*, PREPA is forced to use "less efficient diesel backup units," and "require[es] increased spinning reserve levels [at viable generators] to minimize power disruptions to customers."[47] A review of PREPA's generation patterns reveals that PREPA has, in fact,

[44] CEPR-JF-01-16 Attach 01. Page 6.

[45] *Id.* Page 7.

[46] PREPA Exhibit 1.0 at 313-315

[47] PREPA Exhibit 3.0, lines 367-371.

increased its reliance on the diesel generation fleet in FY2015 and FY2016, doubling its use of distributed generation turbines and tripling its use of the diesel Aguirre CC plant.[48]

Over the *long run*, PREPA's forced outages mean that it is compelled to expend limited capital in the restoration of its system, rather than in fundamental improvements. As we will show in the following sections, PREPA's capital budgets are oriented towards the restoration of existing hardware—generation, transmission and distribution—leaving little space for the fundamental system improvements that PREPA needs to move beyond its current high cost fossil fleet.

We conclude that PREPA's focus in the near term needs to be on the restoration of the system through strategic investments in generation, transmission, distribution and human capital.

B. Low reliability for PREPA customers

PREPA's customers experience a level of interruption above that of most other U.S. utilities by a factor of four or more. PREPA's system is characterized by frequent interruptions, many of which are sustained. Some of these interruptions—like the September 21, 2016 outage—have their origins in large-scale transmission and generation faults that cascade through the PREPA system. Other outages occur due to the deterioration of the distribution system. PREPA states that "the physical structural/mechanical and electrical deterioration of critical components in the transmission and sub-transmission lines have directly caused significant grid outages and service interruptions…Physical access to repair or replace structures is very difficult, which consequently means that in addition to the long service interruptions, the system is exposed to the potential risk of multiple contingencies and cascading outages."[49]

In discussions with PREPA, the state of disrepair become more apparent. According to the director of transmission and distribution, reductions in spending have impacted the system dramatically:

> The fact that we have had capital constraints and haven't been able to replace and construct many of our transmission lines is a problem here. The fact is that we're facing a high level of deterioration of the system. Just to give you an idea, in the first 110 days of this fiscal year, we have faced thirty-eight major transmission line outages. And when I say thirty-eight, we mean that in all of those outages we had a high risk of conductors on the floor. That's the type of situation that we're facing right now.[50]

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[48] CEPR-AH-03-07 Attach 01.

[49] CEPR-AH-02-01(d).

[50] October 20 Conference Call at 2:50.

PREPA characterizes the causes of interruptions as follows:[51]

a) Tree Trimming Conditions – about 35 - 45%

b) Weather Deterioration – about 15 - 25% (this includes heavy rain, normal rain, strong winds, etc.)

c) Structural/Mechanical conditions of poles and cables – 10 – 25%

d) No Cause Reported – 15 – 20% (this is mainly due to undetected conditions at the moment of the failure)

e) Other causes – 10-20%

PREPA's distribution system is spread over 16,000 miles of primary lines spread along the island.[52] Understandably, a significant level of staffing is required to maintain this infrastructure. PREPA has incurred a substantial 22 percent workforce reduction since 2014, with a notable impact on reliability. PREPA states that in reducing the workforce, construction crews have reoriented from preventative to reactive maintenance.[53] Differently stated, the utility describes itself as always playing a catch-up game on maintenance—following outages, instead of improving the fundamental system. PREPA further states that the shortage of funds makes it unable to execute a well-planned preventative maintenance program.[54]

Utilities typically measure the system reliability based on standard reliability metrics. The most commonly reported reliability metrics are SAIFI, SAIDI, and CAIDI.

SAIFI, the **System Average Interruption Frequency Index** can be thought of as the probability that an average customer will have an outage (of any duration) during a reporting period. It is calculated as the fraction of total customers interrupted in a period over the number of customers served in that period.[55] A measured annual SAIFI of 0.35 means that on average, about one third of customers experienced an interruption over the course of a year.

SAIDI, the **System Average Interruption Duration Index** can be considered the average number of outage minutes any given customer can be expected to experience over a

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[51] CEPR-AH-02-01(g).

[52] CEPR-AH-02-01(e).

[53] CEPR-RS-03-03.

[54] *Id.*

[55] SAIFI = Σ sustained customers interrupted / Σ system customers served. Note: counts interruptions of 5 minutes or longer.

reporting period. It is calculated as the number of total customer minutes interrupted in a period divided by the number of customers served.[56] A measured annual SAIDI of 50 would mean that the average customer experienced 50 minutes of interruption every year.

CAIDI, the **Customer Average Interruption Duration Index** is the actual average interruption time experienced by customers who experience an outage. It is calculated as SAIDI divided by SAIFI. If the measured SAIFI is 50 minutes per year, and the measured SAIDI is 0.35 per year, that means that customers who did experience outages were offline for nearly 2.5 hours (50/0.35 = 142 minutes).

In the URS 2013 Report, PREPA stated that its internal SAIDI target was 1.8 hours or 84 minutes.[57] From 2010 to 2013, PREPA was able to keep SAIDI below that target. However, that value excluded outages that were less than fifteen minutes in duration as well as major events such as the effects of tropical storms/hurricanes and disruptions from multiple contingencies.[58] In 2014, PREPA modified its calculations to measure reliability to be more consistent with industry trends.[59] Over that time period, reliability has also degraded.

1. Reliability Trends

PREPA provided reliability metrics (SAIDI, SAIFI, and CAIDI) for the last five years reported by month.[60] PREPA stated its current reliability goals as SAIFI at 0.328 interruptions per connected customer, SAIDI at 48 minutes per connected customer, and CAIDI at 46 minutes per affected customer.[61] Evaluating PREPA's summary data as well as detailed records of interruptions provided by PREPA, we observe that PREPA has often exceeded even these liberal goals. We compare PREPA's reliability goals and its actual metrics in the figures below. As a note, the charts below do not show the impact of the September 21st Aguirre 2.5-day outage. It is not clear why PREPA excluded this event or how it was taken into account, if at all.

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[56] SAIDI = Σ sustained customer minutes interrupted/ Σ system customers served. Note: some utilities provide more granular SAIDI values at district and even feeder level.

[57] URS 2013 Report, pages 58-59.

[58] URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 58.

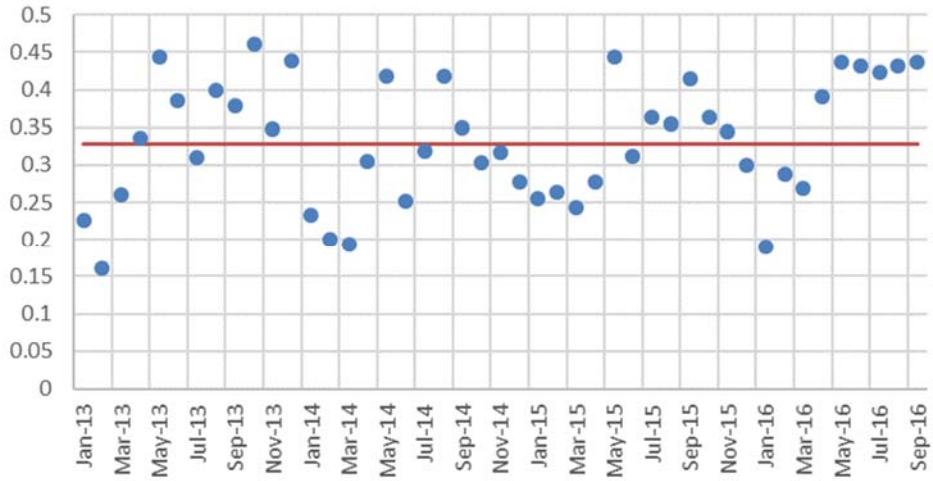
[59] The Institute of Electrical and Electronics Engineers (IEEE) published a standard methodology to calculate reliability metrics to ignore major events (i.e. storms).

[60] CEPR-MC-01-011 Attach 01.

[61] CEPR-MC-01-011(b)(i)-(iii).

PREPA's *monthly* SAIFI target is 0.33,.[62] or an expectation that on average, a customer will have an outage every three months—or four times per year. As shown in Figure 4, PREPA's recorded system SAIFI peaks in September—hurricane season—and is lowest during the winter. However, in data for this calendar year (May through September), we observe that SAIFI has stayed at historic high levels of 0.45, or five and a half outages every year.

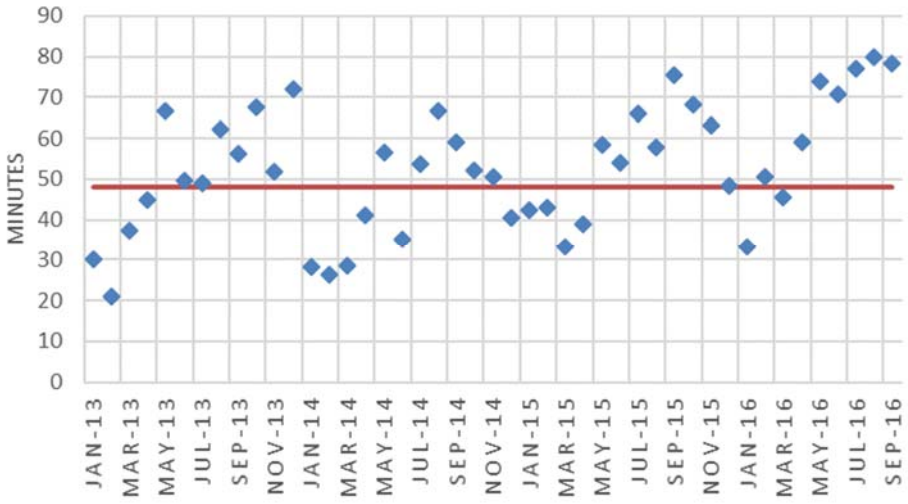
Figure 4. PREPA monthly SAIFI.



PREPA's target for SAIFI is 48 minutes per month, or ten hours of outage per year. In recent months, PREPA's actual has been closer to 16 hours per year. In other words, the average PREPA customer can plan to spend nearly a full day without power each year.

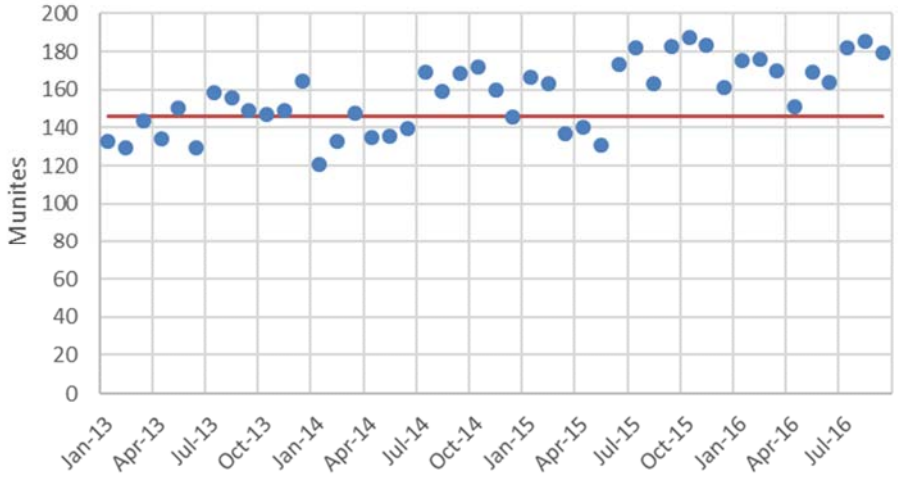
[62] PREPA did not state that the data provided here was by monthly reporting period, but an independent assessment of interruption data provided in CEPR-AH-02-07 Attach 02 confirms that these numbers are monthly. In fact, a review of actual interruption data suggests that interruptions are far worse than portrayed by the statistics here. On average, PREPA customers experience at least a five minute outage every month, or a SAIFI of 11.61 per year – twelve times the average U.S. customer.

Figure 5. PREPA monthly SAIDI.



Outage duration has been increasing, as shown in Figure 6, below. When outages do occur, the average outage is over two hours long. The monthly trend for CAIDI appears to be moving upwards since January 2013. This indicates that when customers experience outages, those outages last longer than in the past.

Figure 6. PREPA monthly CAIDI.



The data provided by PREPA indicates that PREPA's targets for distribution system reliability are extraordinarily high (*i.e.*, permissive), and since January 2013, the Company has exceeded its own monthly reliability targets in 64 percent of the months for SAIDI, 51 percent for SAIFI, and 68 percent of the time for CAIDI.

An independent assessment of outage data provided by PREPA, entailing nearly 400,000 outage events,[63] suggests that PREPA's distribution reliability is actually far worse than shown here. A review of that data indicates that average PREPA customers experience 11.5 outages every year – around 20 hours' worth.

The outage levels experienced by PREPA customers according to these statistics are extraordinary and are far in excess of system-wide values for other utilities. A report from Lawrence Berkeley National Laboratory (LBNL) finds national *annual* SAIDI measures of about 200 minutes per year in 2012—including storm events.[64] PREPA's target--excluding storm events—is 600 minutes per year, above the 75th percentile of utilities measured by LBNL. Removing storm events, utilities in the U.S. average between 75 to 200 SAIDI minutes per year.

Similarly, the target frequency of service interruptions experienced by PREPA customers is about three times that experienced by other U.S. customers. The number of service interruptions experienced by PREPA customers in the last few months of 2016 have been four to five times higher than the average U.S. customer.

The extremely high outage rate for PREPA is indicative of a system with substantial problems, and confirms PREPA's staff's contention that the system is severely degraded.

Changes to improve the reliability of the distribution system will not occur overnight and will not be solved by simply increasing budgets. An integral process to improve the visibility of the distribution system will help PREPA's planners to identify and prioritize areas on the PREPA system.

C. PREPA's MATS compliance conundrum

On February 16, 2012, the U.S. Environmental Protection Agency (EPA) issued the National Emission Standards for Hazardous Air Pollutants (called the Mercury and Air Toxics Standard, or MATS). This rule is targeted at restricting mercury emissions from solid fuel- and fuel oil-fired power plants. The rule required uncontrolled or inadequately controlled coal- and oil-fired power plants to install and operate (or upgrade existing) environmental controls by April 2015, or as late as April 2017 with an extension and special reliability

[63] CEPR-AH-02-07 Attach 02 through 07.

[64] Larsen, P.H., K.H. LaCommare, J.H. Eto, and J.L. Sweeney. Assessing Changes in the Reliability of the U.S. Electric Power System. Lawrence Berkeley National Laboratory. August 2015. Page 9. https://emp.lbl.gov/sites/all/files/lbnl-188741_0.pdf. Provided as Exhibit Fisher and Horowitz, Exhibit 03.

exemption from EPA.[65] For most U.S. coal or oil generators, MATS compliance could be achieved through three primary avenues: install controls (primarily sulfur dioxide scrubbers, sorbent injection and particulate controls), fire with natural gas (which is exempt from the rule), or retire.

PREPA's fleet is in a unique position. Fourteen of PREPA's units, comprising about 2,900 MW of oil-fired capacity, or over half of PREPA's nameplate capacity, are subject to MATS. For many of its units, PREPA is relying on two less often used provisions of the rule that provide exemptions.

Limited use designation: Units that operate below an eight percent capacity factor may be designated as "limited use." EPA exempts units that are designated as limited use, primarily on the justification that these units are effectively backup or peaking generators and do not contribute substantial pollution. In the IRP, PREPA has indicated that it plans to designate a total of eight steam units "limited use" as its compliance mechanism, starting in April 2015. Ms. Miranda's panel discusses that over the last year, PREPA has been unable to meet the limited use definition for those units already designated as such,[66] primarily as a function of other large unit outages.

Exception for combustion turbines: EPA does not consider simple-cycle and combined cycle ("CC") stationary combustion turbines (CTs) applicable under the definition of "electric generating unit" for the purposes of the MATS rule.[67] This means that PREPA's combined cycle units—both existing and potential new units—are not subject to MATS. PREPA maintains some of the few combined cycle units in the U.S. actively fired on liquid fuel, hence the rarity of use of this particular provision.

To handle the remainder of its fleet's compliance, PREPA had effectively three options – install stack controls to limit emissions, retire the units outright, or find a way to bring natural gas to those units.

Early in 2011, PREPA determined that it would meet MATS compliance primarily by building an offshore gasport near Salinas to feed the Aguirre steam and combined cycle units. In doing so, it would convert its largest plant to gas, and then expand its facility at Aguirre, thereby allowing much of the rest of its fleet to retire. The plan relied on an assumption that (a) the gasport would be built in a timely fashion, (b) PREPA could keep its "limited use" units to

[65] However, we have found no evidence that PREPA requested or was granted such an extraordinary level of extension. We therefore assume PREPA's MATS compliance deadline to have been April 2016, allowing for a commonly-granted one-year extension.

[66] PREPA Exhibit 3.0, lines 324-331.

[67] 77 FR 9309.

below an eight percent capacity factor, and (c) EPA would allow PREPA to maintain some non-MATS compliant units until the Aguirre site could be expanded.

Over the course of the next three years, PREPA developed plans for the offshore gasport with Excelerate Energy, a company that operates offshore re-gasification platforms (*i.e.*, from liquefied natural gas to vapor gas), targeting a gasport in service by 2014—a timeline that has now slipped to 2018. The gasport, now called the Aguirre Offshore Gasport ("AOGP") became a major initiative of the utility, and accounts for a substatntial portion of PREPA's capital requirements over the next few years.

In its avid pursuit of the AOGP project, PREPA lost sight of its other compliance options. As the AOGP project became increasingly delayed, PREPA's options for timely compliance evaporated until in March of 2016 PREPA officially passed any form of extension granted to it, implicitly or explicitly. Today, PREPA is out of compliance with MATS at many of the same units for which it was out of compliance in 2011. With current timelines, compliance at Aguirre can't be achieved until late 2018—if not later. PREPA's hopes to bring new gas fired generation online after the gasport is built are also now delayed and thus overall system compliance increasingly looks like it may take until 2022 or later with PREPA's current plan of action.

As we will discuss in this document, PREPA's MATS compliance features prominently in the utility's strategy of investments, from generation to transmission, and is belied by the utility's inability to keep the Aguirre units—key to the AOGP project—online and operational.

Are PREPA's investments in this rate case consistent with its MATS strategy? Yes—but since PREPA relies so heavily on large central station generators, and those generators are failing, PREPA has needed, and may continue to need, to prop up those aging steam generators in order to pursue this strategy, rather than moving towards a cleaner, more efficient fleet.

Was PREPA's move to pursue AOGP at the cost of all other options prudent? Probably not, although an economic analysis of AOGP is still pending before this Commission.

In pursuing AOGP, PREPA failed to complete a permitted, licensed, and half-built pipeline from the EcoEléctrica facility to Aguirre. Ms. Miranda states that one decision with which she disagrees with is "the cancellation of the south gas pipeline in 2009." She states that "based on the previous studies that we (PREPA) did to justify this project, the cancellation of the south gas pipeline in 2009 was not optimal."[68]

In pursuing AOGP, PREPA also narrowed its options for improving and expanding the current MATS compliant fleet, and seeking substantial renewable energy. Instead, by seeking

[68] CEPR-SGH-001-016(a)- Supplemental.

to prop up Aguirre, PREPA created a fleet that, by its own measure, cannot effectively take on renewable energy simply because its existing generators ramp too slowly.

Over the last four years PREPA has increasingly cornered itself into a need for AOGP. Having shed many of its other options, PREPA now finds itself having placed a bet on offshore gas—which may be a "too big to fail" proposition.

Much of our analysis will go back to MATS compliance and how PREPA's investments either support, or do not support, PREPA's need to meet this important regulation, as well as the consequences of PREPA's single-minded pursuit of its strategy for doing so, even as its system deteriorated around it.

IV. LOAD FORECAST

A. Summary of issue and findings

In this chapter, we address the sales forecast used by PREPA in its rate case filing. PREPA's sales forecast is one of the most important elements in the calculation of PREPA's proposed rates. The Commission must decide if the forecast is reasonable. If the Commission decides that PREPA's sales forecast is reasonable, no change will be required. If the Commission decides that PREPA's sales forecast is not reasonable, it must then decide whether or not to require that PREPA reformulate its rate proposal using a different sales forecast.

Below, we discuss the significance of sales forecasts to both short-term and long-term planning, describe how PREPA formulated the sales forecast used in its rate case filing, and critique both the methodology and the results. Our conclusion is that PREPA's sales forecast methodology is poorly conceived and supported, and that the sales forecast was accompanied by insufficient documentation. We believe that the current forecast is likely not reliable for FYs 2018 and 2019 and recommend that the Commission require PREPA to improve its forecasting methodology and prepare a new sales forecast prior to the next major case it brings before this Commission (for example, an IRP Update or the next rate case). We observe that PREPA's forecasts for one year out, while not generally reliable, are not systematically biased. An assessment of actual FY2017 sales by month indicates that PREPA's forecast for FY2017 is likely reasonably close to reality. Therefore we recommend no change to the sales forecast at this time.

B. The need for and significance of the sales forecast

1. PREPA requires an accurate and reasonable sales forecast

The purpose of electric utilities is to supply electricity according to the demand of customers, at just and reasonable rates. In order to operate a safe, reliable, and financially sustainable system, utilities must have a reasonable expectation of how much electricity they will sell in the coming year or years. Utilities engage in load forecasting to predict how much electricity they expect to sell over both the short- and long-terms.

Load forecasts generally have several constituent elements. The main element is a forecast of total demand for or sales of electricity (in kWh or some multiple thereof[69]) and a prediction of "peak load" or "peak demand" over time, often in MW.[70] Utilities may also forecast total generation requirements (also in kWh) as a function of the anticipated level of demand and transmission- and distribution-related losses, as well as other system

[69] kWh: kilowatt-hour, a unit of energy. Depending on the utility, sales forecasts can also be provided in megawatt-hours (MWh; 1 MWh = 1000 kWh) or gigawatt-hours (GWh; 1 GWh = 1000 MWh).

[70] MW: megawatt, a unit of power. Conceptually, peak demand refers to the maximum amount of power that a utility must supply at any one moment of a year.

inefficiencies. While the sales forecast expresses how much total energy the utility expects to sell over the course of a year, the peak load forecast indicates the maximum power the utility expects to need to generate and transmit at any one time during that year.

Ultimately, all electric utilities have need of accurate load forecasts. The Puerto Rico Electric Power Authority (PREPA) is no exception. In systems with traditional volumetric rates, utilities' revenues are largely dependent on sales, as is the case for PREPA. Sales forecasts, and accompanying peak load forecasts, also dictate much of utilities' budgets as discussed further below. As such, preparation of an accurate and reasonable sales forecast is the cornerstone of financial planning for electric utilities.

2. PREPA's sales forecast impacts many aspects of its expected spending and revenue

As mentioned above, the sales forecast has important implications for both a utility's income and its expenditures. In terms of income, revenue is tied – at least partially - to sales for most utilities. For PREPA, the sales forecast is used as the denominator in the calculation of various components of PREPA's rates. When a utility collects revenues primarily through a volumetric (per-kWh) charge, having an accurate sales forecast is necessary to enable collection of sufficient revenue to cover both fixed and variable expenses. Such expenses may include fuel, which in PREPA's case is compensated through a fuel cost adjuster, and load-linked service benefit charges such as for administration of energy efficiency programs. Rate design and the implications thereof are discussed in more depth in the expert report of Commission advisor Paul Chernick.

Utility budgets also depend on accurate sales forecasts. Utilities' expectations of total spending on fuel, purchased power, operations and maintenance, and load-linked programs mentioned above are all depending on their expectations of sales. Increased sales generally lead to increased spending in some or all of these categories.

For PREPA, sales are used as an input into PROMOD,[71] a production cost model.[72] Briefly, PREPA calculates the total amount of energy it needs to generate every year, considering both its sales forecast and factors such as line and non-technical losses.[73] PREPA then inputs its total generation requirement into PROMOD along with other data such as cost and

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[71] CEPR-AP-2015-0001, October 20, 2016 Conference Call.

[72] More detail regarding the structure, capabilities, and use of production cost models can be found in section 3 of the following report: Fisher, J., Santen, N., Luckow, P., De Sisternes, F., Levin, T. & Botterud, A., A Guide to Clean Power Plan Modeling Tools: Analytical Approaches for State Plan CO2 Performance Projections; Synapse Energy Economics and Argonne National Laboratory (2016), http://www.synapse-energy.com/sites/default/files/Guide-to-Clean-Power-Plan-Modeling-Tools.pdf.

[73] Base IRP, Volume III, Section 1.2.1.3.

performance parameters for its generation fleet. PROMOD then determines an optimal dispatch pattern for PREPA's generation fleet over the course of a year, and outputs the costs (as well as expected fuel consumption, emissions, and other system behavior) associated with that dispatch plan. A different sales forecast will therefore lead to a different dispatch pattern with different associated costs.

As discussed further in FUEL AND PURCHASED POWER BUDGETS (Chapter VI, Page 155) below, PREPA's fuel and purchased power budgets are direct outputs of the PROMOD run used to inform the rate case filing.[74] As such, even small changes in sales forecasts can have significant influence on PREPA's fuel and Power Purchase and Operating Agreement (PPOA) budgets. When we probed as to why the fuel and purchased power budgets in this rate case were different than those in the recently closed IRP, PREPA responded that the two cases used different sales forecasts. For example, for FY2017 the sales forecast used in the rate case is higher than the IRP by approximately three percent.[75] The purchased power budget in the rate case is higher by almost five percent and the fuel budget is higher by nearly fourteen percent.[76] These deviations indicate the importance of an accurate sales forecast – even small changes in sales can lead to alterations in budgets amounting to tens or even hundreds of millions of dollars.

Peak (MW) and total sales (kWh) forecasts can impact utilities' planning over the short- and long-terms. Peak load forecasts are the key input to determinations of resource adequacy and are an important part of cost allocation (short term) and resource planning (long term). Local or system-wide increases in peak demand can prompt system expansion, including both new generation or new transmission. In jurisdictions with renewable portfolio standards that are tied to sales, including Puerto Rico,[77] sales indicate the amount of renewable energy that must be added to the system to achieve compliance.

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[74] By contrast, PREPA's sales forecast does not appear to impact its generation-related operations and maintenance budget, as discussed in OPERATING EXPENSE BUDGET, Chapter VII (Page 182).

[75] IRP and Business Plan sales forecast: 16,693 GWh total sales in FY2017. Rate case forecast: 17,268 GWh total sales in FY2017. PREPA's Petition for Rate Review, Exhibit 3.02, slide 2. PREPA confirmed that it used the same sales forecast in the IRP and in the Business Plan in its response to CEPR-AH-01-05(a).

[76] Before performance improvement-related savings. IRP fuel ($671,726,000) and purchased power ($662,018,000) costs from Appendix C-10 (P3F1 with updated fuels) of the Updated Fuel IRP. Rate case pre-performance savings fuel ($763,695,078) and purchased power ($692,572,739) costs from Schedule A-6 REV. Author's sum of total fuel and purchased power expenditures in PREPA's response to CEPR-JF-01-22 Attach 02.xlsx (of the Commission's Sixth ROI, August 23, 2016) confirms that performance improvement-related savings were not taken into account in PROMOD, as the values match the pre-savings values in Schedule A-6 REV.

[77] Act 82-2010, § 2.3(b).

With respect to generation and the transmission network we would expect a significant relationship between capital expenditures and sales. The Commission examined the relationship between sales expectations and PREPA's need for additional generation at length in the IRP proceeding. PREPA found that when demand was reduced, it required less replacement generation in the North than previously thought.[78] PREPA has also indicated that some elements of its transmission-related capital spending plan may be avoidable given lower sales or load.

We asked PREPA what capital projects could be avoided if load was reduced in the system. PREPA provided general categories of projects, but not specific dollar values.[79] Associating PREPA's descriptions with projects, we estimate that PREPA could avoid only a very small amount of capital in the planned transmission and distribution system capital spending in FY2017.[80] As we discuss in the capital section, the vast majority of PREPA's capital spending for transmission and distribution (the two impacted categories) in FY2017are rehabilitation and deferred maintenance programs and thus unlikely to be avoidable by load reductions in the near or mid-term.

The importance of PREPA's sales forecast for nearly every element of its budgeting is clear. This demonstrates both the importance of an accurate sales forecast and the difficulty inherent in changing forecasts without sufficient reason. Adjusting PREPA's sales forecast would require PREPA to run new model runs and potentially to re-examine its capital spending plan rather than providing a simple *pro forma* adjustment.

3. State of PREPA's sales, load, and customer base

In this section, we provide a brief description of sales and load on PREPA's system to provide context to the values shown below.

PREPA oversees a system of nearly 1.5 million customers, the majority of which are residential customers (1.3 million).[81] PREPA has just over 120,000 commercial customers, several hundred industrial customers, and approximately 2,000 agricultural customers. Total sales in FY2016 were approximately 17,439 GWh.[82] Commercial customers make up

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[78] Note that these projects are outside of the time horizon considered by this rate case. Updated Fuel IRP, p2-1.

[79] PREPA's responses to CEPR-PC-09-34(c), (e), and (f) of the Commission's Twelfth ROI (5 October, 2016).

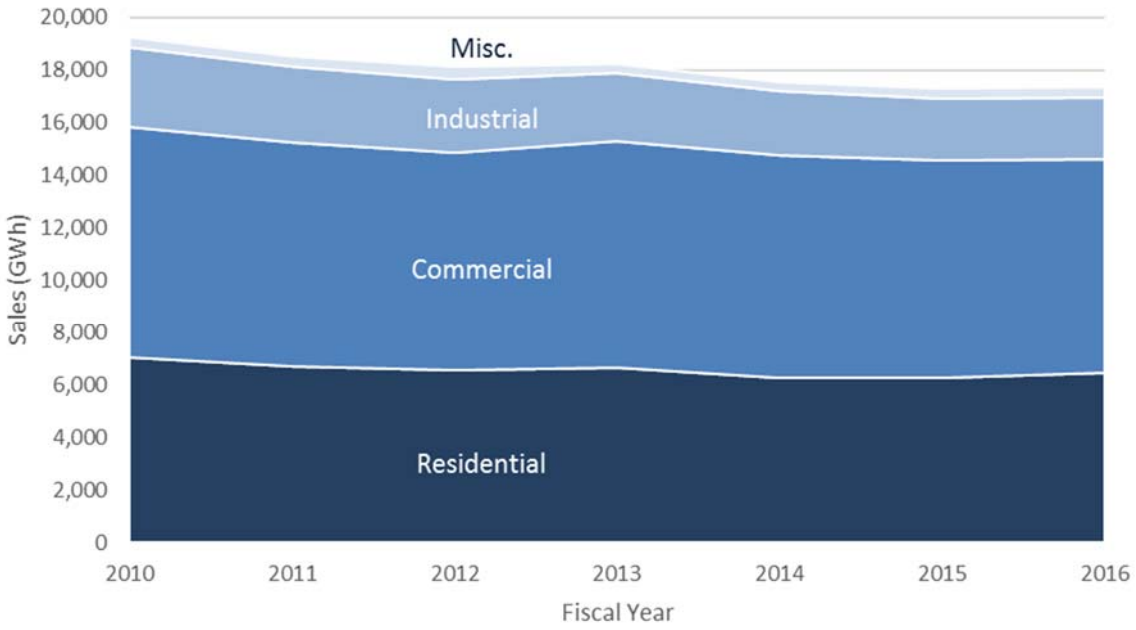
[80] PREPA's Petition for Rate Review, Schedule F-3 REV. Sum of FY2017 values for projects with PlanArea heading "Transmission" or "Distribution."

[81] PREPA's response to CEPR-PC-09-42 of the Commission's Twelfth ROI (October 20, 2016). Refer to CEPR-PC-09-42 Attach 01.xlsx.

[82] PREPA's response to CEPR-AH-06-14 of the Commission's Fourteenth ROI (October 21, 2016). Refer to CEPR-AH-06-14 Attach 01.xlsx.

nearly half of PREPA's sales, at 8,187 GWh in FY2016.[83] Residential customers, at 6,439 GWh, account for slightly more than a third.[84] We show PREPA's sales over time by class in Figure 7[85] below.

Figure 7. PREPA's sales by customer class over time.[86]



PREPA's sales have declined over the past several years, from nearly 20,000 GWh/year in FY2010 to the approximately 17,000 GWh/year mentioned above. Decreases in sales have come nearly evenly from the residential, commercial, and industrial classes.[87] Peak load has also declined by almost 400 MW, from 3,404 MW in FY2010 to 3,030 MW in FY2015.[88] Considering this trend in light of PREPA's financial situation only underscores the importance of sound load forecasts. PREPA must know whether or not its sales will decline further and, if so, by how much. If it forecasts demand that is unrealistically high, PREPA is at risk of overbuilding its system and under-collecting the revenues needed to fund capital projects and day-to-day operations. Meanwhile, if it forecasts demand that is unrealistically

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[83] Author's calculation, based on data provided in CEPR-AH-06-14 Attach 01.xlsx.

[84] *Id.*

[85] In this figure, the "Misc." category includes the sales to public lighting, agriculture, and "Others" as reported by PREPA in CEPR-AH-06-14 Attach 01.xslx.

[86] CEPR-AH-06-14 Attach 01.xslx.

[87] *Id.*

[88] *Id.*

low, PREPA (like all utilities) is at risk of having inadequate resources with which to serve the needs of its customers.

C. PREPA's sales forecast is ill-conceived and ill-supported

1. PREPA did not provide adequate support for its sales forecast

PREPA provided effectively no support for its sales forecast in its initial rate case filing. The forecast is discussed only briefly by the panel of Miranda, Sales, and Sosa:

> The load forecast was updated on April 2016. The revised forecast considered historical data until March 2016 and economic indicators updated in October 2015. It also included an estimate of the cost of kWh considering the securitization cost and the most recently updated fuel price from DOE. This updated forecast was used in the revenue requirement and therefore for this rate case.[89]

PREPA also discussed its forecasting methodology in abbreviated and unclear terms:

> PREPA estimated the energy consumption and generation for the current FY 2015 with extrapolations which consider the monthly behavior of these variables from historical data from FY 1993 through FY December 2014. With the estimates for FY 2015, we used econometric models to forecast the consumption and clients by main class (residential, commercial and industrial) for the next five FY years. The models include the main variables from the Puerto Rico economy, the cost of kWh by customer class and the behavior of the last year consumption for each class. Usually, the energy consumption by kilowatt hour (kWh) as a dependent variable has a correlation with the main variables of the local economy. The variables of Puerto Rico economy are the Gross Domestic Product, the Gross National Product and the Disposable Personal Income.[90]

As discussed below, we conclude that this description is misleading in a number of ways. No further methodological documentation was provided in PREPA's original filing.

In terms of the forecast itself, PREPA's business plan and filed schedules provide only total system sales for FYs 2017 through 2030.[91] Given that Miranda, Sales, and Sosa cite PREPA's

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[89] PREPA's Petition for Rate Review, Exhibit 3, Direct Testimony of Sonia Miranda, Antonio Perez Sales, and Virgilio Sosa, lines 811-815.

[90] PREPA Ex. 3.0, lines 785-795.

[91] PREPA Ex. 3.02, slide 2; Schedule F-1 REV.

econometric models as providing forecasts for "the next five FY years,"[92] the sales forecasts for FYs 2022 through 2030 are entirely unsupported by PREPA. However, while this issue may be of import for planning and other purposes, it has little to no impact on PREPA's planned spending for FY2017, which is the focus of our report.

No further support for the load forecast was provided in PREPA's financial model or other filed workpapers, to our knowledge. PREPA elaborated on its load forecasting methodology and provided incomplete workpapers in response to several ROIs from the Commission, including CEPR-AH-01-05 through -07 and CEPR-AH-06-14, as well as during the October 20 Conference Call.

PREPA's responses to these ROIs were unsatisfactory in several ways. PREPA provided an expanded methodological description in response to CEPR-AH-01-05[93] This document describes PREPA's overall methodology in similar terms to those included in testimony and then presents the "models" used to forecast demand by class. By "model," PREPA refers only to inputs and outputs; no functional form is provided.

For example, PREPA identifies the following as the "model" used to forecast residential demand:

$$LRkWh = \int (LPRM, LDPI, LLAGR)$$

It defines LRkWh as the natural logarithm of residential consumption, LPRM as the natural logarithm of the per-kWh cost of electricity for residential consumers, LDPI as the natural logarithm of disposable personal income at real prices, and LLAGR as the natural logarithm of the previous year's total consumption by the residential class.[94]

This description is exceptionally uninformative, because it provides only inputs without describing an actual functional form or providing coefficients. All that the above equation indicates is that residential consumption is correlated in some way with the price of electricity, disposable income levels, and recent history. The "model" provided by PREPA does not provide the nature of the correlation. We would be equally justified, based only on this poorly defined model, that PREPA believes residential consumption increases as the price of electricity increases, or alternatively concluding that consumption decreases with rising prices. Nor do we have any evidence to evaluate the relative strength of the model inputs on the forecasted result. We have no grounds to conclude whether personal income, electricity costs, or simply the previous year's consumption is the strongest predictor of residential electricity use. Ultimately, we are unable to the reasonableness of PREPA's model

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[92] PREPA Ex. 3.0 at lines 790.

[93] PREPA's response to CEPR-AH-01-05 of the Commission's Fourth ROI (August 9, 2016). Refer to CEPR-AH-01-05_Attach 08.pdf

[94] *Id*., p3.

as PREPA has not, in fact, provided the model itself. The same is true for PREPA's "models" for the commercial and industrial classes.

The remainder of the methodological document is both brief and internally inconsistent. For example, the description repeats the claim that PREPA's econometric models include as inputs "the electricity price by revenue class."[95] However, our examination of the "models" in question indicates that PREPA considers the cost of electricity only in its forecasts of residential[96] and industrial[97] load. Gross domestic product and the previous year's sales for the commercial class are the only inputs used to forecast commercial consumption.[98] PREPA also mentions that it forecasts load for additional customer classes, including public lighting, agriculture, and unspecified "others."[99] The methodology PREPA uses to forecast consumption by these classes is described simply as an "extrapolation method" although the method itself is entirely unexplained (for example, we do not know what data PREPA is using to extrapolate consumption from these classes or what period of time is covered by this data). PREPA also states it assumed estimated consumption by these classes would be constant for the entire forecast period, without justifying this assumption.

PREPA also provided workpapers[100] "related to the calculations performed for this sales forecast."[101] We find these workpapers illuminate some aspects of PREPA's methodology but ultimately raise even more questions and concerns regarding PREPA forecasting methodology. The workpapers reveal that PREPA does not appear to know what models represent its system well. Instead of using a single econometric regression model with a fixed set of inputs for each rate class, we observe that PREPA tries multiple different regressions and then chooses on a forecast-by-forecast basis. Indeed, PREPA attempted five different regressions to model industrial consumption,[102] ten different regressions to model commercial consumption,[103] and no fewer than *nineteen* different regressions to model

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[95] *Id*., p1.

[96] *Id*., p3.

[97] *Id*., p4.

[98] *Id*., p4.

[99] *Id*., p5.

[100] Refer to CEPR-AH-01-05_Attach 10.xlsx through …_Attach 14.xlsx.

[101] CEPR-AH-01-05(d). We note that providing "related" workpapers is not fully responsive to the request, which asked for "functional copies of *any* workpapers" used in the calculation, as well as the source of all assumptions. PREPA failed to provide justification or sources for any of the values that it assumed and hardcoded into its workpapers.

[102] CEPR-AH-01-05_Attach 11.xlsx; "IAU" tab.

[103] CEPR-AH-01-05_Attach 10.xlsx; "IAU" tab.

consumption from the residential class.[104] Confusingly, some of the regressions appear to use the same model or use different models but produce identical results.[105] We have no explanation for this aberrance.

This observation is echoed by an otherwise-cryptic statement in PREPA's methodological documentation for the forecast created for the IRP: "Some extrapolation methods were used to determine the generation and consumption by service class for the fiscal year 2015. We selected the extrapolation that best fitted to the fiscal year behavior of the generation."[106] PREPA's methodology is, to our knowledge, unique. We know of no other utility that attempts this form of "guess and check" load forecasting as opposed to relying on a single, well-vetted model for each applicable cohort of consumers.[107] There are three main problems with this strategy, as enumerated below.

First, the actual inputs and models used to prepare forecasts among which PREPA chose are unclear. PREPA did not provide a glossary of the terms used in workpapers, leaving us with very little ability to audit the basic theoretical grounding of the models themselves. Moreover, the terms used in the workpapers do not correspond to the terms used in the methodological documentation. For example, PREPA's methodological document describes residential load as being a function of "PRM," "DPI," and "LAGR."[108] The indicated model in PREPA's workpapers, however, is a function of "PRES," "YPD," and "LAGRKWH."[109] We conclude from context that "LAGR" is equivalent to "LAGRKWH," "DPI" is equivalent to "YPD," and "PRM" is equivalent to "PRES." Several other variable names appear in PREPA's workpapers, and we are unable to deduce what PREPA means for these names to represent.

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[104] CEPR-AH-01-05_Attach 12.xlsx; "IAU" tab.

[105] For example, only ten of the nineteen regressions presented for the residential class are unique (forecasts 1 through 8, forecasts 19, and two of the three forecasts that are labeled "model 14" in the IAU tab of CEPR-AH-01-05_Attach 12.xlsx; the remainders are duplicates of models 5 or 6). Forecasts 7 and 8 of the ten commercial forecasts provided in CEPR-AH-01-05_Attach 10.xlsx are duplicates of forecasts 3 and 4. All of the industrial class forecasts provided in CEPR-AH-01-05_Attach 11.xlsx are unique.

[106] CEPR-AH-01-05_Attach 01.pdf, p2.

[107] *See*, for example, the methodological descriptions pertaining to load forecasting in the planning documents of the Independent System Operator – New England (https://www.iso-ne.com/static-assets/documents/2016/06/forecast_model_structures_2016.pdf), Pacific Gas and Electric (Section 4.1 of the 2016 IRP, available online at https://www.portlandgeneral.com/-/media/public/our-company/energy-strategy/documents/2016-irp.pdf?la=en), and PacifiCorp (Appendix A of the 2015 IRP, available online at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2015IRP/PacifiCorp_2015IRP-Vol1-3_AllBooks_Redacted.pdf).

[108] CEPR-AH-01-05_Attach 08.pdf, p3.

[109] CEPR-AH-01-05_Attach 12.xlsx, highlighted forecast in "IAU" tab.

Second, PREPA's strategy indicates that it, in reality, has very little sense of what factors impact its customers' consumption patterns. A very wide range of models used by PREPA to forecast residential demand are summarized in Table 1.[110] This table tells us that PREPA considered at least eighteen different models using various combinations of five different variables (three of which, we believe, are the inputs identified in the methodological documentation for the residential forecast). PREPA does not provide evidence that any one of these models is actually accurate, or reliable.

Table 1. Variables included in PREPA's candidate regression models for forecasting of residential sales.[111]

	Variables Considered*				
Model	**PRES**	**YPD**	**PBI**	**LAGRKWH**	**CRES**
1	ln(PRES)	ln(YPD)		ln(LAGRKWH)	
2	PRES	YPD		LAGRKWH	
3	ln(PRES)		ln(PBI)	ln(LAGRKWH)	
4	PRES		PBI		
5		ln(YPD)			
6		YPD			
7			ln(PBI)		
8			PBI		
9		YPD		LAGRKWH	
10		ln(YPD)		ln(LAGRKWH)	
11			PBI	LAGRKWH	
12			ln(PBI)	ln(LAGRKWH)	
13	PRES	YPD			
14**	ln(PRES)	ln(YPD)			
14**	ln(PRES)		ln(PBI)	ln(LAGRKWH)	ln(CRES)
15	PRES		PBI		
16	ln(PRES)		ln(PBI)		
19	PRES		PBI		ln(CRES)

*Author's inferences suggest these variable names have the following meanings: "PRES" = cost of electricity per kWh for residential customers; "YPD" = disposable personal income; "PBI" = GDP; "LAGRKWH" = previous years' residential consumption. We are not aware of the meaning of the variable "CRES."

**Two separate models, and three forecasts, are all labeled as "model 14"

PREPA does not appear to know with certainty whether or not residential consumption is correlated with electricity prices, or with previous years' consumption, or with any of the other variables considered. PREPA does not know whether it can predict consumption with only one variable, or whether four different inputs are required. PREPA does not know whether consumption varies exponentially or linearly with any of the considered variables. Instead, PREPA tries all of these possibilities, and then chooses one—without, it seems, developing any conceptual framework for the factors that impact load in Puerto Rico.

[110] Models included in this table are based on both linear and exponential regressions; exponential regressions predict the natural logarithm of consumption using the natural logarithm, denoted by ln(), of input variables.

[111] CEPR-AH-01-05_Attach 12.xlsx

Finally, and most concerningly, the way in which PREPA actually selected a model to represent future consumption for each class is in fact entirely opaque. PREPA's statement quoted above implies to us that it chose the model for which FY 2016 results were numerically closest to actual FY 2016 consumption. However, if this is what PREPA intended, it is not what PREPA actually did. For the residential class, there are five models that predicted a value for FY 2016 consumption that is closer to actual FY 2016 consumption than the value predicted by PREPA's chosen model.[112] For the industrial class, one model provides a closer prediction for FY 2016 than the model chosen by PREPA.[113] For the commercial class, five out of ten models yield a more accurate value for FY 2016 than the model chosen by PREPA.[114]

For each model, PREPA also provided an "R squared" value. The R squared of a model normally expresses the model's "goodness of fit," or how close the modeled values are to the actual data input into the model. A higher R squared generally indicates a better fit, with an R squared of 1 indicating a perfect overlap between real and modeled data. Identifying the model with the highest R squared value would be one conventional way to select a regression model. However, the models that PREPA chose to rely on in constructing its forecasts do not always have the highest R squared values of all models considered by PREPA.[115] Ultimately, we are unable to recreate PREPA's logic for selecting one forecast over another and have no grounds to conclude that such selections were not simply arbitrary.

We conclude that PREPA's support for its load forecasts is severely lacking, including the methodological description, theoretical underpinnings, and provision of source data and assumptions pertaining to its forecasts. We recommend that the Commission require significantly improved documentation in future proceedings.

2. PREPA's forecasting is, in general, not predictive

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[112] CEPR-AH-01-05_Attach 12.xlsx; author's comparison of values for FY2016 in columns labeled "Real" and "Estimado según modelo." PREPA chose Model 1, which over-predicted FY2016 consumption by 193 GWh. Models 7 and 8, both of the two provided iterations of model 14, and model 19 all yielded more accurate predictions of FY2016 consumption than model 1; model 19 predicted FY2016 consumption to within 48 GWh of the actual value.

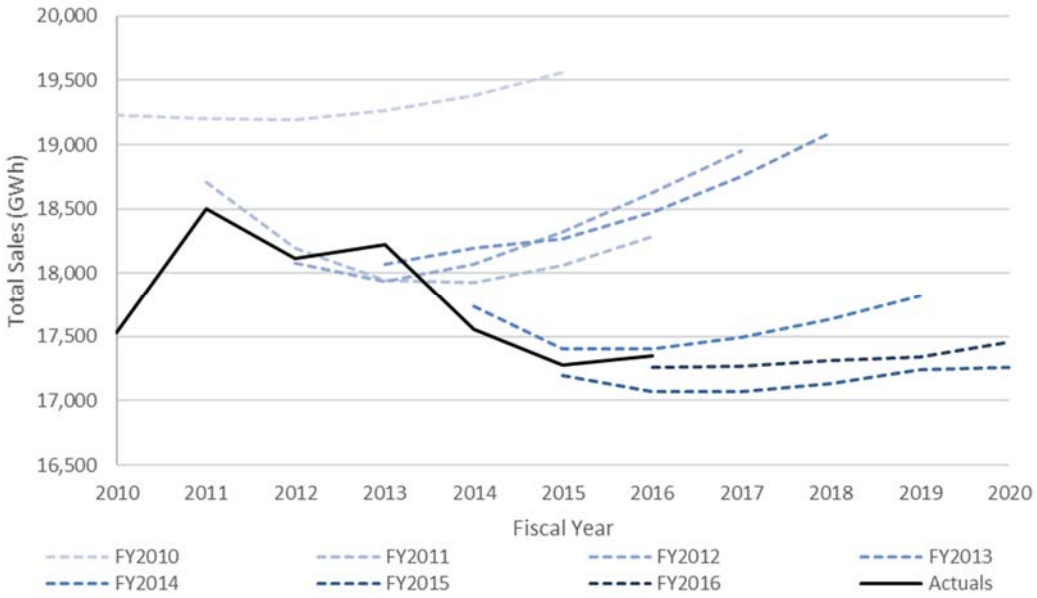
[113] CEPR-AH-01-05_Attach 11.xlsx; author's comparison of values for FY2016 in columns labeled "Real" and "Estimado según modelo." PREPA chose Model 1, which over-predicted FY2016 consumption by 45 GWh. Model 2 under-predicted FY2016 consumption by approximately 4 GWh.

[114] CEPR-AH-01-05_Attach 10.xlsx; author's comparison of values for FY2016 in columns labeled "Real" and "Estimado según modelo." PREPA chose Model 9, which over-predicted FY2016 consumption by 162 GWh. Models 1, 2, 3, 7, and 10 yielded more accurate predictions of FY2016 consumption than model 9; model 3 over-predicted FY2016 consumption by approximately 19 GWh.

[115] For example, the R squared value of residential model 7 is 0.989 as compared to 0.985 for model 1 (the model selected by PREPA).

The multitude of poorly-documented forecasts presented by PREPA is even more concerning when considering that, in general, PREPA has failed to accurately forecast its sales over the long term. PREPA's sales forecasts have consistently been aggressive compared to its actual sales,[116] as shown in the figure below. However, we do note that PREPA appears to have moderated its expectations in recent years. PREPA's vintage FY2010 sales forecast was notably aggressive compared to actual sales.[117] In the period FY2011-FY2013, PREPA forecasted that the decline of its sales would slow, and then reverse itself, leading to net growth in sales by the present day.[118] Instead, PREPA's sales cratered from FY2013 to FY2015.[119] PREPA's more-recent forecasts have reflected this trend, reflecting more modest expectations. Both the FY2015- and FY2016-vintage forecasts are essentially flat over the next several years.[120] However, as discussed below, we have some concerns as to the accuracy of even this relatively conservative prospect.

Figure 8. PREPA's actual total system sales for FYs 2010 through 2016 and contemporaneous forecasts of total sales.[121]



[116] CEPR-AH-06-14 Attach 01.xlsx

[117] *Id.*

[118] *Id.*

[119] *Id.*

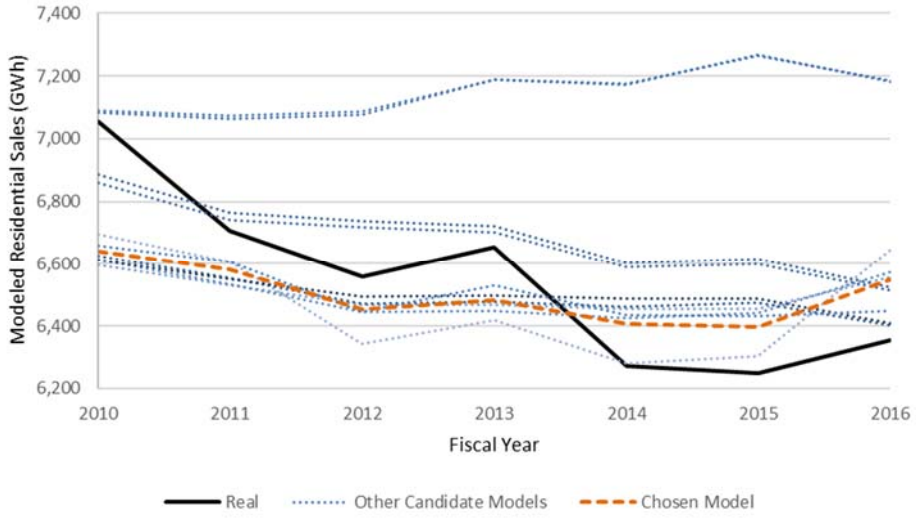
[120] *Id.*

[121] *Id.*

In terms of the by-class models considered for forecast used in this rate case, we again observe that none of the forecasts do a good job of predicting PREPA's actual sales. PREPA appears to have modeled FYs 2010 through 2016 with each of the regression models it considered, allowing us to easily compare the model outputs to the actual sales values from those years.[122] For brevity, we will not discuss the details of the forecasts for each class at length. We find that, in general, none of the forecasts match actual values consistently over multiple years. For each class, the forecasts tend to either under-predict or over-predict actual values, and uniformly fail to capture important features (such as the increase in commercial sales from FY2012 to FY2013).[123]

The following figures[124] show real values as compared to the outputs of PREPA's various models.

Figure 9. PREPA's actual and modeled residential sales for FYs 2010 through 2016.[125]



[122] CEPR-AH-01-05_Attach 10.xlsx (commercial sales forecasts), CEPR-AH-01-05_Attach 11.xlsx (industrial sales forecasts), and CEPR-AH-01-05_Attach 12.xlsx (residential sales forecasts).

[123] CEPR-AH-01-05_Attach 10.xlsx.

[124] Black solid lines denote actual sales; orange dashed lines identify the unadjusted results of the regression model chosen by PREPA to forecast sales of the class in question; and blue dotted lines show the results of the other candidate regression models considered by PREPA. Actual values were normalized to actual FY2010 sales.

[125] CEPR-AH-01-05_Attach 12.xlsx

Figure 10. PREPA's actual and modeled commercial sales for FYs 2010 through 2016.[126]

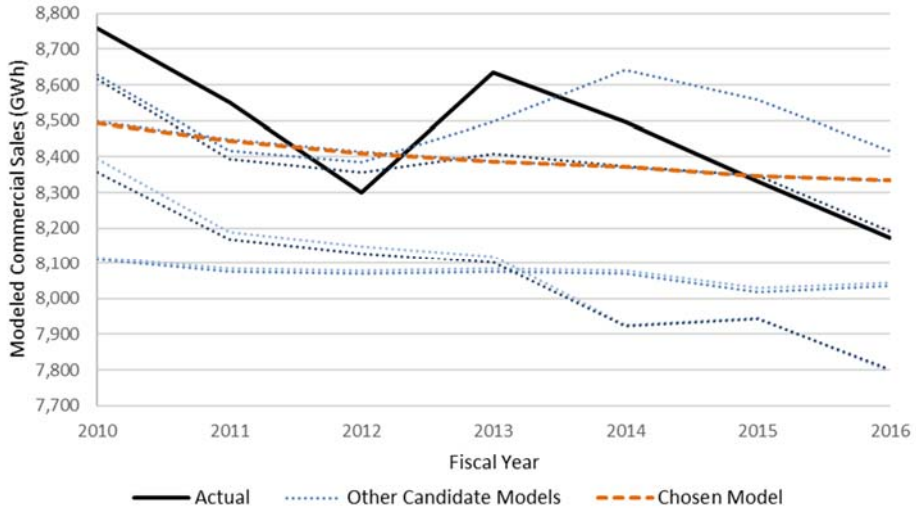
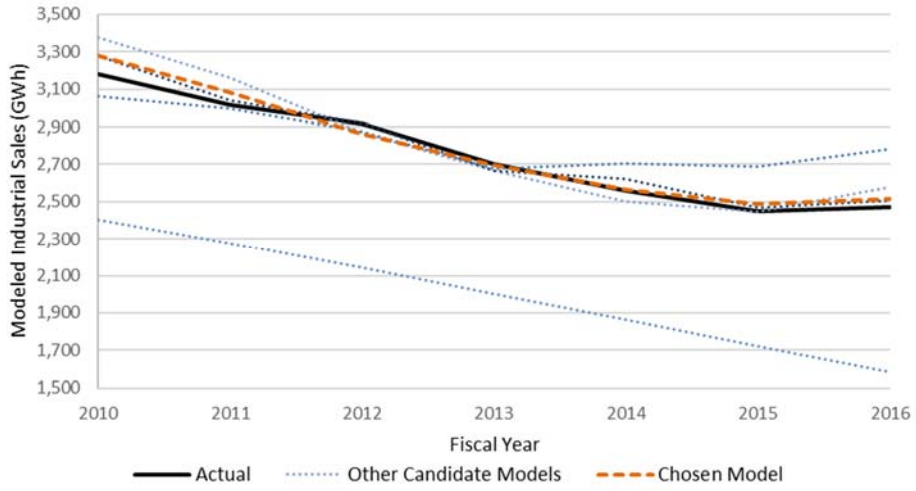


Figure 11. PREPA's actual and modeled industrial sales for FYs 2010 through 2016.[127]

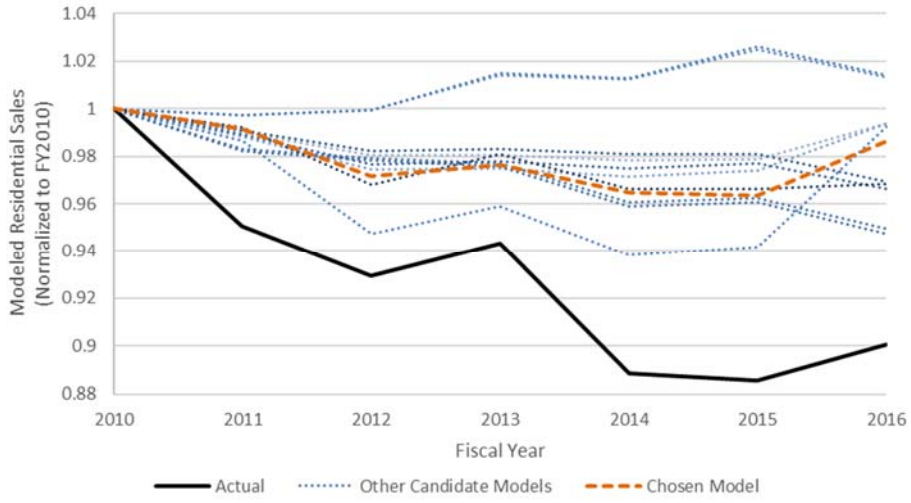


[126] CEPR-AH-01-05_Attach 10.xslx.

[127] CEPR-AH-01-05_Attach 11.xslx.

We observe easily that PREPA's models do the best job of capturing industrial load.[128] Commercial load is often underpredicted while residential load is often overpredicted. However, for both of these classes, there is significant variation in the relationship between the real and modeled data: some forecasts are entirely above the real data, some are entirely below, and some modeled data is above real values in some years and below in others. We observe significant uncertainty in these results. In both the commercial and residential forecasts, none of the models fully capture notable features in the actual data. The inaccuracy of the forecast models can be seen more starkly in the following set of figures,[129] which normalizes all forecasts and actual data to their respective (real or modeled) values for FY2010. This normalization allows us to observe whether or not PREPA's models capture the *pattern* of changing sales, even if they would require adjustment upwards or downwards to better match actual values.

Figure 12. PREPA's normalized actual and modeled residential sales for FYs 2010 through 2016.[130]



[128] With the exception of a single model that consistently under-predicts industrial load by approximately 800 GWh.

[129] As above, black solid lines denote actual sales; orange dashed lines identify the unadjusted results of the regression model chosen by PREPA to forecast sales of the class in question; and blue dotted lines show the results of the other candidate regression models considered by PREPA. Actual values were normalized to actual FY2010 sales. Modeled values were normalized to modeled FY2010 sales as predicted by each regression model.

[130] Author's calculation, based on values provided in CEPR-AH-01-05_Attach 12.xslx.

Figure 13. PREPA's normalized actual and modeled commercial sales for FYs 2010 through 2016.[131]

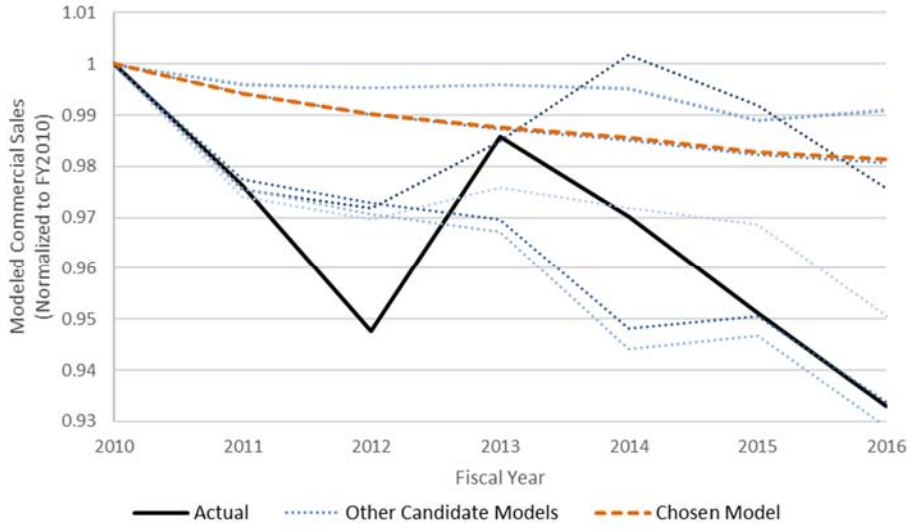
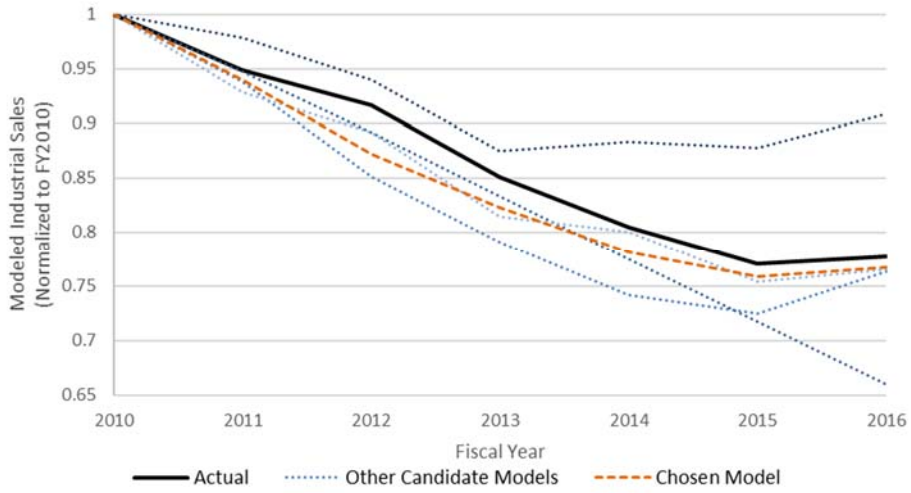


Figure 14. PREPA's normalized actual and modeled industrial sales for FYs 2010 through 2016.[132]



As above, the models capture changes in industrial load acceptably well but do not accurately predict commercial load. The residential results are particularly stark: not a single forecast came close to capturing the actual extent of the decline in residential load between FYs 2010

[131] Author's calculation, based on values provided in CEPR-AH-01-05_Attach 10.xslx.

[132] Author's calculation, based on values provided in CEPR-AH-01-05_Attach 11.xslx.

and 2016. We conclude from these figures that not only do PREPA's models do a poor job of recreating actual historical data, they also fail to accurately represent the magnitude (and sometimes the direction) of year-to-year changes in sales.

This observation raises the question of how PREPA actually arrives at a sales forecast, given that all of its various modeled forecasts return results that deviate significantly from actual historical values. From examination of PREPA's workpapers, we observe that it follows this unusual procedure: first, PREPA uses a given model to forecast sales within a given class for several historical years and five future years. Second, PREPA calculates the year-to-year growth rate implied by that forecast. Finally, PREPA applies that growth rate to actual historical data, regardless of any deviations between the modeled and real historical values. The following table summarizes this technique.

Table 2. Historic actual and modeled residential sales and growth rates thereof.

FY	Historical Data* (GWh)	Actual Annual Growth Rate**	Model Outputs† (GWh)	Modeled Growth Rate**	Modeled Growth Rate applied to Historical Data† (GWh)	Percentage Difference between Modeled and Real Data**
2010	7,057		6,639			-5.91%
2011	6,707	-4.95%	6,582	-0.86%		-1.86%
2012	6,560	-2.20%	6,452	-1.99%		-1.64%
2013	6,656	1.46%	6,482	0.47%		-2.60%
2014	6,271	-5.78%	6,407	-1.17%		2.17%
2015	6,250	-0.34%	6,396	-0.16%		2.35%
2016	6,355	1.68%	6,548	2.37%		3.04%
2017			6,583	0.54%	6,389	
2018			6,626	0.65%	6,430	
2019			6,632	0.09%	6,436	
2020			6,681	0.74%	6,484	

*CEPR-AH-01-05_Attach 12.xlsx, tab "IAU", column "Real."
**Author's calculation.
†CEPR-AH-01-05_Attach 12.xlsx, tab "IAU", column "Estimado según modelo" for model 1.

This methodology is not sound. While it is not unusual for utilities to adjust load forecasts to match actual data from the recent past, PREPA's method cannot be considered a normalization or benchmarking. Rather, PREPA effectively considers the derivative of sales over time to be the actual output of its forecast models. As the above figures demonstrate, the year-to-year growth rates of the modeled data are not any more reliable than the modeled data itself. When the modeled data itself is inaccurate, it cannot supply accurate growth rates. Simply porting over these growth rates to real data has no theoretical basis or defense. PREPA also appears to use elements of this technique in its preparation of a peak load forecast.[133] We recommend that the Commission require PREPA to cease using this

[133] CEPR-AH-01-05_Attach 14.xlsx. Rather than forecasting peak load directly, PREPA calculates expected non-coincident peak load by customer class based on its by-class sales forecasts and a customer class-specific load factor value. Then, PREPA sums all non-coincident peak loads, finds the year-to-year growth rate, and applies that growth rate to the most recent year's peak load data. This

unsupportable methodology, in favor of developing models that have real predictive value as applied to PREPA's system.

3. PREPA's consideration of energy efficiency is inappropriate

The Commission has been clear in its desire that PREPA begin to explicitly consider and pursue cost-effective energy efficiency. In its December 8th Order on IRP Compliance and Intervenors' Comments, the Commission ordered PREPA to explicitly model a trajectory for energy efficiency savings.[134] In the IRP Final Order, the Commission ordered PREPA to pursue or cooperate with a third-party administrator in the pursuit of energy efficiency.[135] Despite this, PREPA appears to have not considered energy efficiency in its sales forecast in any explicit manner. The Consulting Engineer's Annual Report, provided as Schedule I-1, discusses a range of energy efficiency and demand-side management programs administered by various government agencies on the Island.[136] We could find no evidence that these programs were either active or considered to be active by PREPA. The sole exception is the Government Energy Efficiency (EE) program created by Act 57.[137]

In its direct testimony, PREPA claimed that it considers the Government EE program explicitly:

> In the load forecast of the base IRP,[138] Government Energy Efficiency (EE) as mandated by Act 57-2014, to reduce the consumption at government institutions with respect of a benchmark, was forecasted to achieve 80 percent of the mandate.[139]

In describing the sales forecast used for the rate case, PREPA asserted that the Government EE program has not met its targets:

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method is equally invalid. Moreover, the sum of non-coincident peak values is not necessarily predictive of PREPA's coincident peak as these by-class peaks, by definition, do not all occur at the same time.

[134] *Order on IRP Compliance and Intervenors' Comments*, CEPR-AP-2015-0002 (December 8, 2016). Section I.1.b.

[135] IRP Final Order, Section VII.B.1.k.

[136] PREPA's Petition for Rate Review, Schedule I-1, p56.

[137] Act 57-2014, § IV.

[138] The Commission referred to this document as the "Revised IRP" in the Final Order on the IRP. We refer to it here as the "Base IRP" to avoid confusion arising from PREPA's various references to the same.

[139] PREPA Ex. 3.0, lines 798-800.

> …the Government EE, even after Act 57 being in force for a full year, has not achieved the required reduction in consumption. Generally speaking, there was little incentive for government agencies to manage and control their energy consumption, in particular those belonging to the municipalities…The 80 percent estimate for compliance is an extremely optimistic view on government compliance.[140]

PREPA's claim that the Government EE program has not achieved the required reduction in consumption is false. While we were not provided action plans of any individual government entities, the statutory goal of the Government EE program is to achieve a forty percent drop in consumption from 2013 levels by 2022 across all government offices.[141] This target is commensurate with the ten-percent-by-2016 goal suggested in PREPA's response to CEPR-AH-01-07.[142] Efficiency savings data provided by PREPA demonstrates that the government as a whole has more than achieved the interim 2016 target.[143] While the interim goal was to save 226 GWh across the entire government, actual savings have been approximately 327 GWh[144] (or nearly fifteen percent of 2013 consumption).

On a technical clarification call, PREPA clarified that while the actual savings goal has been achieved, fewer than half of the individual government offices and entities have achieved their individual goals.[145] In our estimation, this is irrelevant to the question of whether or not PREPA should consider the Government EE program in its forecasts going forwards. There is no particular reason to assume that all government offices will achieve the statutory requirement at the same rate. Therefore, we find that PREPA has inappropriately disregarded this program. Considering that the total savings associated with the program to date represent approximately two percent of PREPA's FY2017 sales forecast,[146] this failure may have had a significant impact on the load forecast used in the rate case.

PREPA argued, on the same call, that the savings from the program *were* in fact taken into account because historical consumption is used in the forecasting of future sales.[147] As discussed above, PREPA's method of taking historical consumption into account – applying

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[140] PREPA Ex. 3.0, lines 802-805, 807-808.

[141] Act 57-2014 § IV.4.1(b).

[142] PREPA's response to CEPR-AH-01-07(b) of the Commission's Fourth ROI (August 1, 2016). Refer to CEPR-AH-01-07_Attach 02.xlsx.

[143] *Id.*

[144] *Id.*

[145] October 20 Conference Call.

[146] Author's calculation: quotient of total achieved savings from PREPA's response to CEPR-AH-01-07_Attach 02.xlsx (327 GWh) and FY2017 expected total sales from Ex. 3.02 (17,268 GWh).

[147] October 20 Conference Call.

the growth rates of inaccurate model outputs to real data – is not rigorous or defensible. Moreover, at best this allows PREPA to take into account savings *achieved to date*. PREPA's methodology demonstrates no means to modify a sales forecast based on expectations of *future* savings. We are puzzled by this omission as PREPA's peak load forecast contains an explicit assumption of one incremental megawatt of savings due to demand-side management every year.[148] PREPA's assumption of DSM savings on peak load (but not on total sales) dates from at least 2013, as it is described in the Consulting Engineer's Annual Report.[149] Despite this, we have seen no evidence that PREPA or other authorities on the Island are administering, or that PREPA is considering savings due to, active DSM or EE programs apart from the Government EE program. No such programs were described in this rate case or in the IRP proceeding.[150]

In sum, we find PREPA's consideration of energy efficiency in its sales forecast to be inconsistent with its own claims, inconsistent with the facts, and methodologically unsound. Considering the Commission's strong emphasis on energy efficiency as an important part of PREPA's future, we recommend that the Commission require PREPA to improve the manner in which it considers EE in future sales forecasts. The Commission should require PREPA to explicitly note past EE savings by class, to forecast future EE and DSM savings by class (with appropriate documentation and support), and to explicitly demonstrate the impact of future EE savings on sales forecasts by class and on a total-system basis.

4. The elasticity of demand in PREPA's system is unclear

PREPA describes sales in its system as having a significant level of price elasticity; that is, PREPA asserts that demand decreases noticeably when electricity prices increase. As stated by PREPA:

> Before 2006, electricity prices do not shows (*sic*) any effect in the energy consumption patterns, elasticity price. But after that, the constant increases starts (*sic*) affect the energy demand. The PREPA annual energy demand show (*sic*) a price-elasticity correlated to the fuel costs that defines the energy spending patterns of our customers.[151]

There is a key issue raised by this assertion: PREPA is, in this proceeding, applying for a significant increase in rates. According to PREPA's own statement, PREPA and the Commission should expect such an increase in rates to result in a decline in sales. This

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[148] *See*, for example, the columns "Demanda Max.," "DSM," and "Demanda Max. Adjusta" in PREPA's response to CEPR-AH-06-14(a), found in CEPR-AH-06-14 Attach 01.xlsx.

[149] Schedule I-1, p56.

[150] *See* Volume III of the Base IRP; § IV(D) of the IRP Final Order; and Attachment I of PREPA's Motion for Reconsideration on the IRP Order.

[151] CEPR-AH-01-05 Attach 08.pdf, p1.

concern is echoed by several of the intervenors.[152] However, apart from adding in the recently-approved transition charge,[153] PREPA does not appear to have considered increased rates in its load forecasting. Indeed, PREPA's rate case financial model[154] provides for such functionality, but the parameters describing elasticity are set to zero.[155]

If PREPA believes that its customers are particularly price-sensitive, it could have conducted an iterative calculation. For example, PREPA could have forecasted consumption assuming present-day rates, and then recalculated its proposed rates such that those rates would yield sufficient revenue given the assumed level of consumption, and then recalculated consumption again. If such an iterative process were to converge on a stable value for consumption and rates, PREPA could be confident that it would not under-collect due to insufficient sales. PREPA did not do so; indeed, it did not adjust its forecasts whatsoever based on the amount of the rate increase for which it actually applied.

We are therefore left with the concern that PREPA will under-collect due to insufficient sales at its increased rates. We believe that the impact of this effect on FY2017 will be small, as the fiscal year is already well underway and no new rates (apart from the transition charge) have taken effect. However, we consider the question of elasticity to be another important reason that the Commission should disregard PREPA's current sales forecast in any consideration of rates for FYs 2018 and 2019.

5. Use of the sales forecast in the rate case filing is inconsistent

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[152] CEPR-AP-2015-0001, testimony of Ramón Cao Garcia on behalf of ICSE-PR, lines 201-203; testimony of Enrique Alberto Garcia Morelos and Reinaldo Valente Manuel Aguero on behalf of CEMEX, lines 225-227.

[153] CEPR-AH-01-05 Attach 08.pdf, p1.

[154] The financial model is workbook containing many of PREPA's baseline assumptions of spending and revenue for FYs 2017 through 2035 under both restructuring and non-restructuring scenarios. The costs examined in our report do not vary significantly based on PREPA's assumptions regarding restructuring. Many different version of PREPA's financial model have been submitted to the Commission by PREPA throughout the course of this proceeding. For the purposes of our analyses in this report, we relied on the version presented as Exhibit 14.02 of PREPA's Petition for Rate Review (PREPA Ex. 14.02.xslm), the version of the financial model with a restructuring rate change that PREPA submitted as part of its supplemental testimony in compliance with the Commission's Order Requiring Revised Testimony (September 27, 2016) after the issuance of IRP Final Order. We chose to rely on this version of the financial model as it was the most up-to-date model available for the bulk of the time in which we were calculating adjustments. We do not believe that further updates to the financial model substantially impact our analysis or discussion in this report.

[155] PREPA Ex. 14.02.xslm, tab "Scenario," lines 56-65.

Finally, we are mystified to observe that, although PREPA prepared its sales forecast on a by-class basis,[156] the by-class sales values presented in the rate case financial model and the billing determinants workpaper (which informs the embedded cost of service study) are not consistent with these forecasts. The by-class values in these workbooks appear to have been calculated on an *ad hoc* basis. In the rate case financial model, by-class values for FYs 2017 and thereafter are calculated based on the percentage of FY2015 sales represented by each customer class.[157] In the billing determinants worksheet, by-class sales for FY2017 are calculated based on a by-class inflator from FY2014 values.[158] The table below summarizes these disparate values.

Table 3. PREPA's sales forecasts by class, and representations thereof in the financial model and billing determinants workpaper.

Class	Forecasts by Class* (GWh)	Billing Determinants Workpaper** (GWh)	Financial Model† (GWh)
Residential	6,388.82	6,177.45	6,242.81
Commercial	8,169.85	8,347.80	8,322.16
Industrial	2,330.78	2,399.15	2,333.12
Other Public Authorities	-	33.66	-
Agriculture	26.11	26.43	26.14
Public Lighting	316.06	283.83	308.70
PREPA Use	-	-	-
Others	36.71	-	35.39
Total	17,268.33	17,268.33	17,268.33

*CEPR-AH-01-06_Attach 05.xslx
**WP 1 (Billing Determinants) REV 2016-10-11.xlsx, "I-3" tab, line 59.
†PREPA Ex. 14.02.xslm, "Inputs" tab, lines 4-10.

We see no justification for these workpapers to contain inaccurate by-class breakdowns of a forecast that PREPA originally calculated as a sum of by-class values. We recommend that the Commission require PREPA to revise these workpapers to rely on actual by-class forecasts rather than improvised estimations thereof.

D. Recommendation

1. PREPA's FY 2017 sales forecast should stand without adjustments

We recommend that the Commission accept PREPA's sales forecast without modification for FY 2017 only. Our recommendation is based on three observations:

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[156] PREPA's response to CEPR-AH-01-06 of the Commission's Fourth ROI (August 1, 2016). Refer to CEPR-AH-01-06_Attach 05.xslx.

[157] PREPA Ex. 14.02.xslm, "Inputs" tab, lines 4-10.

[158] PREPA's Petition for Rate Review, WP 1 (Billing Determinants) REV 2016-10-11.xlsx (originally provided as Exhibit 4.0), "I-3" tab, line 59.

First, PREPA's forecasts are generally reliable for the first forecasted year considered, albeit they are uniformly overstated for more-distant future years. As summarized in Table 4, PREPA's last six forecasts have been, on average, two percent off from actual values of the first future year.[159] For example, the FY2011-vintage forecast predicted FY2012 sales to within four-tenths of a percent. When considering only one year in the future, PREPA's forecasts are under-stated nearly as often as they are over-stated. By contrast, PREPA's forecasts are on average five percent too high when considering the third year of the forecasted values. This observation suggests that the Commission can safely rely on PREPA's forecasted values for FY2017 but should not do so for FYs 2018 and 2019.

Second, recent monthly actuals also suggest that PREPA's FY2017 forecast has been generally within three percent of real monthly sales.[160]

Third, variation in the single-digit percentages from forecast to forecast is not unusual for electric utilities.[161]

Forth, and in light of the above, there is essentially no benefit that can be gained by adjusting the load forecast. As described above, PREPA's load forecast impacts both its calculation of rates and its formation of fuel and PPOA budgets. The impact of a small change in forecasted sales is therefore not easy to predict. As PREPA will likely have a budget reconciliation process of some form, we conclude that the amount by which PREPA would over- or under-collect due to any inaccuracy in its sales forecast is likely to be small enough that it can be reconciled through such a process.

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[159] Author's calculation, based on source data from CEPR-AH-06-14 Attach 01.xlsx.

[160] Author's calculation, based on values from CEPR-AH-01-06_Attach 01.xlsx, CEPR-AH-01-06_Attach 05.xlsx, and PREPA's July 2016 and August 2016 monthly reports. Relevant pages attached as Fisher and Horowitz Exhibit 04. PREPA's rate case forecast was 2.2% below July's actual monthly sales (1549 GWh forecasted versus 1584 GWh actual) and 2.6% above August's actual monthly sales (1536 GWh forecasted versus 1496 GWh actual).

[161] *See*, for example, the variation in sales forecasts between PacifiCorp's 2015 IRP and IRP Update as seen in Figure 3.1 of the 2015 IRP Update (available online at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2015%20IRP%20Update/2015%20IRP%20Update_20160426.pdf). See also variation between the Independent System Operator – New England's 2014 and 2015 Capacity, Energy, Load, and Transmission forecasts of total system sales (available online at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/?).

Table 4. Deviations of PREPA's sales forecasts from actual values after one and three years.[162]

Forecast Vintage	% Deviation from Actual Sales in First Future Year	% Deviation from Actual Sales in Third Future Year
FY2010	3.8%	5.7%
FY2011	0.4%	2.1%
FY2012	-1.6%	6.0%
FY2013	3.6%	6.5%
FY2014	0.7%	
FY2015	-1.6%	
Average (Absolute Value)	**2.0%**	**5.1%**

2. PREPA must improve its forecasting methodology and documentation

Even though we recommend no change to PREPA's FY 2017 sales forecast, we recommend that the Commission require significant adjustments to PREPA's forecasting methodology and documentation, and that the Commission require certain corrections to the use of the sales forecast in the rate case. These recommendations are summarized as follows:

a. PREPA must develop a single, reliable, theoretically-sound forecasting model for each rate class. These models should be able to adequately predict historical sales given historical values of the relevant parameters.
b. PREPA must develop a new sales forecast based on these models prior to filing another planning or rate case with the Commission.
c. Any changes to PREPA's forecasting models in the future must be clearly documented and supported by evidence that the prior model did not sufficiently account for relevant circumstances or data.
d. PREPA must adequately document its load forecasts, including through the provision of clear, comprehensive, and accurate methodological documentation. PREPA must provide workpapers showing all relevant inputs and calculations, and it must clearly note sources for all assumptions and hardcoded values.
e. PREPA must correct its financial model, cost of service studies, and all other relevant workbooks to use actual by-class forecasts instead of *ad hoc* breakdowns.

[162] Author's calculation, based on source data from CEPR-AH-06-14 Attach 01.xlsx. Percent deviations are based on actual values one and three years after the forecast was prepared. For example, the deviations shown for the vintage FY2010 forecast are calculated based on the difference between modeled and real sales in FY2011 and FY2013.

V. CAPITAL BUDGET

A. Summary of issue and findings

In this chapter, we address PREPA's budget for spending on capital expenses. PREPA's capital budget includes the its planned spending major improvements and expansions of its transmission, distribution, and generation infrastructure—as well as its planned spending on the Aguirre Offshore Gasport (AOGP).

The Commission must decide if the PREPA's capital budget, both overall and for specific projects when possible, is reasonable. In particular, the Commission must ascertain whether PREPA's capital budget is sufficient but not excessive to allow PREPA to operate a safe and reliable electric system. If the Commission decides that PREPA's capital budget and the individual projects therein are reasonable, no changes will be required. If the Commission decides that PREPA's capital budget or aspects thereof are not reasonable, it must then decide whether or not to make adjustments to that budget.

Below, we discuss the significance of the capital budget, describe the evidence (or lack thereof) supporting that budget and comment on several concerning patterns observed in PREPA's historical spending and FY2017 budget. We come to the conclusions that PREPA's capital budget is poorly-supported and -documented and that PREPA's prioritization of capital projects has historically been misguided. However, we also find that PREPA's generation and transmission infrastructure are in sufficiently deteriorated state (due to perennially deferred maintenance) that significant capital spending is necessary. We recommend several specific budget adjustments, including a limit on spending at AOGP in accordance with the Commission's Final Order on the IRP, a cancellation of PREPA's planned spending on advanced metering infrastructure (AMI), and a recategorization of several maintenance contracts as operational rather than capital expenses. In addition, we recommend that the Commission interrogate PREPA's capital budgeting process further in its pending investigation on PREPA's performance. We summarize our overall findings further in Section BLANK below.

B. PREPA's use of capital

1. Overview

a. Definition of capital expenses

For the purposes of this case, we need to distinguish between what is defined as a capital expenditure and a maintenance expenditure.

Operating and maintenance (O&M) expenses are required to run the utility day-to-day. For a utility's physical (generation, transmission, and distribution) infrastructure, this category includes ordinary repairs, which are standard repairs and maintenance required to keep an asset in operational condition. These types of repairs should be accounted for in the period

incurred—*i.e.*, expensed in a maintenance category. Maintenance costs also include repairs that may last more than a year, but shorter than a full maintenance cycle.

Capital costs, on the other hand, are expenses that increase the useful life of a unit, and are generally long-lasting. Used to acquire property, assets, or equipment, or extend the life of an existing asset, capital is typically depreciated (paid off) over the life of an asset. Capital investments occur more rarely, require substantial budget allocations, and increase the life or capabilities of an asset.

In most utility circumstances, capital budgets are amortized over the life of the asset (or the improvement) and depreciated. The purpose of this accounting practice is to provide intergenerational ratepayer equity, and ensure that the costs of a long-lived asset are spread across the beneficiaries.

When an asset is severely degraded, the line between a capital cost and an operating expense may be thin. Simply repairing the asset may be insufficient to keep it operational. Instead, it requires a larger level of investment. For example, a project designed to temporarily patch a boiler is almost certainly an operational expense (the patch is not designed to last multiple years), but the replacement of the boiler in the next major outage cycle incurs an expense anticipated to last many years.

This rate case stretches the line between capital and operational expenses. As PREPA recovers from years of deferred maintenance and deficient budgets, it is required to replace a large amount of deteriorated infrastructure—including equipment that may not have required replacement if day-to-day maintenance had been executed appropriately and at the appropriate time. PREPA may require multiple years of capital expenses to make up for deferred maintenance. Many of these projects appear designed to replace or refurbish brittle infrastructure.

b. Capital projects as incurred, rather than in service

In standard utility rate cases, capital projects only become part of revenue requirements once the project is in service. Utility commissions follow a "used and useful" principle, in which capital projects must be in service, operational and providing useful service to ratepayers before they become a ratepayer burden. For such a mechanism to work, utilities must have access to some form of active capital market to fund the project's full expense through construction and hold the debt on the project, gradually paid off by ratepayers.

In PREPA's case, the utility has no ready access to low-cost capital markets, and thus PREPA is left in the unenviable position of funding capital projects with no lender but ratepayers. As discussed by the Commission's other experts in this case, PREPA is effectively asking ratepayers to take the place of a lender and pay for many of the capital projects in full, as the costs for those projects are incurred. This is a sharp contrast to normal utility operations, and requires an extraordinary amount of transparency between PREPA and the Commission. As a regulator of a public power utility (as opposed to an investor-owned utility), the

Commission's available avenues to have any party other than ratepayers absorb the impact of imprudent decisions are already limited. To have capital expenses incurred by ratepayers as PREPA engages in them exposes PREPA's customers to the utility's decisions with little or no buffer.

In this rate case, PREPA has requested that ratepayer exposure to capital project requirements be immediate and absolute: PREPA expects ratepayers to fund capital projects as the dollars for those projects are spent. Large capital projects are often multi-year in nature, requiring a capital outlay to procure equipment, additional expenses to install equipment, and payments to contractors at successful operation. New generators may have capital spending schedules that are spread across years, and even smaller projects may be incurred over extended periods before reaching completion.

Because of the utility's lack of access to capital markets, PREPA's capital budget reflects PREPA's spending through multi-year projects, rather than at the end of the project—as might be expected in other utilities. This unusual process means that in FY2017, PREPA ratepayers will be paying for some capital projects in whole, paying the last fraction of capital projects started in FY2016 or even FY2015, or paying for the first part of projects that might last through FY2020.

Again, this unusual request by PREPA requires an extraordinary amount of transparency: is a line item in the capital budget just a fraction of the whole expense, and if so, when did the project start and when will it end? The Commission is charged with evaluating the reasonableness of PREPA's projects –in planning, implementation, and in total cost. By only revealing a fraction of the total budget for any given year, the Commission's job is hampered. Questions become more difficult to answer: When did PREPA plan the project? What was the due diligence process behind the project? Has PREPA implemented the project effectively and appropriately contained its costs? Is the budget for the project appropriate for the scope of work? These questions are all squarely in the Commission's purview, but PREPA's documentation regarding the costs of these projects leave the Commission with little resolution on these questions from the start.

2. PREPA's expected capital expenditures by area

In Schedule F-3 REV ("Revised"), PREPA provided an extensive table of projects that contribute to the capital budget. PREPA specifically pulled out the capital budget for AOGP and provided this separately from all other capital projects. PREPA's list of non-AOGP projects included over 400 individual line items and included budgets ranging from $1,000 to $20,000,000 in FY2017. Nearly thirty percent (119) of the projects had zero or a blank budget in FY2017, and over one-third (45) of those had no budget listed in *any year* considered in this rate case, FY2017-FY2019.

Of the 357 non-AOGP projects with a budget listed in at least one year between FY2017 and FY2019, budgets were divided relatively evenly between production, transmission, and distribution, with a smaller budget amount allocated to the area of "office furniture and

equipment," a category primarily oriented towards transportation and computer equipment. Table 5 below shows the breakdown of the capital budget by area, sub-area, and year.

Table 5. Total capital requested by PREPA in FY2017 through FY2019, by area and subarea. Does not include AOGP.

	FY2017	FY2018	FY2019
Production			
Thermal Steam Generation*	55.6	52.5	60.9
Combined Cycle and CTs**	25.4	23.2	29.7
Hydraulic Production Plant	2.2	2.0	4.1
Production Total	**83.2**	**77.6**	**94.7**
Transmission			
115 kV	37.4	59.7	62.7
230 kV	18.4	23.2	20.3
38 kV	11.9	9.9	17.4
38KV	0.6	0.6	0.0
Other Transmission	13.0	11.4	7.5
Transmission Total	**81.3**	**104.7**	**107.9**
Distribution			
13.2 kV	10.4	13.5	14.1
4.16 kV	0.6	0.5	0.9
8.32 kV	31.5	24.9	38.2
Distribution	30.8	25.1	39.1
Other Distribution***	0.7	0.6	0.8
Distribution Total	**73.9**	**64.5**	**93.1**
Office Furniture and Equipment			
Transportation Equipment	19.4	12.5	16.5
Computer Equipment	13.1	6.2	7.5
Other Equipment	4.3	4.3	6.0
Office Equipment	0.0	0.0	0.0
Office Furniture and Equipment Total	**36.8**	**23.0**	**30.0**
General Land and Building			
Building	2.4	1.4	1.8
Land	1.0	0.8	0.8
General Land and Building Total	**3.4**	**2.1**	**2.6**
Preliminary Surveys and Investigation			
Preliminary Surveys	1.6	1.3	2.0
Total	**280.2**	**273.3**	**330.2**

*Thermal Production Plant, by PREPA
**Other Production, by PREPA
*** Blank, by PREPA

This section will discuss PREPA's capital budgets and allocations, reviewing individual projects and historic spending to gauge the reasonableness of PREPA's asks.

We note that we were *not* able to assess each and every one of the 357 individual capital projects,[163] and thus only focus on some of the most key spending areas with open questions. For the purposes of this rate case, **we recommend that the Commission accept PREPA's budget estimates for areas that we do not explicitly discuss**. In the future, we expect that

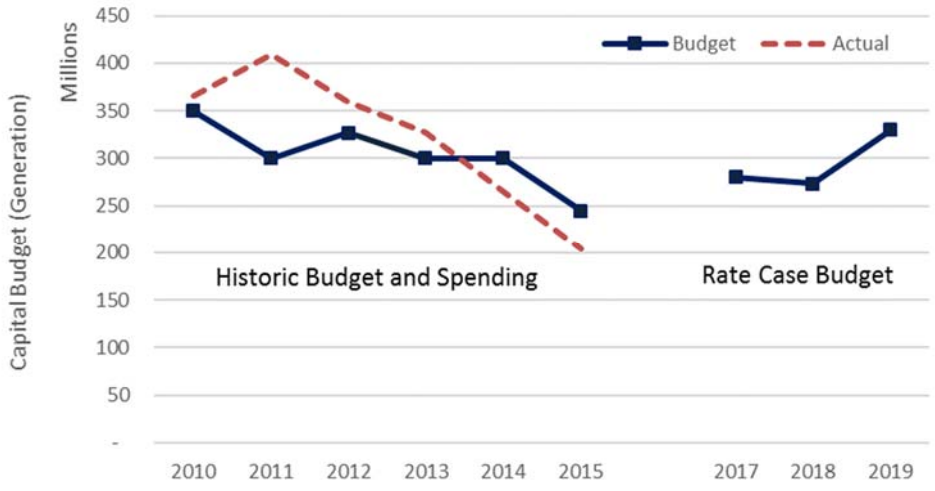
[163] 402 total projects, 357 with spending in FY2017-FY2019.

PREPA will provide substantially more transparency on its budget estimation process, its prioritization, and the basis for expected budgets.

a. Historic spending patterns in capital budget

PREPA's total capital budget has been internally capped at about $300 million (with the exception of 2010), a trend which is still present in the utility's budget for this rate case (see Figure 15, below).

Figure 15. PREPA total capital budget and spending for all areas, historic and rate case, by fiscal year (millions).[164] Does not include AOGP spending.



PREPA exceeded its capital budget from 2010 through 2013. In 2014 and 2015, the utility underspent its anticipated capital budget by about $50 million each year. This tells us that PREPA is capable of spending within a budget cap, although as we've indicated elsewhere in this report, it is not clear that PREPA's spending in 2014 and 2015 was sufficient to maintain system reliability.

PREPA's structure is divided into sixteen directorates or responsibility areas, nine of which use capital budgets. The following table divides out the directorates and those that utilize capital budget or report capital spending.[165]

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[164] Schedule F-3 REV and PREPA's response to CEPR-AH-05-10 of the Commission's Eleventh ROI (October 7, 2016). Refer to CEPR-AH-05-10 Attach 03.

[165] *Id.*

Table 6. PREPA Directorates

Code	Nombre de la Dirección	Directorate Name	Capital Budget
A01	Junta de Gobierno	Board of Governors	
A02	Ejecutivo	Executive	X
A03	Asuntos Laborales	Labor Matters	
A04	Consultor Jurídico	Legal Adviser	X
A05	Planificación y Protección Ambient	Environmental Planning and Protection	X
A06	Ingeniería	Engineering	
A07	Finanzas	Finances	X
A09	Recursos Humanos y Asuntos Laboral	Human Resources and Labor Affairs	X
A10	Generación	Generation	X
A11	Servicio al Cliente	Customer Service	X
A12	Transmisión y Distribución	Transmission and Distribution	X
A14	Responsabilidades Corporativas	Corporate Responsibilities	
A16	Seguridad Corporativa	Corporate Security	

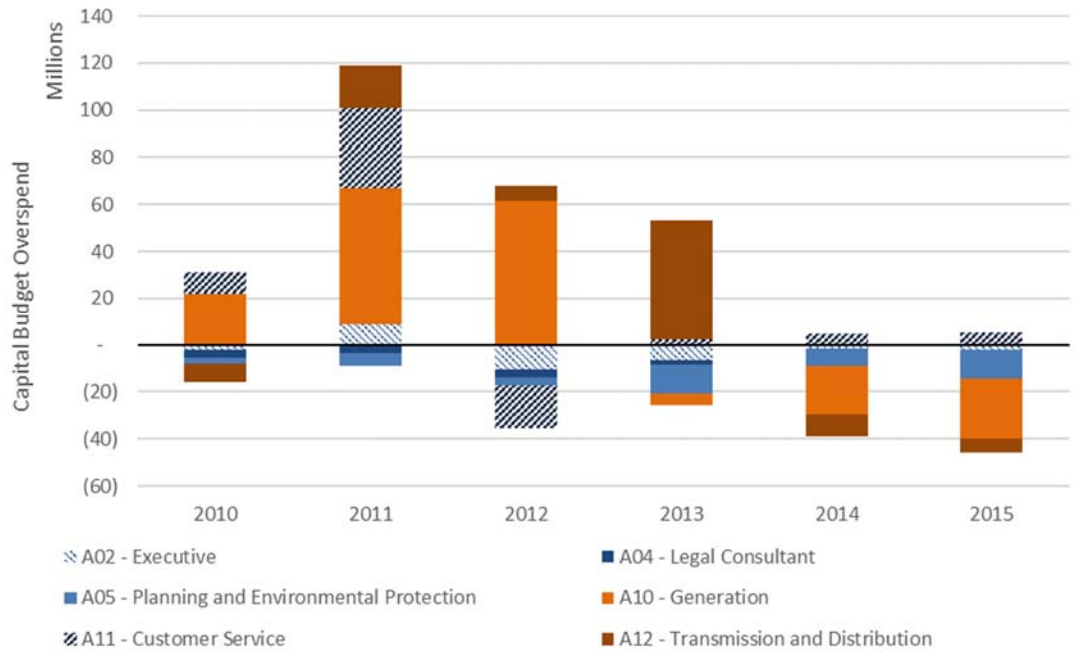
Overall, the vast majority of historic capital expenditures were used in the generation directorate ($100 million), and transmission and distribution directorate ($150 million), followed by the customer service directorate ($15-$30 million). In PREPA's directorate structure, the generation directorate appears to hold responsibility for all of PREPA's generation facilities. Transmission and distribution attends to poles, wires, and substations, while the customer service directorate handles meters and service drops (*i.e.*, connection to meters).

Historically, moderate budgets were allocated to the environmental planning and protection division ($7-$14 million) which conducts overall planning and appears to engage in one-off projects, including environmental controls. The forward-going budgets for this directorate are substantially lower than the last three years.

In contrast, the formerly modest budgets of the executive directorate ($5-$17 million) are substantially higher in this case ($20-$30 million). From a capital perspective, this directorate is responsible for transportation, computers, infrastructure management, and safety.

Figure 16, below, shows PREPA's historic over- and underspending by directorate. The generation directorate has the most substantial annual swings in capital budget, having spent 120-160% of its allocated budget, but underspending substantially in 2014 and 2015. With the exception of one year (2013), the transmission directorate hits its budget targets fairly accurately, despite the size of its overall budget.

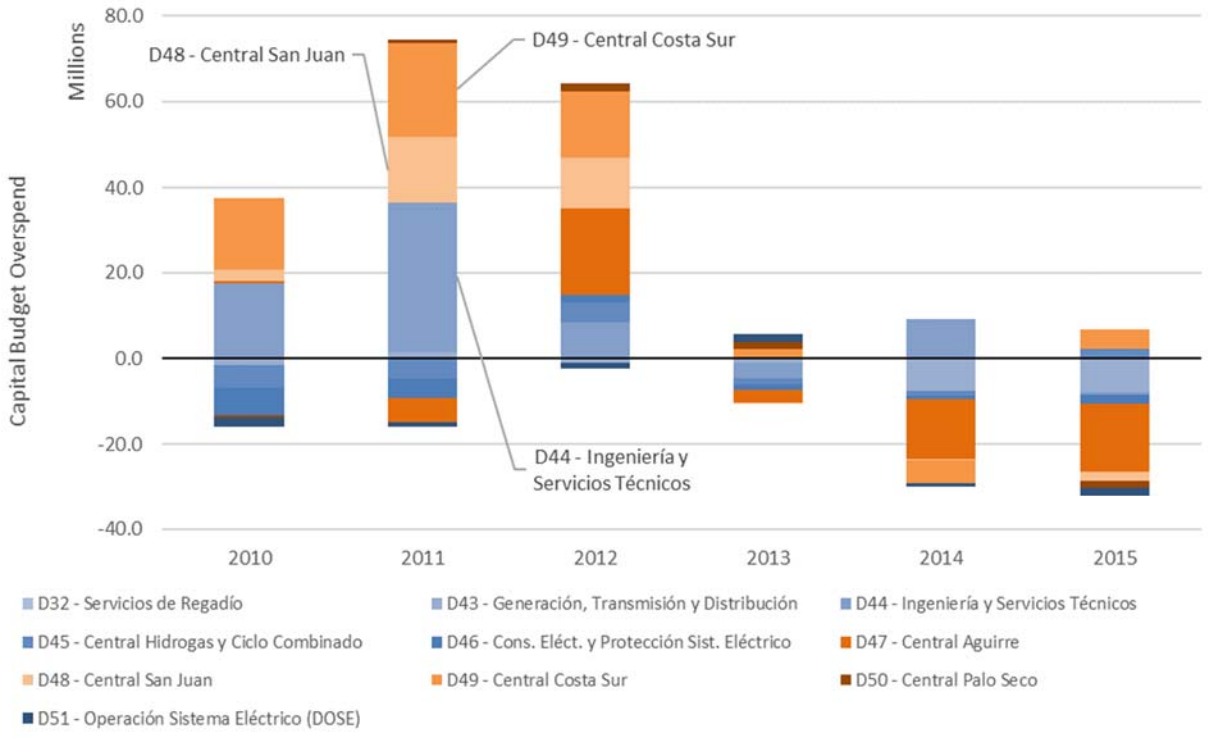
Figure 16. Historic capital budget overspending (underspending) by directorate, by fiscal year.[166]



Much of the generation directorate's under- and overspending is attributable to single large projects that are either canceled (leading to underspending) or go substantially over budget—this includes boiler and turbine replacements, and some unexplained spending patterns. Figure 17, below, shows that much of the overspending in the generation directorate in 2011 and 2012 was associated with specific projects at the large central station generators (San Juan and Costa Sur in 2011, and also Aguirre in 2012), and a large allocation into a miscellaneous fund of "technical services."

[166] CEPR-AH-05-10 Attach 03. For visual clarity, graphic excludes A07 (Finance) and A09 (Human Resources) with budgets of less than $1,000,000.

Figure 17. Historic capital budget overspending (underspending) by Department in the Generation, by fiscal year.[167]



Looking more deeply into the technical services directorate, we see that about half of overall generation directorate overspending in FY2011 is attributable to a "new generation" resource.[168] That line item amounted to $48 million of unbudgeted spending in FY2011 and FY2012. When queried during the October 20 Conference Call, PREPA was unable to describe the basis of this spending. It is likely that this cost was associated with transitioning Costa Sur to a gas-fired plant, although it is curious that the project was unbudgeted.

While there are macro patterns above the directorate level, it is difficult to dissect down into the utility's spending and the drivers of the capital budget deviations without substantially more documentation from PREPA—and often that documentation was difficult to come by. From the perspective of a rate regulator—*i.e.*, this Commission—it is difficult to choose to allocate budget without a clear understanding of both its purpose and the utility's propensity and ability to stick to budget.

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[167] CEPR-AH-05-10 Attach 03. For visual clarity, graphic excludes A07 (Finance) and A09 (Human Resources) with budgets of less than $1,000,000.

[168] CEPR-AH-05-10 Attach 03. Department A10 – Generation, Division D44 - Ingeniería y Servicios Técnicos, Responsibility 101 - Nueva Generación.

3. Issues in reviewing PREPA's capital budget estimates

PREPA's capital budgets were not transparently conveyed and many were poorly supported by the evidentiary record requested of PREPA. Due to the poor records provided by PREPA, the lack of documentation on the purpose or basis of many of the projects, and the complex nature of the tasks facing PREPA in their generation and transmission facilities, we are only able to provide an accounting of a limited number of projects anticipated by PREPA. In many utility cases, the individual projects at existing plants (generation or transmission) are on either an established schedule, correspond to known initiatives, or are generally in line with prior year expenditures. In PREPA's case, many of the projects are unique to the circumstances of PREPA today, represent deferred maintenance projects, or are simply undocumented.

Here we discuss some of the key issues facing us as we review PREPA's capital budget.

a. Poor record keeping and descriptions hamper review

PREPA was unable to provide justification for the projects listed in the capital budget, a fundamental component to providing regulatory oversight. In discovery, we requested that PREPA identify which projects had work orders or contracts for engineering, procurement and construction (EPC) for projects. PREPA denied the request in full, stating that their records were not sufficient to provide such justifications. PREPA's astonishing response was as follows:

> PREPA does not have electronic systems configured to be able to assess automatically which work orders are associated with a particular CAPEX [capital expenditure] project; most of this information is on paper records. And those paper records are not organized by project in a central location. Further answering, the process of preparing the CAPEX budgets start in PREPA's transmission and distribution districts, generating plants, customer service offices, among others.[169]

PREPA further explained that:

> The particular details of each project are managed locally, not at a central location. Once the final complied spending limits are met, the plan can go through the final approvals. Regarding projects with no money spent, any documents reflecting the corresponding justifications and related information is located in the multiple generation plants, distribution offices, customer

[169] CEPR-AH-02-02(c).

> service areas, and other offices or departments that are responsible for or use that CAPEX project. [170]

While we can, and will, debate PREPA's approach to budget prioritization amongst projects and districts, it is unacceptable that the fundamental bases of projects cannot be provided on demand. On average, PREPA's capital projects come at a cost of $1,000,000 per year.[171] For the vast majority of these projects, PREPA could not provide any form of documentation explaining the project, justifying the expense, how the estimate was generated, and the value of the project. This indicates a breathtakingly cavalier approach to the dispensation of ratepayer dollars.

Following PREPA's failure to provide work orders or contracts for projects in the capital budget plan, we asked PREPA to provide a *detailed description* of each capital project with expected FY2017 spending above $1,000,000 *and how capital costs were estimated*. PREPA provided a spreadsheet with anywhere from a sentence to a short paragraph on 72 of the projects.[172] Nowhere did PREPA provide an explanation of how it derived budget of *any* project.

The explanations provided by PREPA were, for the most part, deeply insufficient. A "Boiler Improvement" at Aguirre 1 with $6.5 million in spending was described—in full—as "replacement of ma[j]or *[sic]* life extension components as part of Gas natural conversion outage."[173] Only through sifting through the 2013 URS Report and extrapolating from a prior maintenance schedule[174] did it become apparent that this was part of a 50,000-hour regular major maintenance outage cycle. The 2013 URS report describes that:

> The scope of work will include an environmental outage plus boiler modifications to the convection section (superheat and reheat) headers and tubes to be compatible with gas firing. Other work will include repairs to thermal insulation, installation of new motor control center (MCC) and switchgear for the circulating water pumps. [175]

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[170] CEPR-AH-02-02(c).

[171] Author's calculation. Average FY2017 cost of capital budget items with non-zero spending.

[172] CEPR-JF-02-02 Attach 01.

[173] *Id*. PID 15243.

[174] AH-06-12 Attach 01.

[175] URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 11.

While still insufficient for auditing PREPA's cost estimate, and three years out-of-date, the 2013 URS Report explanation is far more informative than the information provided by PREPA in this case.

b. Engineering audit required to assess project necessity and budget allocation

We note here explicitly that PREPA's capital encompasses a very wide range of projects, from the refurbishment of individual turbines or generators, to balance of plant operations, building new poles and lines, acquiring advanced transmission and distribution equipment, ordering new utility vehicles, computer systems, and network equipment. In the particular absence of workpapers justifying PREPA's expenses, a thorough evaluation of PREPA's spending, budget gaps, and budget allocation would have required a team of engineers and auditors. We have neither the time nor expertise to engage in each of these areas of inquiry. Our analysis below therefore focuses on several specific projects and an evaluation of PREPA's capital budgets by area in the aggregate.

c. Capital budget is capped based on PREPA's historic limits

PREPA's capital budget appears to have an internal cap based on factors that are not clear. In maintaining this hard cap, PREPA may have imposed distortionary effects on its capital budget. A review of PREPA's capital budgets from FY2010 to FY2015 indicates that PREPA sets a top-down budget cap applicable to the entire system. In FY2010, PREPA set its capital budget at exactly $350 million. In FY2011, 2013 and 2014 PREPA's budget was set at exactly $300 million. In FY2015, PREPA's total capital budget fell to $244 million, but we suspect that this drop reflects an internal budgeting mechanism and not necessarily a more efficient use of funds.

Figure 15, above, shows PREPA's historic capital budget caps and actual spending, as well as the budgets proposed in this rate case, exclusive of the AOGP project. Neither spending nor explicit budget data for FY2016 were made available; PREPA has indicated that its FY2016 budget was set at FY2015 levels because the board failed to approve a FY2016 budget.[176] The aggregate budget and spending show several remarkable features.

i. PREPA's capital budget is capped from the top down

[176] CEPR-RS-16-11(a). "The approved FY2015 budget was automatically adopted (per Article 504 of the 1974 Trust Agreement) as the FY2016 budget when the Board did not approve a new budget prior to the start of FY2016. Section 504 of the 1974 Trust Agreement establishes that if for any reason the Board does not adopt the Annual Budget before the first day of any fiscal year, the budget for the preceding fiscal year shall be deemed to be in force and shall be treated as the Annual Budget."

PREPA sought to maintain an exact, top-down budget every year from FY2010 to FY2015 meaning that, regardless of the condition of the system. PREPA explains that:

> Historically, there has been political pressure to not increase PREPA's rates in response to cost and investment needs and therefore PREPA has had to sacrifice needed capital expenditures in order to remain solvent and to not run out of cash.[177]

While PREPA's policy of maintaining a budget cap may generally be a mechanism of narrowing and prioritizing key projects, this approach only works if PREPA deploys that limited capital strategically, assesses when projects go overbudget, and seeks to reallocate efficiently across departments.

Based on our assessment of specific budget items, it is not clear that PREPA has an effective mechanism for the strategic deployment of capital under this budget cap. Instead, PREPA appears to use a general rule of thumb for the deployment of capital. In discussions with PREPA,[178] the finance director explained that PREPA's budgets are designed such that departments are allocated *the lower* of their past historic budget or their last year's actual spending, except in extraordinary circumstances.

PREPA's mechanism of simply limiting departments to historic budgets or spending creates distortionary effects, requiring some departments to find creative ways to spend dollars (or risk losing it the next year) and limiting basic system needs at other departments.

One area in which this distortionary impact is readily apparent is in the allocation of capital dollars to critical deferred maintenance at PREPA's generating and transmission facilities, versus PREPA's move to start rolling out smart meter technology. In a strategic document for Advanced Meter Infrastructure (AMI), PREPA explains that it "allocates $10 Million annually to the meter replacement program. This plan contemplates using this fund to implement the replacement of the network [with AMI]."[179] Given the dire state of PREPA's system, a reasonable budget prioritization process would have determined that the far more expensive AMI system is a luxury that PREPA may have to defer until the system is reliable,

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[177] CEPR-SGH-01-08. Page 11.

[178] October 20, 2016 Conference Call, Ernesto Ramos, 1:11:00-1:15:00. Ernesto Ramos. "Historically, we have spent about $300 million for maybe the last two fiscal years. This is related to the available funds that we have for construction. This constraint is related to the funds we have in construction fund. That limits what we ask for from planning [department]…. The construction fund is dedicated to cover capital expenditures. The dollar value is created by our trust agreement. It is not more than $300 [because] of our financial capacity."

[179] CEPR 161020 Request No. 8. Attach 01. Page 4. "La AEE, asigna anualmente $10Millones al programa de remplazo de metros. Este plan contempla utilizar este fondo para implementar el remplazo de la red."

safe and affordable, and that that $10 million could have been better used elsewhere even if that meant spending it on projects other than meter replacements.

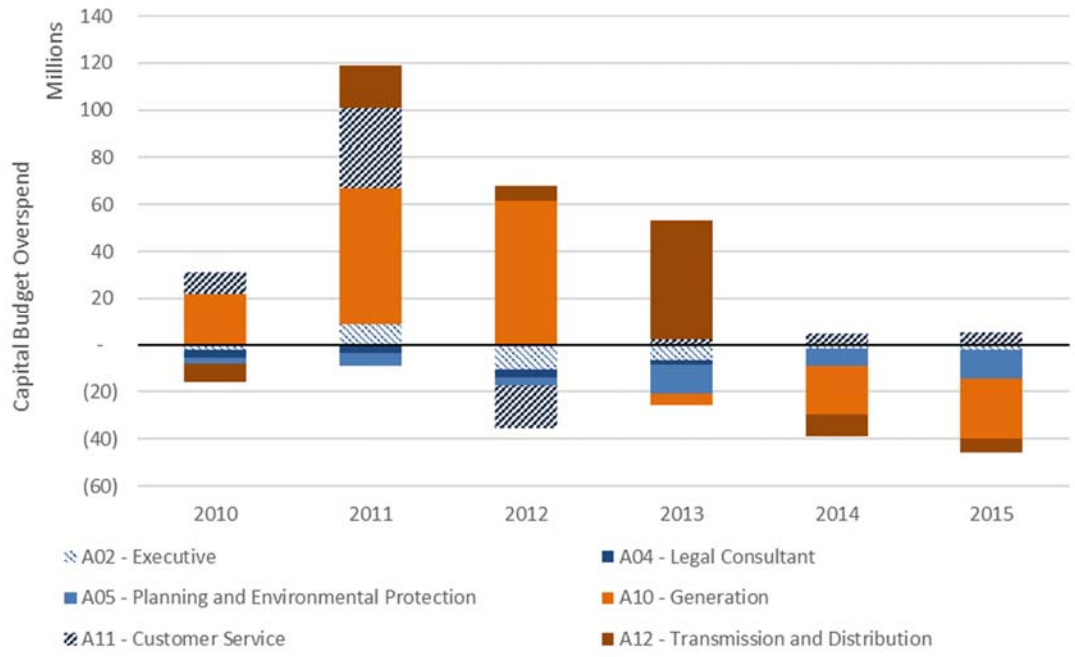
Because the budget is allocated from the top, it is difficult to determine the real state of need for any given area of infrastructure without a full engineering audit.

ii. PREPA has exceeded historical capital budgets

A review of PREPA's historic spending indicates that, until FY2014, PREPA regularly overspent its capital budget. As Figure 18 shows, the majority of the overspend from 2010 to 2012 was in the generation directorate ("A10"), followed by an overspend in the transmission and distribution directorate ("A12") in FY2013.[180] PREPA underspent its capital budgets in FY2014 and FY2015. From our perspective, without a deep dive into all of the subcomponents of the PREPA system, it is almost impossible to discern the basis of any year's capital budget or the reasons for an overspend or underspend. These patterns, however, are indicative of how PREPA might use the budgets decided in this rate case, and provide insight into PREPA's decision-making processes.

[180] CEPR-AH-05-10 Attach 03. Author's calculations and aggregations by directorate, department and responsibility.

Figure 18. Historic capital budget overspending (underspending) by directorate, by fiscal year.[181]



There are useful stories in the capital budgets and spending schedules that we will illustrate throughout this report. For example, this chart shows that the generation directorate spent 120-160% of its allocated budget in FYs 2010-2012, while in FYs 2014 and 2015 the directorate underspent its budget substantially. We observe that the generation directorate's overspending in FY2011 is primarily a function of $33 million in "new generation" for which PREPA was unable to provide an explanation,[182] while its underspending in 2014 and 2015 relates to substantial maintenance projects at Aguirre which did not occur. PREPA later explained that these projects were deferred until the AOGP project came online—now scheduled for late 2018. In the absence of these deferrals, PREPA would have nearly hit capital budgets in 2014 and 2015. While PREPA's underspending on generation may seem to be a substantial gain in the name of budget control, PREPA's generation fleet has suffered dramatic losses in the last two years—possibly as a function of this reduction in spending.

4. Relationship between the capital budget and the Integrated Resource Plan

[181] CEPR-AH-05-10 Attach 03. For visual clarity, graphic excludes A07 (Finance) and A09 (Human Resources) with budgets of less than $1,000,000.

[182] October 20 Conference Call, discussion with Generation Directorate manager,

a. Correspondence between Schedule F-3 REV and IRP

According to Puerto Rico Regulation 8720 (March 28, 2016), the rate filing requirements for Schedule F-3 shall "list projected construction and capital expenditure requirements for each of the three (3) years following the test year," and that "this schedule shall include an explanation of how the projected capital expenditures correspond with PREPA's Integrated Resource Plan."[183]

In theory, the schedule provided by PREPA should have explained which projects were associated with the Integrated Resource Plan (IRP) and their relationship to the plan. In practice, providing a detailed explanation between 350 capital expenses and the IRP is understandably difficult. PREPA's version of this compliance was to state that "PREPA's capital improvement program is consistent with the IRP in that it contains projects such as AOGP to transition Puerto Rico's generation mix to Natural Gas, replace inefficient aging units, bring PREPA into compliance with MATS [Mercury and Air Toxics Standard], and improve overall system reliability."

PREPA then marked projects as either being "CAPEX" or "IRP," where "CAPEX" projects are associated with PREPA's vintage-2014 Major Capital Projects plan for FYs 2015 and 2016.[184] For projects labeled as "IRP" it was not always clear if they emerged from the IRP process, or were simply consistent with the utility's preferred resource plan.

While the requirement to explain how projects in the capital expenditure schedule correspond to the IRP was ambiguously worded, a reasonable interpretation is that PREPA should have explained how its capital spending strategy was influenced by the IRP process and demonstrated that its preferred portfolio and resultant action plan from the IRP were reflected in the spending schedule. PREPA's demonstration on this front falls short.

Schedule F-3 REV identifies twenty (20) transmission projects with an FY2017 cost of $48.2 million as associated with the IRP. There are no non-transmission projects listed as associated with the IRP, and the remaining transmission projects only amount to $10.5 million.

One of the primary features of PREPA's IRP was the decision to proceed with building the Aguirre Offshore Gasport (AOGP). A review of PREPA's historic spending, however, indicates that the decision to proceed and begin substantial investments in AOGP preceded the IRP process by a substantial margin, and that since at least 2011 PREPA has made a series of decisions embedding its assumption of AOGP as a future resource into its present spending, including deferring maintenance at Aguirre station, opting to reduce investments at units

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[183] Section 2.08(C) of Regulation 8720, New Regulation on Rate Filing Requirements for the Puerto Rico Electric Power Authority's First Rate Case.

[184] CEPR-AH-05-08 Attach 02.

PREPA assumed would be replaced by improved gas-fired generation from AOGP, actively shunning alternative options to the gasport, opting to pursue air permits on the assumption that the gasport would be finalized, and generally betting the entire utility's MATS compliance on the gasport's timely completion.

b. Spending at AOGP does not reflect Commission requirement for economic assessment before proceeding

In the Final IRP Order, the Commission disapproved AOGP, and called for a $15 million budget cap on the project, subject to Commission review. The Order required that PREPA file an economic analysis of AOGP ("AOGP Economic Analysis"),[185] and that PREPA could not exceed the cap unless expressly approved by the Commission subject to review of the analysis. PREPA did not file an economic analysis, request permission to proceed with AOGP, seek clarification on the requirements of the Final Order, or indicate its intent to pursue such an analysis in the immediate future. Instead, PREPA motioned for reconsideration on the Final Order.

On September 27, 2016, the Commission required PREPA to re-file exhibits and testimony with respect to revenue requirements ("27 September Order"). The Order specifically required that PREPA's rate case reflect the Commission's findings that "spending on permitting, planning and engineering related to the Aguirre Offshore Gas Port ("AOGP") shall not exceed $15 million from the date of the issuance of the IRP Order," and further clarified that "the spending limit applies to the total combined spending associated with AOGP and the gas conversions."[186]

Despite having amended the rate case filing to hypothetically comply with the 27 September Order, PREPA failed to adjust their revenue requirements to meet the Commission's requirement that the rate case be consistent with the IRP Final Order. As of today, PREPA's petition reflects a stated intent to spend approximately $56 million[187] on AOGP in FY2017.[188] PREPA's planned spending on AOGP is inconsistent with the Commission's requirement that PREPA cap its spending at $15 million until the AOGP Economic Analysis is approved, or cease the project.

5. Overview of findings

Below we present our general findings from our review of PREPA's capital budget.

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[185] IRP Final Order B.1.a.(2)

[186] Docket CEPR-AP-2015-001. Order requiring revised testimony. Page 2.

[187] Schedule F-3 REV.

[188] We discuss AOGP, and PREPA's treatment thereof in this rate case, in more detail in SECTION below.

a. PREPA budget process is poorly-documented

i. PREPA's provision of documentation to support its capital budget demonstrated gross managerial incompetency

As discussed above generally, and as we will discuss in depth on individual projects, PREPA was unable to provide basic explanations, workplans, or other due diligence documentation on many of the capital projects contemplated in Schedule F-3 REV. This failing inappropriately left the burden of budget review and justification to us, rather than PREPA. We were compelled to assess separate records of generator operations, forced outages, historic spending, and explanations scattered across dozens of disparate data responses to even begin to gain a coherent view of the state of PREPA's system, their needs, and the value of the projects requested by PREPA. PREPA's explanation that the workplans and justification for the projects requested in F-3 REV were in paper records, "not organized by project", and scattered across PREPA's system gives us extraordinarily low confidence in PREPA's ability to coherently assess their own needs, coordinate projects, evaluate budgets, and strategically deploy dollars.

Overall, our findings are tempered by our inability to review PREPA's due diligence mechanism, assess if any such mechanisms were employed by PREPA, or even ascertain the nature of some projects.

ii. PREPA's provision of documentation as required by PR 8720 2.08 was deficient.

PR 8720 2.08(d) requires that Schedule F-4 "shall include a detailed description and references to supporting documentation used in developing the projections." With respect to capital expenditures, PREPA's F-4 filing had four short paragraphs stating that investments were necessary to maintain PREPA's system and bring the utility into compliance with environmental regulations. PREPA provided no support or documentation for its capital projections. Over the course of the discovery process, we were able to elicit contracts with budget figures, internal presentations with budget estimates, and PREPA's FY2015 Capital Improvement Program.[189] These documents would have provided some level of insight into PREPA's process. And while PREPA does maintain many contracts on its website, it is inappropriate to believe that the Commission should be responsible for connecting the 242 contracts listed on that page with PREPA's major capital projects.

While we are disappointed by PREPA's inability to provide sufficient explanation of their budget creation process, we are unable to justify—at this time—recommending a substantial

[189] CEPR-AH-05-08 Attach 02. FY2015 Programa de Mejoras Capitales.

reduction of PREPA's capital requirements based on a failure to provide documentation, as it is also apparent that the system is in dire need of maintenance and basic improvements.

b. FY2017 capital budget does not represent the full scope of projects committed to or completed in FY2017

PREPA's budgets as provided in Schedule F-3 REV provide an estimate of capital on an as-spent basis, rather than an in-service basis. This makes it very difficult to assess total project costs for the purposes of benchmarking budgets and expenditures to industry standards.

PREPA has multiple projects that land in the FY2017 budget that started in prior years and are reaching completion in FY2017, as well as projects that are just starting in FY2017 and are expected to be completed in a future year. There is no place in which PREPA discloses the all-in cost of any given project, and it was only by explicitly requesting project spending from FY2015 to FY2020 that we were able to discern the total project costs of specific initiatives.

Overall, we find that the FY2017 capital budget does not appropriately indicate the level of investment required by PREPA, or committed to in this case.

c. Deferred spending has led to rapid deterioration of PREPA's generation fleet since FY2014

PREPA's generating fleet has deteriorated rapidly over the last two fiscal years with a dramatically increased percentage of time in forced outages.[190] While the underlying causes of these outages appear to be widespread, many of the outages can be linked to the deterioration of physical plant, including leaking pumps and valves, cracked ducts, broken and boilers, pipes, fans, and gates.

The maintenance problems at PREPA's fleet have proceeded in lock step with PREPA's declining generation and operational budgets. In an internal briefing from mid-2015, PREPA acknowledges that there has been a recent increase of forced outages during 2015,[191] a trend that continued well into 2016. According to the utility, one of the primary reasons PREPA's system has deteriorated is that it has not been able to acquire replacement materials due to budget constraints, and has deferred substantial repairs pending the AOGP project.[192]

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[190] CEPR-JF-01-16 Attach 02. Author's assessment.

[191] CEPR-JF-01-16 Attach 01 (Public). Page 3

[192] *Id*. Page 6

A surprisingly large fraction of PREPA's fleet has had substantial maintenance problems through 2015 and 2016, driving up system costs in PREPA because of an increased reliance on higher-cost units previously reserved for peaking and emergency purposes.[193]

These observations lead us to the conclusion that PREPA's recent historic capital spending has likely been insufficient to maintain a safe and reliable system.

d. Budget priorities may be distorted by artificial cap

PREPA's capital budget is designed to hit an approximate $300 million target. This target is PREPA's impression of budget availability that can be allocated to capital projects, based on historic collections.[194] Significantly, PREPA also allocates budget to departments on the basis of prior year spending or budget, whichever is lower.[195] This budgeting process is more in line with a government agency with little year-to-year variation in total budget allowance or spending needs, and less in line with a business with substantial tangible assets under changing fuel, environmental and demand conditions. Without a carefully considered deployment of that limited budget, this policy results in departments that are incentivized to use or lose budgets that are not fully required, and limits departments that have substantial needs.

This rate case provides an opportunity for PREPA to make a case for spending capital dollars to provide the people of Puerto Rico a functional and efficient electricity system. Both PREPA and the Commission have a role in then determining if PREPA's needs are legitimate and if PREPA's dollars are appropriately deployed. Under the current mechanism, PREPA has prioritized projects, but there are indicators that the prioritization process is faulty.

For example, PREPA's move to continue and expand an AMI program, rather than reallocate limited dollars to failing generating stations is a significantly misguided use of funds. In addition, as will be discussed in the next section, the budget cap and prioritization process favors triage spending, rather than reasonable preventative maintenance.

Overall, in PREPA's circumstance, the utility's budget should reflect the spending that PREPA needs to maintain and support the system, without allowing generation and transmission to fall into disarray.

We find that PREPA's capital budget limit as applied in this rate case is inappropriate. In future cases, the Commission should require PREPA to clearly lay out budget requirements on the basis of requirement to meet minimum utility standards, clearly distinguishing

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[193] PREPA Exhibit 3.0, lines 367-369.

[194] October 20 Conference Call, discussion with financial director on budget caps and priorities.

[195] *Id*.

between spending for emergency purposes, preventative maintenance, system improvement, and system expansion.

e. Budget prioritization process appears to favor brittle infrastructure to the potential detriment of operational infrastructure

A review of PREPA's budget priorities in generation and transmission and distribution indicates that the utility's budget priorities are focused on infrastructure that is currently failing—revealing a spending pattern focused almost exclusively on triage. While it is not inappropriate to prioritize spending with the aim of ensuring an operational system, PREPA's budget priorities may in fact be neglecting key operational infrastructure.

For example, at Palo Seco Plant, PREPA is investing in the maintenance of Palo Seco 3 & 4, hedging that EPA will agree to allow the utility to maintain these MATS non-compliant units through 2020. As we will discuss later, Palo Seco 3 & 4 have had numerous extended forced outages over the last two years. PREPA is consequently spending $8.5 million at those two units in FY2017.

In contrast, PREPA has earmarked Palo Seco 1 & 2 as "limited use" units under MATS with the expectation that these units will not contribute meaningfully to the PREPA system. Nonetheless, Palo Seco 1 & 2 have proven to be more reliable, or at least failing in fewer hours, than Palo Seco 3 & 4. The fact that Palo Seco 3 & 4 are actually available for use and contribute meaningfully to PREPA's system suggests that PREPA may want to ensure that these units are kept in working order, even if they are only meant to provide peaking or backup power to the system. PREPA did not identify any capital dollars spent on maintenance at Palo Seco 1 & 2 over the last six years[196] nor did it disclose the last time that these units were provided a significant maintenance cycle,[197] suggesting that the utility is willing to allow these units to simply go out of service due to neglect.

We find that PREPA's budget prioritization process may fail to provide sufficient capital for infrastructure that PREPA still relies on and provides service to the utility.

f. Most of FY2017 AOGP budget should be deferred to FY2018 in compliance with Commission's IRP Final Order

In this report, we extensively discuss PREPA's decisions to move forward on the AOGP project in spite of the Commission's requirement to submit an AOGP Economic Assessment or be capped at a $15 million budget. In light of the fact that we (a) have no AOGP Economic

[196] CEPR-AH-06-12 Attach 01

[197] CEPR-AH-06-12 Attach 02

Assessment with which to judge the prudence of the project, and (b) PREPA has shown no signs of impending submission of such an assessment, we believe that this cap still applies.

Further, PREPA has to date spent only a miniscule fraction of its anticipated FY2017 budget for AOGP, and a recent discovery response indicates that it does not anticipate any further major expenditures until it signs the notice to proceed, currently targeted for early 2017,[198] or the first quarter of 2018,[199] depending on which PREPA source we rely upon. We believe that PREPA has adequate time to file an AOGP Economic Analysis and demonstrate if the AOGP project is economically viable without substantially interrupting the current schedule. Assuming that PREPA is cooperative in moving such an analysis forward efficiently, the project could encounter no delays from the Commission's review. However, if PREPA fails to submit such a document in a timely fashion and is held to the $15 million limit, this may cause the utility to push back current deadlines, regardless of the status of permits or other logistical hurdles.

We recommend that the Commission revise PREPA's revenue requirement for FY2017 to reflect a $15 million spending cap at AOGP, and find that doing so is unlikely to substantially impact the current project schedule. Maintaining this $15 million cap reduces FY0217 revenue requirements by $41,339,807.

g. Maintenance contracts at San Juan Combined Cycle and Cambalache should be allocated to operations and maintenance

Our assessment of PREPA's capital budget revealed two long-term maintenance contracts for San Juan Combined Cycle ("CC") and the Cambalache Gas Turbines ("GT"). These contracts provide for oversight staff, regular inspections, maintenance equipment, and the procurement of generator replacement parts. These contracts provide maintenance services to PREPA.

For the purposes of this rate case, we characterize these maintenance contracts as an operational expense rather than a cost to be capitalized. There may, in fact, be costs under these contracts that represent legitimate capital expenses—*i.e.*, long-lasting replacement parts and new equipment—but the contracts themselves generally do not specify the provision of those parts at specific costs, and thus we believe that it is appropriate to characterize the costs of these contracts as an operational maintenance cost that has been outsourced.

We find that PREPA's maintenance contracts at San Juan CC and Cambalache GT are more appropriately characterized as operations and maintenance expenses, rather than capital.

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[198] CEPR-JF-04-02 Attach 01.pdf. Excelerate Aguirre Detailed Design Schedule, September 2016.

[199] CEPR-JF-04-02(d)

We recommend that the Commission recharacterize these capital expenses as O&M, an adjustment which shifts a total of $16 million in FY2017 from the capital budget to the generation-related operational expense budget.

h. Transmission budget is reasonable

PREPA's primary capital budget for transmission in FY2017 is for the rehabilitation of two 230 kV lines and one 115 kV line that together form the primary north-south corridor from Aguirre and AES to San Juan, and the rehabilitation of two 115 kV lines from the Cambalache plant in Arecibo back to San Juan. Our assessment of the cost and scope of these budgets are in line with other utility estimates for line construction and rehabilitation. Much of the remainder of PREPA's transmission budget is allocated small, single items, many of which are difficult to individually assess. However, the fact that the transmission directorate has historically stayed within budgets gives us confidence that the overall budget request is likely reasonable.

We find that PREPA's capital budget request for transmission is likely reasonable and recommend that the Commission approve it without modification. However, PREPA's budget does not account for the September 21st 2016 fire at the Aguirre substation, and subsequent transmission failure at both of the 230 kV lines emerging from that substation. While it is not necessarily appropriate to continuously update a budget request within a filed rate case, this outage represents a significant enough occurrence that it behooves the Commission to gain a thorough understanding of its causes and implications.

We recommend the Commission require PREPA to present the results of its investigation into this outage to this Commission and disclose its budget requirements from that event.

i. Distribution non-meter budget is reasonable

PREPA discusses extensively that its distribution system is in a substantial state of disrepair and requires rehabilitation. In particular, PREPA discloses that poles are rotting, insulation has degraded, and PREPA is spending substantial budget on deferred maintenance in the system.

Our review of the distribution budget shows that the largest items are generally "blanket" estimates for the purchase of equipment on an as-needed basis. Without additional detail, it is difficult to assess the reasonableness of these blanket estimates.

PREPA places meter acquisition into its customer service directorate, which we will address below.

We find that PREPA's capital budget request for non-meter distribution spending is likely reasonable and recommend that the Commission approve it without modification.

j. Meter acquisition budget is not reasonable, and misallocated to advanced meters

In reviewing PREPA's capital budget plan with respect to meters, we learned that PREPA was in the middle of an extensive, and expensive, advanced meter infrastructure ("AMI") program. AMI meters, otherwise known as "smart meters," allow the utility to communicate back to the customer or customer's meter on a near-instant basis. Many utilities think that the eventual integration of smart meters will allow the utility to direct power flows more efficiently, handle distributed generation more efficiently, fix problems on the distribution system faster, and implement complex and interactive rate structures. PREPA was unable to provide reasonable substantiation for the smart meter program, and at a cost nearly double the cost of the current advanced meter reading ("AMR") infrastructure that PREPA began implementing less than a decade ago, we cannot find a reasonable justification for this program.

PREPA engaged in an acquisition of 15,000 smart meters through a local wholesaler and reported that nearly half of the first batch installed were not within specifications. Between the extraordinary cost of even a well-structured smart meter rollout, and the planning required to ensure that such a rollout is successful we cannot condone the further expansion of this program at this time, or even the acquisition of additional smart meters.

We propose an adjustment to PREPA's revenue requirement to account for the utility's need to replace meters without investing in this substantial infrastructure.

We find that PREPA's allocation of budget to new smart meters or AMI is misplaced and likely a poor allocation of funds given PREPA's otherwise degraded state in generation, transmission and distribution. We recommend that the Commission strike this item from PREPA's capital budget.

C. Generation and Production capital budget

1. Overview

The following section will describe PREPA's capital budget request for generation and production facilities. To understand PREPA's requirements, we assess the state of PREPA's system, and how PREPA's capital budget requirements address the utility's most pressing needs.

As we will show below, PREPA's ability to move forward with strategic investments geared towards a cleaner, more efficient fleet are severely hampered by a state of crisis. Having been drained of both monetary and experienced human capital, PREPA's fleet appears to be operating on fumes today. Driven by a monetary crisis, poor management, and a lack of a clear strategic vision, PREPA's generation fleet requires substantial investment simply to stay operational.

We will discuss PREPA's crisis and budget requirements. It is not clear, however, that PREPA's anticipated budget is sufficiently geared to help the utility emerge from this reliability shortfall. PREPA's capital requests show a triage mentality, but risk leaving the utility in a continuously-reactive mode, rather than being able to get ahead of its current predicament.

Table 7, below, shows PREPA's capital spending by plant for each fiscal year 2015-2020. Note that 2015 and 2016 spending only show costs associated with projects that still exist in 2017 or beyond. Thus, this table may not represent all capital spending at PREPA's generators in FY2015-2016, and no information was provided on a project specific basis for those years.

Table 7. Capital spending at PREPA generators by fiscal year[200]

		2015	2016	2017	2018	2019	2020
Steam Generators	Aguirre Steam	$2.9	$7.4	$27.0	$23.4	$14.7	$3.2
	Costa Sur Steam	$6.4	$2.0	$12.1	$18.0	$22.2	$30.0
	Palo Seco Steam	$0.5	$1.4	$8.5	$3.0	$2.4	$6.0
	San Juan Steam	$0.1	$0.0	$0.2	$0.7	$15.5	$0.0
	Palo Seco/San Juan	$0.2	$0.3	$0.5	$0.1	$0.0	$0.0
Combined Cycle	Aguirre Combined Cycle	$1.9	$3.8	$4.9	$4.7	$7.8	$6.5
	San Juan Combined Cycle	$12.1	$14.0	$13.0	$13.0	$14.8	$17.5
Simple Cycle Generators	Cambalache	$2.2	$2.7	$4.0	$4.0	$4.0	$10.0
	Mayaguez	$0.3	$0.7	$0.6	$0.6	$1.0	$0.6
	Culebra	$0.6	$0.2	$2.0	$0.0	$0.0	$0.0
	Hydro Gas Plant	$1.7	$0.3	$3.4	$3.3	$5.4	$5.4
	All Units	$2.1	$3.9	$6.3	$6.5	$6.5	$7.4
	Substations	$0.1	$0.3	$0.4	$0.3	$0.5	$0.4
	Total	**$31.2**	**$37.1**	**$82.7**	**$77.6**	**$94.7**	**$87.0**

With the exception of the hydro gas plant, Culebra, and the substation category that falls under the production directorate, all of which have limited information available, we will discuss the capital budget request and pertinent issues at each of PREPA's generators.

2. Aguirre steam units

Aguirre Plant is a 1,492 MW plant near Salinas. Aguirre is comprised of three subcomponents,[201] a steam power plant (900 MW), a combined cycle power plant (520 MW), and a simple cycle power block (72 MW).[202] The Aguirre steam power plant, built in 1975,[203]

[200] Schedule F-3 REV.

[201] Federal Energy Regulatory Commission. February 2015. Aguirre Offshore GasPort Project: Final Environmental Impact Statement (FEIS). Docket Nos. CP13-193-000 and PF12-4-000. Section 1.4.1.

[202] PREPA Base IRP, August 17, 2015. Table 3-1, and author's calculation for simple cycle power block based on FEIS and IRP.

[203] Aguirre Power Plant, PREPA website. http://www.prepa.com/aguirre.asp

is divided into two electrical generating units (EGUs) of 450 MW each, and fired by heavy fuel oil (No. 6).[204]

The Aguirre Plant complex is the largest single plant in the PREPA system, making up over one quarter (26 percent) of PREPA's capacity.[205] Over 60 percent of the capacity at Aguirre Plant is provided by the two steam units ("Aguirre Steam Units") which are, individually, the largest central station generators on PREPA's system. Combined, these units represent 16% of PREPA's system capacity.

The Aguirre Steam Units are not compliant with EPA's Mercury and Air Toxics Standard (MATS), which affects fourteen of PREPA's generating units. PREPA's strategy for reaching MATS compliance at Aguirre is to switch the units from oil to natural gas through the construction of the AOGP project.

Since 2012 the Aguirre Steam Units have operated at a roughly 50% capacity factor (i.e. providing about half of their absolute generation available),[206] although this value fell substantially in FY2015 and FY2016 due to extended forced outages.

In this rate case, PREPA estimates $27 million in capital expenditures at the Aguirre Steam Units in FY2017.[207] The individual projects represented by these costs in many cases extend through FY2018 and FY2019. In total over the three years presented in this case, PREPA anticipates $65 million in capital at Aguirre Steam Units. The most substantial projects at the Aguirre Steam Units are geared towards toward the rehabilitation of the turbines and boilers at the plants.

a. Issues at Aguirre Steam

i. Forced Outages at Aguirre Steam

The forced outage rate at the Aguirre Steam Units are substantial. Forced outages occur when a generator either automatically turns off or is brought offline for a mechanical, safety, or environmental problem or violation. These outages represent times when the unit cannot contribute to capacity or reliability, and cannot provide energy to the system. A high forced outage rate is indicative of a unit that is either in need of repair, suffers a chronic operational problem or error, or is prone to operator error.

From 2012 to 2014 (calendar year), the Aguirre Steam Units averaged a seven percent forced outage rate; on average, the units were suffering an unexpected outage during 612 hours, or

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[204] PREPA Base IRP, August 17, 2015. Table 3-1

[205] Total system capacity 5,659 MW. PREPA Base IRP, August 17, 2015. Table 3-1

[206] CEPR-AH-03-07 Attach 01

[207] Schedule F3-REV, sorted by project per index in CEPR-AH-02-03.

twenty-five and a half days every year.[208] In 2015, Aguirre Steam Unit 1 suffered an extended outage from mid-July to the end of the year,[209] starting with pump failure and cascading through a series of faults in the generator and boiler economizer.[210] Aguirre Steam Unit 2 then suffered an even more substantial outage starting December 1st of 2015 when the turbine suffered a fault. The turbine remained offline under a state of repair through the last provided record in August 2016, or an outage of 246 days.

These extraordinary outage levels resulted in combined forced outage rates in of 27 percent in 2015 and 46 percent in 2016 – effectively out as often as not. A unit with this extraordinarily low ability to meet demand requirements due to outages has very little capacity value to the system. So, while the Aguirre Steam Units are the largest units in PREPA's system, they are also extremely non-reliable.

In an undated internal briefing document, PREPA explained that outages in 2013 and 2014 at Aguirre 1 were primarily caused because "delays in paying vendor lead to [a] delay in receiving materials."[211] PREPA describes the problems encountered at Aguirre 2 as a "failure in [the] transformer," and "natural damage of materials as a result of normal wear and aging." While the failure to receive parts[212] and normal wear and tear may have caused outages in 2013 and 2014, the extended outages in 2015 and 2016 appear to be a series of cascading outages in which one failure led sequentially to another failure.

PREPA's log of outages[213] tells a story of maintenance failures and extreme downtime for single issue events. For example, in early July 2015, a feedwater pump[214] at Aguirre 1 broke down, requiring PREPA to bring the boiler down to half operation for six days. Fourteen days later, PREPA took the whole unit offline for a day and a half to fix a leak in the same boiler. For the next full month, PREPA kept the unit at half capacity while the same feedwater pump remained out of service. Just four days later, now in early September 2015, the turbine began reporting an electrical failure, taking the unit offline for two days. The unit was brought back online for nine hours, only to trip off again when the generator failed, taking the unit offline for exactly three months, until the end of November 2015. PREPA successfully brought the unit back online for 15 hours, only to have the boiler fail again – this time in the economizer. Having resolved the boiler issues, two days later the feedwater pump failed again, taking the

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[208] CEPR-JF-01-16 Attach 02

[209] July 7th, 2015 to December 31st, 2015

[210] CEPR-JF-01-16 Attach 02. Log of forced outages.

[211] CEPR-JF-01-16 Attach 01. Forced Outage ("FO") Analysis: Business Case. *Undated*. (Public). Page 14.

[212] *Id.*

[213] CEPR-JF-01-16 Attach 02. Log of forced outages.

[214] Feedwater pump: a pump designed to move freshwater into the boiler system.

unit offline until December 31st, 2015. Over the six-month period, Aguirre 1 was available to generate for less than one month's worth of time, operating at half or less of its capacity for two months, and completely unavailable for three months.

Such sequential failures are not a function of normal wear and tear or aging, but are indicative of systematic maintenance failures, a failure to perform predictive maintenance, operational errors, and faulty repairs. These failures indicate either a unit under severe disrepair or an inability of staff to meet minimum maintenance requirements.

ii. Relationship to AOGP

The Aguirre Steam Units are a cornerstone of the Aguirre Offshore Gasport (AOGP) project. As PREPA explains in the Motion for Reconsideration of the Commission's Final Order in the IRP docket,[215] the AOGP project is primarily designed to help bring PREPA into compliance with MATS. Specifically, the AOGP project is meant to provide natural gas to the Aguirre Steam Units, which are the only units at the Aguirre Plant complex which require mitigation to come into compliance with the rule.

In this rate case, PREPA has coupled the conversion of the Aguirre Steam Units from oil to gas with the construction of the offshore gasport and associated facilities as a single capital expenditure. But there are other capital expenditures associated with keeping the Aguirre Steam Units operational through and beyond the conversion, including substantial expenditures on the boilers and turbines of these units.

The choice of whether to spend substantial dollars revitalizing the Aguirre Steam Units is complicated. PREPA indicates that much of the spending at Aguirre has been deferred while PREPA "waited for [the] gas conversion [from AOGP] before investing in major repairs."[216] The net result may have been that the Aguirre Steam Units began to fail while the program was delayed, resulting in substantial deferred maintenance. On one hand, PREPA should invest in capital dollars to ensure that the Aguirre units remain online during critical periods, and make up for critical deferred maintenance projects. The outage rate of the Aguirre Steam Units is unacceptable, strains PREPA's grid, and requires PREPA to operate more expensive units on an ongoing basis. On the other hand, it may be unwise for PREPA to spend substantial capital dollars on life extension projects at the Aguirre Steam Units if the Commission concludes that the AOGP project should not proceed and the Aguirre Steam Units require relatively rapid replacement.

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[215] PREPA's Motion for Reconsideration of Provisions of the Final Resolution and Order, October 13, 2016, CEPR-AP-2015-0002, paragraphs 23, 24, and 28.

[216] CEPR-JF-01-16 Attach 01. Forced Outage ("FO") Analysis: Business Case. *Undated*. (Public Version). page 7.

Under PREPA's IRP plan, the utility expects to retire the Aguirre Steam Units by 2026 and 2027, respectively.[217] With this plan, it would make sense to continue capital investments to ensure reliable operation for another decade. However, if the AOGP Economic Analysis indicates that AOGP should not be pursued, PREPA should seek to make minimal investments at the Aguirre Steam Units to ensure that the units are operable and reliable, but not invest in a complete renovation of the units.

The purpose of the capital expenditures at the Aguirre Steam Units with respect to AOGP will remain unresolved until PREPA submits the AOGP Economic Analysis.

b. Cost of Capital Projects at Aguirre Steam

Overall, PREPA anticipates spending $27 million in non-AOGP specific retrofits at the Aguirre Steam Units in FY2017 (see Table 8). As with PREPA's other capital projects, this capital represents both the tail of spending begun in prior years, as well the start of spending for projects expected to extend through FY2018 and 2019. These continuing projects, as well as a future project, are expected to require a total of $65 million between FY2017 and FY2019. Combined with the natural gas conversion projects, PREPA is planning on spending $114 million in capital on the Aguirre Steam Units between FY2017-2019. The spending discussed here only accounts for projects that are currently planned in the next two years. It is likely that between now and 2019, PREPA will plan, scope and budget for additional capital projects at the Aguirre Steam Units.

Table 8. Historic and expected capital spending at Aguirre Steam Units by Fiscal Year, millions of dollars.[218]

	2014[219]	2015	2016	2017	2018	2019	2020
AOGP Unit 1 & 2 Conversions	15.6	20.6	1.8	6.4	43.2	0.0	0.0
Boiler Improvements	0.0	2.2	1.7	8.7	11.1	0.0	0.0
Turbine Improvements	0.0	0.7	5.7	16.2	11.4	13.0	3.0
Balance of Plant	0.0	0.0	0.0	2.0	0.8	1.7	0.2
Total Aguirre Steam Unit Capital	**15.6**	**23.5**	**9.3**	**33.4**	**66.6**	**14.7**	**3.2**

i. Basis for Capital Projects at Aguirre Steam

[217] PREPA Base IRP (August 17, 2015). Table 7-4.

[218] Sources. Dollar figures on AOGP from CEPR-AH-01-01 Attach 01 (2017-2020); CEPR-AH-05-11 (2014-2016). Dollar figures for boiler, turbine and balance of plant from Schedule F3-REV (2017-2019) & CEPR-AH-02-02 (2015-2020). Note that PREPA may have substantial historic capital spending for boilers, turbines and balance of plant at Aguirre Steam Units, but did not provide information for spending not associated with specific capital projects identified in F3-REV.

[219] Indicates 2014 or before. PREPA provided data only indicates spending in FY2015-2017 and cumulative to date. Author's calculation to derive pre-2015 spending.

PREPA's spending and explanations indicate that the utility started a series of substantial retrofits of the boiler, turbine and generator at Aguirre Unit 2 in 2015 (or before). These costs appear to represent an overhaul of key plant components, including a rebuild of the primary boiler heat exchangers,[220] a full rehabilitation of the turbines,[221] and a stator rewind at the generator.[222] See Table 9, below.

It is not clear if the Aguirre 2 projects are required to simply allow Aguirre to operate reliably over a short, near-term basis or represent a large life-extension effort. While PREPA's explanation for the turbine and generator projects both indicate that they are for purposes of extending the useful life of Aguirre 2, the turbine rehabilitation effort coincides with the complete failure of the turbine at Aguirre 2 in November 2015.[223] Therefore it is clear that PREPA requires at least minimum capital to keep these units available while the Commission determines if they should be continued through 2027, or replaced more rapidly.

According to PREPA's records, Aguirre 1 will also receive substantial new retrofits at its boiler, turbine and generator, amounting to $27.6 of spending between 2017 and 2019. The description for these projects are effectively identical to the spending at Aguirre 2, and therefore the same questions are unanswered: are these projects necessary if Aguirre were to be maintained through a near term replacement – i.e. 2021?

[220] CEPR-AH-06-09.(b).1

[221] CEPR-AH-06-09.(b).9

[222] CEPR-AH-06-09.(b).8

[223] CEPR-JF-01-16 Attach 02

Table 9. Historic and expected capital spending on individual projects at Aguirre Steam Units for projects with spending from FY2017 to FY2019, millions of dollars.[224]

	PID	Project Description	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
Unit 1	15243	Boiler Improvement	0.4	-	6.0	6.5	-	-
	14165	Turbine Generator Improvement	-	-	2.0	0.5	7.0	-
	14727	Generator Improvement	-	1.1	1.4	4.1	-	3.0
Unit 2	14169	Boiler Improvement	0.8	1.1	2.1	4.6	-	-
	18651	Turbine Generator Improvement	0.1	3.6	6.0	-	-	-
	16749	Generator Improvement	0.0	-	1.8	4.1	-	-
Common Expenses	14151	Steam Valve Reconditioning	0.1	0.9	-	-	2.0	-
	14725	Boiler Support Structures Improvement	1.0	0.6	0.6	-	-	-
	13442	HP and IP Rotor Improvement	0.4	-	5.0	2.7	4.0	-
	14143	Main Steam Condenser	0.0	-	0.9	-	-	-
	15921	Cathodic Protection and Improvement	-	-	0.1	0.1	-	-
	14135	Water Demineralizer Plant & Polishers	-	-	0.7	0.4	-	-
	14142	Discharge Canal Maintenance	-	-	0.4	0.3	0.5	-
	14125	Water Treatment Plant Clarifiers	-	-	-	-	1.2	0.2

ii. Reasonableness of Capital Projects at Aguirre Steam

Based on the extraordinary outages at Aguirre, it would appear that substantial capital may, in fact, be required to keep these units operational even over the near term. However, if PREPA is unable to operate these AOGP cornerstone units effectively, this undermines the potential savings that PREPA asserts will be made available through the AOGP project.

We have insufficient records and expertise to assess if the dollar values budgeted by PREPA are commensurate with the projects described here. However, PREPA's total anticipated spend at the Aguirre Steam Units on a dollar per kilowatt (kW) basis, averaging $24/kW from 2017-2019 for non-AOGP projects, are in line with "run-rate" capital dollars budgeted for steam coal units at other utilities, and are therefore not a pressing cause for concern.

c. Recommendation Regarding Capital Projects at Aguirre Steam

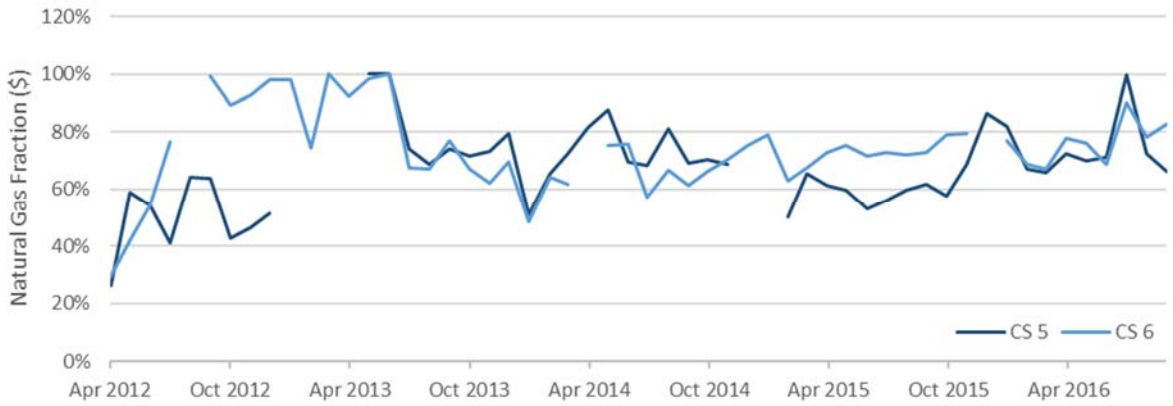
We recommend the Commission approve PREPA's FY2017 capital spending at Aguirre Steam.

3. Costa Sur steam units

[224] Schedule F3-REV

Costa Sur Plant is a 990 MW plant near Guayanilla. The Costa Sur Plant is comprised of four steam boiler electrical generating units, two sized at 85 MW and two sized at 410 MW.[225] While not discussed in PREPA's other literature, PREPA maintains two simple cycle turbines at the Costa Sur site, the capacity of which are have not been disclosed.[226] The Costa Sur units are designed to be fired by heavy fuel oil (No. 6).[227] Since 2012, Costa Sur units 5 & 6, the larger units at the plant, have been fired with approximately 60-80%[228] natural gas acquired from Gas Natural Fenosa, the majority owner of the EcoEléctrica power plant. The fraction of gas versus oil burned at units 5 & 6 has varied over time, but is rarely less than 60%.

Figure 19. Natural gas fraction of fuel consumed at Costa Sur 5 & 6 since April 2016.[229]



PREPA's 2015 IRP indicated that these units burn a specified natural gas fraction, but clearly the amount burned at the plant varies substantially. The IRP stated that "Costa Sur 5 burned 80 percent of natural gas and 20 percent of No. 6 fuel oil and Costa Sur 6 burns 75 percent of natural gas and 25 percent of No. 6 fuel oil."[230] With the exception of one month in late 2013, there is no time in which Costa Sur have either hit these targets or been restricted to these limits.

The Costa Sur Plant is the second largest single plant in the PREPA system, making up about 17 percent of PREPA's capacity.[231] The smaller two units at Costa Sur, 3 & 4, are not MATS compliant. PREPA has designated these units "limited use" as a mechanism of meeting MATS

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[225] PREPA Base IRP, August 17, 2015. Table 3-1.

[226] CEPR-AH-03-07 Attach 01

[227] PREPA Base IRP, August 17, 2015. Table 3-1

[228] CEPR-AH-06-01. Percentages by equivalent heat content.

[229] CEPR-AH-06-01.

[230] PREPA Base IRP, August 17, 2015. Table 7-5, footnote 1.

[231] Total system capacity 5,659 MW. PREPA Base IRP, August 17, 2015. Table 3-1.

requirements.[232] Under this designation, the units should remain below an eight percent capacity factor, starting in FY2016. In FY2016, PREPA required the use of these units, with Costa Sur 3 exceeding its allowed utilization with an 11.3 percent capacity factor.[233]

The larger two units at Costa Sur have operated with an average capacity of 65% over the last five years, and are therefore the highest utilization units on the PREPA system.[234] These units have maintained an average availability of 97 percent from calendar year 2012 to 2015, meaning that the duration and severity of their forced outages were relatively low.[235] PREPA's capital investments in these units have historically been at about the same level as at Aguirre, but the units are appear to be in better shape. For example, Aguirre's Steam Unit 1's last major maintenance cycle was in 2012,[236] and Costa Sur 5 & 6 received their last major maintenance outage cycle in 2013 and 2010, respectively.[237] This cycle structure suggests that Costa Sur and Aguirre should be at about the same level of maintenance, but Costa Sur is in far better shape than the Aguirre Steam units.

This rate case envisions a substantially lower level of investment at Costa Sur than Aguirre, even excluding the AOGP gas conversions at the Aguirre Steam Units. Overall, Costa Sur appears to be preparing for a major overhaul in FY2018-FY2020, with substantial investments in boilers and turbines. In addition, Costa Sur is in the process of modifying its cooling intake and discharge systems to meet environmental regulatory requirements.

a. Capital Projects at Costa Sur

PREPA anticipates spending $7.4 million on capital improvements at Costa Sur Units 5 & 6 in FY2017, a level which will increase substantially through FY2020[238] as the plant moves into a seven-year overhaul cycle.

PREPA has **not** indicated any capital expenditures at Costa Sur 3 & 4, even though these units are expected to remain online and providing backup capacity in PREPA's long-term plans, and even though they were utilized, albeit in a limited fashion, in FY2016. It is unclear the extent to which the Company expects to maintain or rely on these units without continued maintenance spending.

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[232] PREPA Base IRP, August 17, 2015. Table 7-5, note 3.

[233] CEPR-AH-03-07 Attach 01.

[234] *Id.*

[235] CEPR-JF-01-16 Attach 02. Author's calculations.

[236] CEPR-AH-06-12 Attach 02.

[237] *Id.*

[238] Schedule F3-REV.

Table 10. Historic and expected capital spending on individual projects at Aguirre Combined Cycle for projects with spending from FY2017 to FY2019, millions of dollars.[239]

PID	Project Description	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
16972	Boiler Improvement Unit 5	3.1	-	-	-	4.5	13.5
16973	Boiler Improvement Unit 6	-	0.2	2.7	7.0	6.5	-
New	Steam Coils Unit 5 and 6	-	-	0.2	0.2	0.3	-
New	Air Preheater Baskets Unit 5 and 6	-	-	0.6	1.0	-	-
15923	Water Heaters Unit 5 and 6	0.2	1.1	1.5	1.7	-	-
16974	Turbine Generator Improvement Unit 5	1.1	-	-	-	3.0	9.0
16975	Turbine Generator Improvement Unit 6	-	-	1.8	3.0	4.4	-
16941	Turbine Generator Back Up Improvement	1.5	0.7	0.6	-	-	4.0
New	Foxboro Automation System	-	-	0.1	-	-	-
16766	Mod. to the Cooling Water Intake Structure	0.5	0.1	1.5	3.0	3.0	3.0
16786	Modification to Cooling Discharge System	-	-	3.0	2.0	0.5	0.5
15029	Breaker Replacement - 480V and 4160V	-	-	0.2	0.2	-	-
	Total	**5.9**	**1.9**	**7.4**	**12.9**	**18.7**	**26.5**

i. Basis for and Reasonableness of Capital Projects at Aguirre Steam

PREPA's spending patterns suggest that the utility is targeting an approximate seven-year overhaul at Costa Sur 5 & 6. The capital dollars for the boiler and turbine refurbishment are in line with similar projects envisioned by PREPA and seen elsewhere.

PREPA's total anticipated spend at the Aguirre Steam Units on a dollar per kilowatt (kW) basis, averaging $16/kW from 2017-2019, are in line with "run-rate" capital dollars budgeted for steam coal units at other utilities, and are therefore not a pressing cause for concern.

b. Recommendation Regarding Capital Projects at Costa Sur

We recommend the Commission approve PREPA's FY2017 capital spending at Costa Sur 5 & 6.

In addition, we recommend that PREPA track capital dollars spent at each "limited use" facility separately then the units that are expected to be maintained. For Costa Sur, PREPA should track and report on projects at Units 3 & 4. Further, PREPA's long-term modeling should consistently assess if these limited use facilities are available for peak purposes, and if not, assess the value of maintaining units that neither contribute to peak purposes or provide energy to the system. PREPA's lack of maintenance spending at these units is inconsistent with its continued peak use of the facilities.

[239] Schedule F3-REV

4. Palo Seco steam units

Palo Seco Plant is comprised of four large electrical generating units in a complex on the western side of the Bahía de San Juan on Toa Baja, about two linear miles from downtown Old San Juan. Palo Seco has a similar, but smaller, setup than Costa Sur. Palo Seco 1 & 2 are 85 MW, and Palo Seco 3 & 4 are 216 MW.[240] Like PREPA's other large steam plants, PREPA maintains simple cycle turbines at the Palo Seco site, in this case six units not otherwise discussed in the literature.[241] Like PREPA's other units, Palo Seco was designed to be fired by heavy fuel oil (No. 6).[242] The Palo Seco Plant is the fourth largest plant in the PREPA system at 602 MW, making up about 10 percent of PREPA's capacity.[243]

a. Issues at Palo Seco

i. MATS compliance at Palo Seco

None of the steam units Palo Seco are MATS compliant, and PREPA has not designed a MATS compliance strategy to bring the Palo Seco plant into compliance. While PREPA indicates that it has designated the smaller two units at Palo Seco to be "limited use" as a mechanism of meeting MATS requirements,[244] the larger units do not have a specific compliance strategy. In the IRP, the consultant writes that "Siemens assumes that PREPA enters into a settlement agreement with EPA regarding Palo Seco 3 & 4 steam units (with a total capacity of 432 MW) allowing these units to continue operation burning No. 6 fuel oil through December 31, 2020, after that will be either replaced or designated as a limited use unit."[245] This strategy relies on PREPA's ability to replace the Palo Seco units on an expedited basis.

PREPA's designation of the Palo Seco 1 & 2 units as limited use would require the units to remain below an eight percent capacity factor, starting in April 2015 (FY2016). In FY2016, PREPA required the use of these units, and both Palo Seco 1 & 2 exceeding their allowed utilization by a substantial margin, with capacity factors of 39 and 44 percent, respectively.[246] Considering that in prior years Palo Seco 1 & 2 have been operated as baseload or intermediate units, with capacity factors equivalent to, or exceeding, PREPA's other steam-fired units. It is not clear under what circumstances PREPA would be able to operate these units under a "limited use" designation, consistent with the utility's commitment to EPA.

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[240] PREPA Base IRP, August 17, 2015. Table 3-1.

[241] CEPR-AH-03-07 Attach 01

[242] PREPA Base IRP, August 17, 2015. Table 3-1

[243] Total system capacity 5,659 MW. PREPA Base IRP, August 17, 2015. Table 3-1

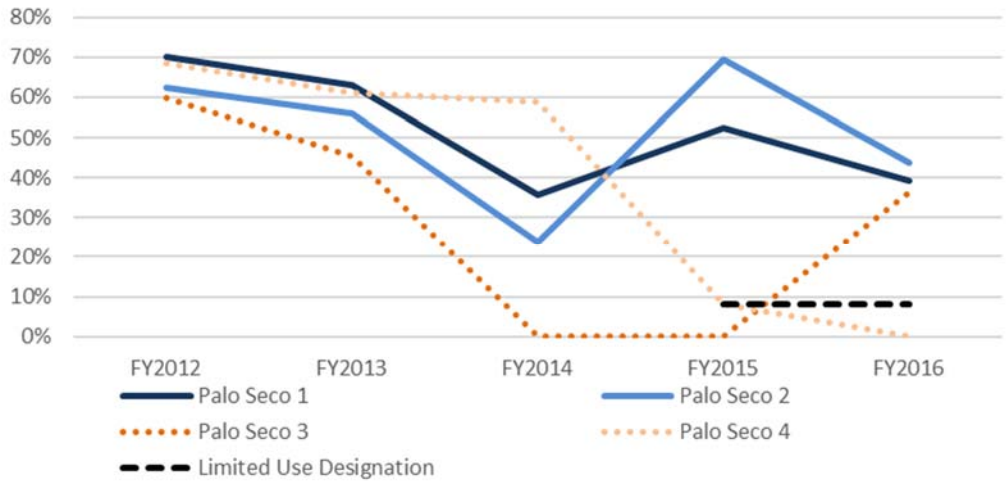
[244] PREPA Base IRP, August 17, 2015. Table 7-5, note 3.

[245] PREPA Base IRP, August 17, 2015. Section 7-5.

[246] CEPR-AH-03-07 Attach 01

As shown in Figure 20, the capacity factors of Palo Seco 1 & 2 have exceeded that of Palo Seco 3 & 4, which are supposed to be the units PREPA is invested in as Palo Seco 3 & 4 come offline. This does not appear to be the case.

Figure 20. Capacity factor at Palo Seco units FY2012-2016 and "limited use" designation for MATS compliance on Units 1 & 2.[247]



PREPA explains in discovery that, for the "limited use" units to be in service, the other generating stations operated by PREPA, in particular the other units at San Juan and Palo Seco, need to be in good operational order – which is currently not the case. Palo Seco 3 & 4 have had substantial outages, and PREPA does not expect Palo Seco 4 to be back in full service until the third quarter of FY2017, or January 2017.[248]

ii. Forced outages at Palo Seco 3 & 4

Palo Seco 3 & 4 are a fundamental part of PREPA's northern fleet, but have suffered substantial outages, in excess of those seen at the Aguirre Steam Units. Like Aguirre, the forced outage rate at Palo Seco has increased dramatically in 2014 and 2015. Between the four steam units, Palo Seco was only available about two-thirds (65 percent) of the time in calendar year 2015, a steep decline from its availability in 2012 and 2013 (97 and 94 percent, respectively).

It is confounding why a unit like Palo Seco cannot be kept operational, and its outages likely point to larger problems at the plant with maintenance and labor skills. From December 2014 to the present day, Palo Seco 4 has suffered substantial outages.[249] Starting in December 2014, steam turbine was de-rated (reduced in maximum output) by about half for about two

[247] CEPR-AH-03-07 Attach 01. Author's calculations.

[248] CEPR-JF-01-10(c).

[249] CEPR-JF-01-16 Attach 02

months while "high vibrations" caused operational concerns. In February 2015, while the unit was still de-rated, the steam turbine rotor failed and was "severely damaged."[250] After assessing the extent of damage, PREPA took the unit down for a five-month inspection to identify possible additional damage, and began a full overhaul.[251] After two months of operation, the turbine appears to have failed yet again, and the unit came offline again. The unit has not operated through the end of the record provided by PREPA (to August 2016), and has remained out of service.[252] Overall, Palo Seco 4 stayed on forced outage for over a year and a half, with only two months of actual operation in that time.

Palo Seco 3 has had a similarly spotty history with a series of forced outages beginning in October 2015.[253] Notably, PREPA reports only 41 days of forced outages in 2012 and 2013, and none in 2014. But starting in 2015, Palo Seco 3 began failing often. First, the cooling water intake structure failed, followed by leaks in the boiler, both of which caused substantial de-rates. By November 2015, the plant was experiencing debris and seaweed in the cooling water system and cracks in the boiler's air ducts, leaving the unit at about half capacity. Finally, by March 2016, the circulating water pumps had failed and the plant was taken offline for half a month for repairs. Less than two weeks after coming online, a new series of failures began in the condensate system and turbine controls. Through the end of July 2016, the unit continued to operate at a limited output.

b. Capital projects at Palo Seco

PREPA anticipates spending $8.5 million on capital improvements at Palo Seco Units 3 & 4 in FY2017. Most of the anticipated expenditures are targeted for this fiscal year (2017), and the most substantial projects are meant to mitigate the current damage and forced outages incurred at the plant. The largest single project, PID 13448 ("Turbine Generator Improvement") is a full overhaul of the turbine at Palo Seco 4 to restore this unit back to service. The second largest set of expenditures on traveling screens, the condenser water pump and improvements (PID 19639 and "New") are designed to mitigate significant problems in the intake water structures that get filled with debris and have caused substantial forced outages at Palo Seco 3.[254]

PREPA has **not** indicated any capital expenditures at Palo Seco 1 & 2, even though these units are expected to remain online and providing backup capacity in PREPA's long-term plans as "limited use" units. In FY2016, despite the units' "limited use" designation, these two units produced substantial energy at moderate capacity factors. It is unclear if PREPA can run

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[250] CEPR-AH-06-06(b)

[251] *Id*

[252] CEPR-AH-06-06(a)

[253] CEPR-JF-01-16 Attach 02

[254] CEPR-AH-06-07(a-c)

these units as "limited use," given the requirement to have generation in the north and continuing outages at PREPA's other northern power stations.

Figure 21. Historic and expected capital spending on individual projects at Palo Seco for projects with spending from FY2017 to FY2019, millions of dollars.[255]

PID	Project Description	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
13448	Turbine Generator Improvement Unit 4	-	0.3	3.0	-	-	2.0
16969	Boiler Improvement Unit 4	-	-	0.3	-	-	2.0
19660	Piping Hangers Replacement Unit 3 and 4	-	-	0.3	0.3	0.3	0.5
16950	Steam Coils Replacement Units 3 and 4	-	-	-	-	1.2	1.2
19639	Traveling Screens -Palo Seco	0.4	0.8	0.6	-	-	-
New	Condenser Circulating Water Pump	-	-	0.7	-	-	-
New	Condenser Improvement Unit 4	-	-	1.0	-	-	-
New	Loading Platform for DEMI Plant	-	-	0.1	-	-	-
12246	Feed water Pump Turbine Improvement	-	-	-	0.3	0.3	0.3
New	Bunker C Reserve Tank R3 Conversion to Diesel	-	-	2.0	2.0	-	-
19621	Water Demineralization Plant Improvement	0.2	0.3	0.2	-	-	-
New	Treatment Plant Filters	-	-	0.3	-	-	-
New	Waste Treatment Plant Nautilus 1 Replacement	-	-	-	0.4	-	-
New	Waste Treatment Plant Nautilus 2 Replacement	-	-	-	-	0.6	-
	Total	**0.5**	**1.4**	**8.5**	**3.0**	**2.4**	**6.0**

c. Recommendation with respect to capital projects at Palo Seco

We recommend the Commission approve PREPA's FY2017 capital spending at Palo Seco steam plant.

In addition, the Commission should **require PREPA to provide a strategic plan for Palo Seco**, including the following elements, at a minimum: maintenance plan, MATS compliance plan, an investment plan for maintaining (or not) Palo Seco 1 & 2, and a reliability study – i.e. what strains are placed on the system in the presence or absence of the Palo Seco steam units.

We recommend that the Commission require PREPA to track and report on projects at Palo Seco 1 & 2, regardless of if these units are considered limited use.

5. San Juan Steam units

The San Juan Steam Plant sits in San Juan at the southern end of the Bahía de San Juan. It is comprised of four 100 MW steam units[256] built between 1965-1969, making it the oldest

[255] Schedule F3-REV

[256] PREPA Base IRP, August 17, 2015. Table 3-1.

steam plant still in active use at PREPA. The San Juan Steam Units were designed to be fired by heavy fuel oil (No. 6).[257]

a. Issues at San Juan steam units

i. Forced outages at the San Juan steam units

Like Palo Seco and Aguirre Steam, San Juan Steam has seen a substantial and increasing forced outages over the last two years, although the reasons for the outages appear to be a variety of failures across the individual units. San Juan 10 was taken out of service in October 2014 and due to "high vibrations" has seen about two months of full service since that time in mid-2015, with an effective availability of about 18% in calendar year 2015. The unit is still offline and not expected to return to service until "the third quarter of 2017," or spring 2017.[258]San Juan 9 has also had a series of outages in mid-2015, but has generally remained serviceable over the last six months with relatively minor outages compared to San Juan 10.

San Juan 7 & 8 have had a better track record than San Juan 9 & 10, maintaining better availability over the last two years. It is not clear why San Juan 7 & 8, which have generally been considered less viable units, have remained available while San Juan 9 & 10 have succumbed to so many maintenance problems. PREPA's MATS compliance strategy stands in stark contrast to the condition of these units.

ii. MATS Compliance at the San Juan steam units

PREPA has no immediate mechanism of meeting MATS compliance obligations at San Juan plant aside from operating the units at or below EPA's "limited use" eight percent capacity factor limit. In April 2013, PREPA submitted a letter to the Puerto Rico Planning Board stating an intent to designate San Juan 7 & 8 as "limited use," and petitioning for leniency with respect to San Juan 9 and 10. The letter explained **San Juan 9 & 10 could not be designated as limited use units** because such a reduction would have an adverse impact on the electrical system operation. The letter states:

> These units are among the largest ones on the north side of the system. In combination with San Juan Power Plant units, they provide the required load generation balance for the reliable and stable operation of the system, and also they have the largest frequency regulation range on the north coast of the island. The power generation from these units is required to maintain the reliability of the electrical system, especially under contingencies of the northern generating units. Based on the above, these units are considered critical reliability units. Their retirement or generation reduction (limited use)

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[257] PREPA Base IRP, August 17, 2015. Table 3-1

[258] CEPR-JF-01-10(c)

> will have an adverse impact on the electrical system operation and reliability, as well as the people of Puerto Rico's wellbeing and national security stability.[259]

Instead, PREPA offered that it "plan[ned] to convert these nits to burn natural gas on a duel fuel scenario with Bunker C fuel oil," and that PREPA was "conducting an evaluation to identify the feasible infrastructure to supply and manage natural gas to the units in the north coast of the island" with an "estimated date of completion by the second quarter of 2017."[260]

Despite a Commission requirement, PREPA did not provide a response from the Puerto Rico Environmental Quality Board (PREQB) or U.S. EPA on either PREPA's designation or petition. PREPA's plans to extend natural gas to the north were not seriously considered in the 2015 IRP,[261] and where they were considered, PREPA did not envision this scenario until July 2022.

PREPA's preferred scenario in the 2015 IRP envisions that San Juan 9 & 10 would be retired in December 2020.[262]

In the meantime, San Juan 7 & 8, which were supposed to be designated as "limited use" units for MATS compliance purposes, have continued to operate at capacity factors well above their regulatory requirement. Over the last five years, these two units have maintained an approximate 60 percent capacity factor.

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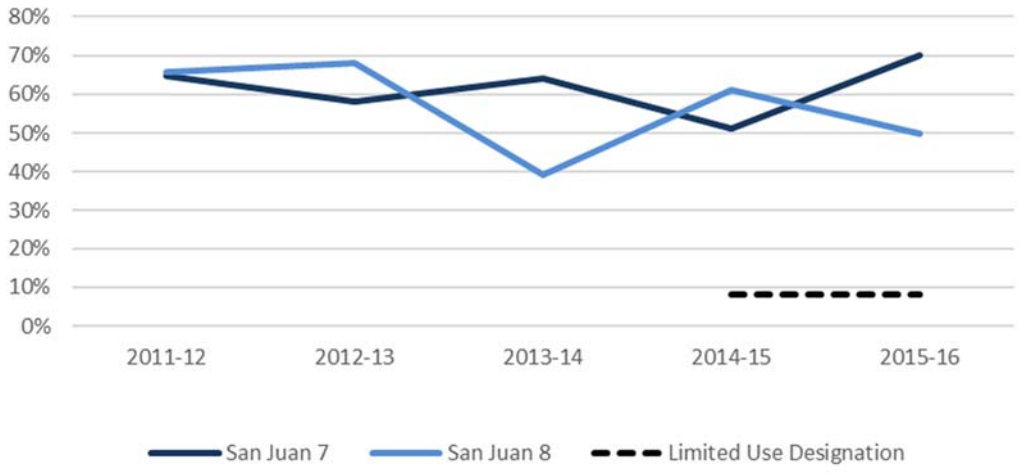
[259] CEPR-JF-01-10 Attach 01. Early Notice of Compliance Plan – Mercury and Air Toxics Standards (MATS) pages 9-10.

[260] *Id.*

[261] While the IRP considered scenarios in which gas is available in the north, there were no studies to suppor either the timing, infrastructure requirements, legal or permit requirements, costs, or viability. With respect to this option, PREPA states "Gas to the North presents an appealing proposition of enabling PREPA to build new or convert existing generation close to the demand centers and reduce the level of dependence on the South-to-North electric transmission system. While gas to the North could potentially be achieved via LNG infrastructure in the North or a South-to-North gas pipeline, the feasibility of either option is yet to be evaluated." PREPA 2015 Integrated Resource Plan, Section 6.3.1.

[262] Base IRP. Section 8.10. "Portfolio 3 Future 1 (P3F1). P3F1 key decisions include:…6. San Juan 9&10 and Palo Seco 3&4 will be either retired or designated to limited use by December 31, 2020." Also Table 7-5.

Figure 22. Capacity factor at San Juan 7 & 8 FY2012-2016, relative to "limited use" designation for MATS compliance.[263]



These inconsistencies in PREPA's claims and records leave this Commission with an unfortunate set of uncertainties. The following questions are unresolved by PREPA's record and remain unclear:

1. What PREPA can do to achieve reasonable MATS compliance at San Juan Plant, if at all.
2. What steps PREPA is taking to achieve MATS compliance at San Juan 9 & 10.
3. What expectations have been set with EPA with respect to MATS compliance at San Juan 9 & 10.
4. If PREPA still relies on the assumption that San Juan 9 & 10 will be converted to natural gas with a "gas to the north" scenario.
5. How the extremely poor operational record at San Juan 10 comports with PREPA's claim that this unit is critical for reliability in the north of Puerto Rico.
6. How PREPA expects to meet the limited use designation for San Juan 7 & 8.

b. Capital Projects at San Juan Steam

Despite the extraordinary poor reliability of San Juan 10 and the stated critical nature of the San Juan plant according to PREPA's claims, the utility has lined up very few capital projects at the plant. In fact, the level of expenditures are so low that under other circumstances it could signal an intent to potentially abandon the plant.

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[263] CEPR-AH-03-07 Attach 01. Author's calculations.

Table 11 shows PREPA's expected spending at San Juan. As shown in the table, PREPA expects to spend $200,000 at all of San Juan Steam in FY2017, a paltry sum to support the reliability and operations of a theoretically critical plant. At $200,000 in FY2017, PREPA is effectively spending $0.50/kW, or about an order and a half of magnitude less than steam plants of this size might typically require. Spending in FY0218 is equally small. Only in FY2019 does PREPA's expected capital spending actually translate into real project spending at $15 million for improvements to the turbines and boilers at San Juan 9 & 10.

Table 11. Historic and expected capital spending on individual projects at San Juan steam for projects with spending from FY2017 to FY2019, millions of dollars.[264]

PID	Project Description	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
19477	Traveling Screens Units 7 to 10	0.1	0.0	0.2	0.2	-	-
New	Air Preheater Baskets Unit 7	-	-	-	0.5	1.0	-
New	Air Preheater Support Trunion Replacement U-10	-	-	-	-	2.0	-
New	Turbine Improvement Unit 9	-	-	-	-	4.0	-
New	Turbine Improvement Unit 10	-	-	-	-	4.0	-
New	Install High Pressure Parts (SH, RH, Econ) Unit 9	-	-	-	-	4.5	-
	Total	**0.1**	**0.0**	**0.2**	**0.7**	**15.5**	**-**

These spending expectations at San Juan are problematic for a variety of reasons:

First, the lack of spending in the near term for San Juan 9 & 10 is inconsistent with the stated critical nature of these units, the current extended outage at San Juan 10 and the spotty nature of San Juan 9's reliability. It is difficult to imagine how PREPA expects to maintain units with an extraordinary failure rate and expect to spend no capital dollars on replacement parts at the failing units until FY2019.

Second, while San Juan 7 & 8 have been designated as "limited use" by PREPA, they are still able to provide peaking services and have clearly played a role in supporting PREPA's system while San Juan 10 has been down. PREPA's capital budget suggests that these units will not be maintained at all. Again, like PREPA's other limited use designated units, if PREPA requires the capacity from these units during critical or emergency periods, the units need to be maintained at a minimum level. If PREPA absolutely does not require these units for reliability purposes, they should be retired. The idea that PREPA can simply abandon these units from a capital or maintenance perspective and still hope that they will provide services is poor utility practice and endangers PREPA's system.

Third, PREPA's expectations of substantial capital spending in FY2019 on San Juan 9 & 10 are inconsistent with the IRP's expectation that these units will either be declared "limited

[264] Schedule F3-REV

use" or retired by December 2020. It is unclear why this spending is deferred and then spent just prior to these units potentially coming out of service.

c. Recommendation Regarding Capital Projects at San Juan Steam

We recommend the Commission approve PREPA's FY2017 capital spending at San Juan Steam.

In addition, the Commission should **require PREPA to provide a strategic plan for San Juan**, including the following elements, at a minimum: maintenance plan, MATS compliance plan, an investment plan for maintaining (or not) San Juan 7-10, and a reliability study – i.e. what strains are placed on the system in the presence or absence of the San Juan steam units.

We recommend that the Commission require PREPA to track and report on projects at San Juan 7-10, regardless of if these units are considered limited use.

6. Aguirre and San Juan Combined Cycle Units

The Aguirre and San Juan Combined Cycle ("CC") Units are the only combined cycle units in PREPA's current fleet. Located at the Aguirre and San Juan plant sites, respectively, these units are comprised of combustion turbine ("CT") units and heat recovery steam generators ("HRSG"). These units are designed to capture waste heat from the combustion turbine and harness that heat for the purposes of creating additional generation. Both sets of combined cycle units burn diesel fuel.

The two Aguirre CC units each have a nameplate capacity of 296 MW, but are considered to have a 260 MW maximum output by PREPA,[265] for a total of 520 MW. Each CC unit is comprised of four combustion turbine units and a single HRSG.[266] The units were built in 1977 and have a very high heat rate (i.e. low efficiency) for a combined cycle unit (11.1 MMBtu/MWh).[267]

The two San Juan CC units each have a nameplate capacity of 220 MW, but are considered to have a 200 MW maximum output by PREPA,[268] for a total of 400 MW. The units were built

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[265] Base IRP. Table 3-11, footnote 3.

[266] CEPR-AH-03-07 Attach 01.

[267] Inconsistent reports: Base IRP. Table 3-1: ~7,700 btu/kW. URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 9: 8,253 btu/kWh.

[268] Base IRP. Table 3-11, footnote 3.

very recently, in 2008 and 2009. As such, they have relatively low heat rates (i.e. high efficiency) at around 8.0 MMBtu/MWh.[269]

a. Issues at the Combined Cycle Units

i. MATS Compliance

Outside of the natural gas fired Costa Sur 5 & 6, the Aguirre and San Juan Combined Cycle units are the rare fossil generating units in PREPA's fleet that are compliant with MATS before any retrofits or refueling options. Falling under the definition of stationary combustion turbine,[270] these combined cycle units are not affected units under the rule.

ii. Forced Outages at Aguirre CCs

PREPA did not provide forced outage records or estimates for the Aguirre Combined Cycle units. The 2015 IRP indicated an appallingly high 20% modeled forced outage rate for these units.[271] Considering that a review of the IRP's estimates against historic outage rates often appear relatively low, and the it seems likely that the recent forced outage rate of the Aguirre Combined Cycle units are likely well above that reported in the IRP.

iii. Commission IRP Requirement to Pursue Repowering Project Aguirre CCs

In the 2015 IRP, PREPA discussed a plan to repower the Aguirre CCs, replacing the unit's turbine to increase output and improve the heat rate of the unit. Presumably this retrofit process would or could substantially reduce forced outages. The case for improving this MATS compliant unit was so compelling that the Commission ordered that "PREPA shall pursue permitting and start a competitive bidding process pursuant to Section 6B(a)(iii) of Act 83 and the Joint Regulation approved by the Commission and PREPA to that effect, for the repowering of the Aguirre 1 and 2 CC units with new, dual-fuel capable turbines.[272] The Commission noted that "turbine replacement will allow this facility to continue operating, with more flexibility. Turbine replacements for the Aguirre 1 and 2 combined cycle units come at a moderate cost, but provide a 21% improvement in heat rate and a three-fold increase in capacity factor," and found "that repowering of the Aguirre CC units is a sound investment."[273]

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[269] Base IRP. Table 3-1.

[270] 77 FR 9486, §63.10042

[271] Base IRP. Appendix B-1.

[272] Final IRP Order, VII(B)(1)(c)

[273] Final IRP Order, VI(A)(4)

PREPA's modeling of their system for the IRP and as provided in this rate case[274]

Neither the repowering nor the planning or permitting costs for the repowering are part of PREPA's petition for a rate increase.

iv. Gas Conversion of Aguirre CC

In the 2015 IRP, PREPA proposes to convert the Aguirre CC to operate as a gas fired facility starting in 2018, with the conversion coming online with the AOGP project. In the rate case, PREPA ties in the gas conversion of the Aguirre CC with the AOGP project from a capital perspective, seeking to spend $46.6 million at the units for conversion work. As discussed in that section, PREPA has not yet signed a contract for this work, but has engaged in informal discussions on the topic with General Electric.

The costs of the gas conversion at the Aguirre CC are not discussed here.

b. Capital Projects at the Aguirre and San Juan CCs

i. General

PREPA's capital budgets at Aguirre and San Juan CCs are both very different from each other and tell a story about PREPA's priorities. At Aguirre CC, PREPA proposes to spend $17.8 million from FY2017 to FY2019, (see Table 12) or an average of about $11.5/kW. The bulk of these projects comprise scheduled maintenance and "automation" systems. PREPA's spending on scheduled maintenance in FY2017 is commensurate with the amount spent in FY2016, and yet according to PREPA's records the it appears that the outages at Aguirre CC keep this unit from contributing meaningfully to PREPA's electrical system. In addition, PREPA seeks to make the gas conversion of the Aguirre CC a key component of the AOGP project and gasification of the south. It is unclear why PREPA would not seek to implement comprehensive projects to ensure that the plant is available to provide reliable power rather than just spending on a business-as-usual schedule.

PREPA's projects at Aguirre CC appear to be primarily driven by individual improvement projects, run by PREPA staff.

In contrast, at San Juan CC plant, PREPA seeks to spend $40.8 million from FY2017 to FY2019, (see Table 12) or an average of about $34/kW. The vast bulk of the spending is directed towards an external maintenance contract (PIDs 16945 & 16946), discussed in the next section. It is not clear why PREPA allocates such a larger dollar figure towards the San Juan CCs, aside from the fact that the utility holds an external contract that may require minimum spending to meet contract quality obligations.

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[274] CEPR-JF-01-22 Attach 02

Overall, the difference in spending between the CC projects suggests that PREPA is prepared to have relatively poor operations at Aguirre CC (until the units are repowered in 2020 or beyond) while San Juan CC is considered a key critical resource. This spending pattern appears to, again, be a reactive mechanism by which PREPA reactively – only when a critical problem emerges – and defers spending until a major project like AOGP can be justified. The Company's modeling indicates that a repowered Aguirre CC unit, operating with a lower heat rate and better reliability, is a key mechanism by which PREPA can retire Palo Seco and San Juan steam units. Nonetheless, the utility's spending seems potentially low on a unit characterized with a 20 percent failure rate.

Table 12. Historic and expected capital spending on individual projects at Aguirre and San Juan CCs for projects with spending from FY2017 to FY2019, millions of dollars.[275]

Unit	PID	Project Description	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
Aguirre Combined Cycle	14672	Scheduled Maintenance Stage 1	1.0	2.4	2.1	2.3	2.1	2.0
	7542	CO2 Cooling System Units Turbine	0.0	-	-	-	0.1	-
	16752	Steam Turbine and Generator Improvement	0.4	0.8	0.6	-	4.8	4.0
	15763	Valve Replacement and Improvement of HRSG	0.3	-	0.3	0.2	0.3	0.3
	New	Foxboro Automation System for Steam Turbine	-	-	1.2	1.4	-	-
	16451	Seawater Cooling Tower Improvement	-	0.5	0.4	0.2	0.2	0.2
	16455	Make-Up Water System Replacement	-	-	0.2	0.4	-	-
	13534	New Transformer 500kVa 4160/480	0.1	0.0	0.1	0.1	-	-
	16017	Battery Banks	-	-	-	0.2	0.3	-
		Total (Aguirre Combined Cycle)	**1.9**	**3.8**	**4.9**	**4.7**	**7.8**	**6.5**
San Juan Combined Cycle	16945	Combined Cycle Improvement U-5	6.7	8.3	6.0	6.0	6.0	6.0
	16946	Combined Cycle Improvement U-6	5.4	4.8	6.0	6.0	6.0	6.0
	17039	Scheduled maintenance HRSG - Unit 5	-	-	0.3	-	2.0	2.5
	17040	Scheduled maintenance HRSG - Unit 6	-	-	-	0.3	-	2.5
	17041	Spares and Maintenance Components - U5 & 6	0.1	0.7	0.3	0.3	0.3	0.5
	19500	Combustion Turbines Insulation - U5 & 6	-	0.2	0.3	-	0.5	-
	New	Torque Converters - U5 & 6	-	-	0.1	0.3	-	-
		Total (San Juan Combined Cycle)	**12.1**	**14.0**	**13.0**	**13.0**	**14.8**	**17.5**

ii. Maintenance Contract at San Juan CC

The primary spending at San Juan CC is a maintenance contract from Mitsubishi-Hitachi ("MHPS-PR") to service the combustion turbines and generators (PIDs 16945 & 16946).[276] This long-term services agreement, signed in March 2016, extends and expands the scope of services provided by MHPS-PR from technical support and assistance, as agreed to at the end of 2007, to a full maintenance contract. The URS June 2013 Annual Report describes the contract:

[275] Schedule F3-REV

[276] Response to Oct 20 2016 clarification call CEPR Request No. 4 (supplemental). Long-Term Service Agreement between PREPA and HMPS-PR.

> The Authority has a long term multi-year service agreement with the combustion turbine vendor to provide technical advice and to perform inspections of the combustion turbine generators and the steam turbine generators that comprise San Juan Units 5 & 6. The Authority is responsible for the inspection and maintenance of auxiliary equipment in these units. [277]

The full version of this contract was only made available to the Commission a week before the expert reports were due, and thus it is impossible at this stage to assess if the scope of services under this contract are reasonable for the price, and if the aggregate $12 million per year budgeted by PREPA is consistent with the contract.

It is clear, however, that most – if not all – of the services provided under the contract are associated with ongoing standard maintenance cycles. Because this contract is specifically associated with the regular maintenance of the generator, the costs of this contract should likely be considered an operations and maintenance (O&M) expense rather than a capital cost.

Inspections and overhauls at power plants are typically divided into tiers, not dissimilar to car companies' recommendations for service intervals. Minor maintenance and inspections are performed multiple times every year to look for operational problems. More significant maintenance cycles, requiring the temporary idling of a unit, are typically scheduled for low load seasons. Finally, major maintenance outages occur on multi-year cycles, and are designed to overhaul and replace worn equipment and keep units in a good state of repair.

The San Juan CC contract with MHPS-PR provides for layers of inspections at multi-year intervals, and can be expected to provide ongoing service for several years. While we do not have evidence that the maintenance contract at San Juan is not currently effective, the contract lacks any form of performance incentive or metrics. The contract appears to insulate the contractor from performance failures as well. While the terms of the contract are considered proprietary, the penalties imposed on the contractor for outage delays do not appear commensurate with the cost of those delays on PREPA.

The 2013 URS Report suggests that in 2011 and 2012 the contractor, who was the predecessor to HMPS-PR, failed to keep the then brand-new units online. At only two years since commissioning, the generators at the San Juan CCs began deteriorating, failing substantially three times between 2011 and 2013.

> The **failure** of CT 6's generator late in fiscal year 2011 had caused the Authority to put ST 6 in reserve shutdown for economy. In fiscal year 2012 it was accruing days in reserve shutdown for economy when Unit 5's steam

[277] URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 23

> turbine generator rotor **failed**. To return Unit 5's steam turbine to available status, the Authority installed the Unit 6 generator rotor into ST 5's generator…. The generator rotor from ST 5 was sent to a mainland facility to be refurbished. It was returned to Puerto Rico for installation in ST 6 in August; the steam turbine was ready for service in September. After less than 100 hours in operation the rotor **failed** again. In October the OEM removed the rotor and sent it for repairs. The repaired rotor returned to the island in December and the steam turbine was available for service in January.[278]

(Unfortunately, this train of events as recorded in the URS study cannot be seen in the forced outage records provided by PREPA, which extend back to early 2012.)

It is unclear how a relatively new unit like the San Juan CCs failed so many times so shortly after commissioning, and if the failures were due to ambient conditions, the quality of materials available, operational problems or failure, staff failures, or poor maintenance contracts.

c. Recommendation Regarding Capital Projects at the Combined Cycle Units

We recommend that the maintenance contract at San Juan CC be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $12 million in FY2017 from capital to O&M.

We recommend that the Commission approve the other capital expenses at San Juan and Aguirre Combined Cycle Units.

We recommend that the Commission examine the MHPS-PR contract and the performance of MHPS-PR to determine if the contractor is meeting performance expectations for maintenance service at San Juan CC.

We recommend that the Commission require PREPA to file notice of any long-term contract with service providers with a potential net present value of $25 million value or higher.

7. Cambalache and Mayagüez

Cambalache and Mayagüez are two combustion turbine (CTs, also known as "gas turbines" or GTs) that burn diesel. Cambalache, near Arecibo on the northern central coast, is comprised of three power blocks of 83 MW each, or 249 MW. It was built from 1997-1998.

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[278] URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 25

Mayagüez station, located in Mayagüez on the west coast, is comprised of four power blocks at ~50 MW each, or 200 MW.[279] The GT units at Mayagüez are some of PREPA's most recently built, coming into service in 2009.

PREPA did not provide a comprehensive record of forced outages at Cambalache or Mayagüez. The 2013 URS Report discussed a critical failure at the Cambalache plant when a control system fault led to the buildup of unburnt fuel in a turbine, leading to an explosion that severely damaged Unit 1 in 2013.[280] The same report discusses more minor outages at Mayagüez, including an incorrectly installed turbine which required modification under warrantee.

a. Capital Projects at Cambalache and Mayagüez

PREPA's capital expectations for Cambalache and Mayagüez are comprised entirely of flat fees for "inspections" at Cambalache (PID 15880) and "improvement" at Mayagüez (PID 16978).

At Cambalache, the inspection represents an ongoing service contract with Alstom, valued at $4 million per year.

At Mayagüez, PREPA simply indicates a flat $600,000 per year "improvement."

While PREPA provided the Alsom maintenance contract, it is not clear what projects are included under the Mayagüez umbrella, or if it simply represents maintenance spending. It is also unclear why PREPA anticipates spending $4,000,000 per year at the older, less efficient 249 MW Cambalache plant, and only one-sixth ($1/6^{th}$) of that capital at the far more efficient, newer Mayagüez station. This discrepancy reinforces the concern that PREPA's maintenance budgets are not well balanced, and put their most valuable, flexible and reliable resources at risk through underinvestment.

i. Maintenance Contract at Cambalache

The primary spending at Cambalache is a maintenance contract with contractor Alstom Caribe (now a division of GE Power). The twelve-year contract, signed in May 2011, is designed to provide an inspection and refurbishment of combustion turbines and generators every two and a half years.[281] Specifically, the contract provides services for what are termed

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[279] Conflicting evidence: URS June 2013 Annual Report. Page 9: 55 MW each. Base IRP. Table 3-1: 50 MW each.

[280] URS June 2013 Annual Report. PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 27

[281] Alstom Cambalache 2011 Contract, available as CEPR 161020 Request No. 4. Attach 01.pdf. Term is to December 31, 2023 or six "C inspection" cycles, whichever is earlier.

"C Inspections," performed at 25,000 operating hours[282] – or approximately every two to three years.

Like the San Juan CC maintenance contract, Alstom divides maintenance into cycles, denoted as "A" through "D" inspections. "A" inspections occur approximately every month and a half (1,000 hours) and include preventative maintenance. "B" inspections occur every year and half (12,500 hours) and include the disassembly of the turbine unit for closer review. "C" inspections, every two and a half to three years (25,000 hours), include the refurbishment of the turbine and combustion chamber. Finally, "D" inspections, every five to seven years (50,000 hours), entail the refurbishment or replacement of any worn component in the generator or turbine.[283] The maintenance contract at Cambalache is specifically geared to the "C" inspection cycle.

According to the URS June 2013 Annual Report, "under this contract the OEM [Original Equipment Manufacturer] provide *[sic]* a full time technical assistant (TA) during class C inspections and for the replacement parts needed in the hot gas path during class C inspections of the combustion turbine." [284] Maintenance responsibilities under the contract are split between PREPA and Alstom, where Alstom provides turbine cleaning, inspection and refurbishment services, but PREPA "employees are responsible for the installation of replacement parts,"[285] and day-to-day operations and site maintenance.[286]

The "C" inspections provided under this contract would appear to fall into standard ongoing standard maintenance cycles. Because this contract is specifically associated with the regular maintenance of the generator, the costs of this contract should likely be considered an operations and maintenance (O&M) expense rather than a capital cost.

While the contract requires that Alstom provide a "permanent on-site operations and maintenance advisor,"[287] and provides a "technical field advisor" for "A" and "B" inspections, the contract does not actually specify the role of the technical field advisor, who leads the inspection and refurbishment process, and most importantly, who bears responsibility for correctly executed inspections, maintenance, and replacement.

The contract recognizes that Alstom relies on PREPA staff for much of the execution of maintenance, and specifically seeks to reduce Alstom's liability for PREPA staff negligence or deficiencies. Alstom included a contract provision that "excludes any and all liquidated

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[282] URS June 2013 Annual Report. Page 6

[283] URS June 2013 Annual Report. Page 6-7

[284] URS June 2013 Annual Report. Page 26

[285] URS June 2013 Annual Report. Page 26.

[286] Alstom Cambalache 2011 Contract, Paragraph 1.5 and Appendix 1.

[287] Alstom Cambalache 2011 Contract, Paragraph 1.1(h)

damages for outage schedule delays, unless such delay is one hundred percent attributable to a negligent act or omission of ALSTOM (i.e. ALSTOM fails to deliver a correct part or make available the required personnel and such late delivery/performance causes an outage delay)."[288]

Since PREPA did not provide a record of forced outages at Cambalache, including any reasons for outages or delays, we cannot thoroughly evaluate the performance of the maintenance contract at Cambalache. The URS June 2013 Annual Report describes a two-year outage at Cambalache based on a control system failure resulting in an explosion in the turbine.[289] While it is not clear if this failure and the subsequent outage are attributable to Alstom, it occurred under the predecessor contract.

The Cambalache contract also contains no performance incentives or penalties to keep the units in operation or in a state of good repair. Alstom's liabilities are limited to a small fraction of the cost of the contract, even in the most severe cases.[290]

b. Recommendation Regarding Capital Projects at the CTs

We recommend that the maintenance contract at Cambalache be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $4 million in FY2017 from capital to O&M.

We have insufficient information on the nature of the improvements at Mayagüez station, and although we suspect that these represent standard maintenance cycles, this clarification must be made later. Considering this uncertainty and due to the relatively small impact of this specific expense, **we recommend that the Commission approve the $600,000 FY2017 improvements at Mayagüez**.

We recommend that the Commission examine the Camabalache contract and the performance of Alstom to determine if the contractor is meeting performance expectations for maintenance service at Camabalache.

D. Aguirre Offshore GasPort capital budget

1. Introduction and Overview

The Aguirre Offshore GasPort ("AOGP") is a re-gasification facility meant to allow the Aguirre Steam and Aguirre Combined Cycle units (collectively "Aguirre Plant") access to natural gas shipped to Puerto Rico as liquefied natural gas (LNG). The facility is currently in the final

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[288] Alstom Cambalache 2011 Contract, Paragraph 1.1(f)

[289] URS June 2013 Annual Report. Page 27

[290] Alstom Cambalache 2011 Contract, Paragraph 8.3.

stages of permitting and engineering. Per PREPA's records, the utility has spent limited dollars on the port facility itself, but has made substantial monetary commitments to the project and has advanced the process of converting the plants at Aguirre Plant to burn natural gas. This rate case contemplates **$56.3 million in FY2017** and **$413.3 million in FY2018** capital spending for AOGP-related projects.

AOGP is supported by PREPA on four primary points. Per the Environmental Impact Statement (EIS) prepared by the Federal Energy Regulatory Commission (FERC), AOGP "would [1] contribute to the diversification of energy sources in Puerto Rico, [2] allow the Aguirre Plant to meet the requirements of the EPA's Mercury and Air Toxics Standard rule, [3] reduce fuel oil barge traffic in Jobos Bay, and [4] contribute to energy price stabilization in the region."

The AOGP project is comprised of the installation of infrastructure meant to support and transport natural gas from an offshore LNG re-gasification ship to the Aguirre Plant. When complete, AOGP's vendor, Excelerate, would dock a "Floating Storage and Regasification Unit" (FSRU) at the offshore port. Arriving tankers would transfer LNG to the FRSU, which would decompress the LNG on an as-needed basis, shipping the decompressed natural gas through an undersea pipeline to the Aguirre Plant.[291]

2. AOGP project boundaries

AOGP, as addressed in this rate case, refers to four distinct but interlinked projects, as well as other back office initiatives to bring the project to fruition. The four projects:

1. The offshore project: an LNG berthing platform and submerged pipeline to the Aguirre Plant site;
2. The onshore project: a pipeline from Jobos bay to the Aguirre Plant facilities;
3. Combined cycle conversion project: the installation of natural gas burners and control equipment at Aguirre Combined Cycle Units 1 and 2;
4. Units 1 & 2 conversion project: the installation of natural gas burners, boiler modifications, and control equipment at Aguirre Steam Units 1 and 2.

The definition of AOGP as used in this rate case differs substantially from the definition in PREPA's Integrated Resource Plan (IRP), docket CEPR-AP-2015-002. In the IRP, the AOGP project refers exclusively to the offshore and onshore projects, while the conversion projects are considered separately. In the rate case, by contrast, all four projects are bundled under

[291] Federal Energy Regulatory Commission. February 2015. Aguirre Offshore GasPort Project: Final Environmental Impact Statement (FEIS). Docket Nos. CP13-193-000 and PF12-4-000.

one umbrella.[292] While there are differences between costs and timelines as proposed in the IRP and in this rate case, care should be taken not to overlook the substantial differences between the definitions in both cases. For the purposes of this report and case, AOGP refers to the entire project, including the offshore and onshore components, as well as the natural gas conversion projects at Aguirre Plant.

This section on AOGP details the Company's justification for the AOGP project, the due diligence and analyses conducted by PREPA, the reasonableness of the construction contract for AOGP, this Commission's findings in the IRP proceeding with respect to AOGP, and the role of that finding with respect to this rate case.

3. Cost, contracting and financing at AOGP

a. Capital cost of AOGP

AOGP, as used in this rate case, encompasses four major projects and back office components. As of the time this rate case was filed, PREPA anticipated the cost of the total AOGP at $552 million, including financing costs. The total cost of the project also includes financing costs. The capital costs that PREPA associates with the AOGP project are a combination of vendor contracts and in-house efforts. We discuss the contracts held by PREPA in the section below.

As of July 2016, the filing of this rate case, PREPA's budget for the whole AOGP project was $517 million, before financing costs, as shown in Table 13, below.

Table 13. Aguirre Offshore Gasport capital budget – 2014, 2016

Project	2016 Budget Estimate[293]
Offshore Project	339,063,421
Onshore Project	27,345,940
Combined Cycle Gas Conversion	46,637,480
Steam Unit Gas Conversion[294]	87,490,350
Back Office Components	
Professional Services	6,509,452
MOU Permitting Costs	5,000,000
PREPA Permits	164,012
Environmental Justice	2,000,000
Project Management	2,560,744
Total	**516,771,399**
	31,014,105

[292] PREPA's responses to CEPR-AH-01-02 and CEPR-AH-03-013. "The financed cost of AOGP as used in the IRP does not include the cost of performing fuel conversions at the Aguirre steam and combined cycle units, but the rate case value does include these conversion costs."

[293] CEPR-AH-01-01, and CEPR-01-01_Attach 01.

[294] Includes contingency at $5.15 million.

This budget is does not appear to be consistent over time.

First, PREPA has not contracted for the conversion of the combined cycle unit, and only holds estimates from GE, as discussed in the next section on contracts. Therefore, PREPA's budget for this line item is still unresolved.

Second, when PREPA experienced a construction budget increase for the offshore project of $20 million[295] (or $24 million, depending on the source[296]) it also reduced its contingency holdback by $2 million. This is poor engineering practice: an increase in budget should signal that the contingency should be maintained, if not increased – not decreased.

Finally, PREPA is conducting other projects at the Aguirre Steam Units that are specifically designed to support the natural gas conversion, but are not clustered under the AOGP umbrella. Specifically, PREPA identifies three boiler improvements at Aguirre that are prerequisite and complementary projects for the natural gas conversion.[297] At least one of these projects, a heat exchanger replacement at Aguirre Steam Unit 1, was not contemplated in PREPA's 2015 major capital projects,[298] and adds another $12.5 million to the prospect of the conversions.[299]

PREPA's commitments and investments under AOGP are not limited to the capital costs of the project. As we discuss in the contracting section below, the finalization of the AOGP also triggers the hiring of the FRSU vessel from Excelerate, a 15-year commitment at $40.7 million per year – or a present value of $422 million.

Unlike the remainder of its capital projects, PREPA also assumes it will be able to secure financing for much of the cost of AOGP. PREPA's financing assumptions adds $35 million to the capital costs of the AOGP project, bringing PREPA's current estimate to $552 million. The financing assumption includes both interest charged during construction (an equivalent of Allowance for Funds Used During Construction, or AFUDC) and a financing amount assumption.[300] In the 2015 IRP, PREPA assumed a different financing rate, with 2%

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[295] CEPR-01-01_Attach 01, footnote 2

[296] CEPR-AH-01-04(h)(ii). "The primary discrepancy [between the rate case and IRP] is a $24 million increase in costs to fund the Offshore Project, which can be attributed primarily to the need for Horizontal Directional Drilling (HDD) Construction Work and associated permitting costs to bury the gas pipeline underground from the offshore gas port through the bay to the shoreline."

[297] CEPR-AH-06-09(b)(1-3).

[298] CEPR-AH-06-09(d).

[299] CEPR-AH-06-09(a).

[300] CEPR-AH-01-04_Attach 01.

interest.[301] In this proceeding, PREPA has assumed 5% interest for financing AOGP.[302] It is not clear why PREPA changed its assumptions here.

b. Contracting at AOGP

PREPA holds, and is planning on, multiple contracts to support the AOGP project, including contracts for the development of the offshore gasport itself ("Infrastructure Agreement"),[303] the gas conversions of the Aguirre Plant units, engineering, the development of the environmental impact statement (EIS) materials for FERC, the development and shepherding of permits through Puerto Rico and federal agencies, and legal services. In addition, PREPA has signed contracts for the operation and maintenance of the gasport facilities once in place ("Terminal Operation and Maintenance Agreement"),[304] and the long-term hire of the FRSU facility ("Time Charter Party and LNG Storage and Regassification Agreement", or "Time Charter").[305]

While the authors of this report have reviewed the contracts, we are not attorneys. There may be elements of these contracts that are not clear outside of the legal profession. Therefore, these are opinions based on a lay review of these contracts and do not represent an attorney's view or opinion.

A large majority of spending at AOGP is will be incurred by contracts with three vendors, and from PREPA's personnel. The three major vendors and their contracts are:

1. Excelerate Energy, a Texas firm specializing in offshore regassification of LNG.
    a. Memorandum of Understanding (MOU), signed May 17, 2011. Amended through January 30, 2014.[306] Designed to provide permitting materials to FERC, develop engineering specifications for AOGP, and result in a contract for services with Excelerate ("Definitive Agreements").[307] This MOU expired when the remainder agreements with Excelerate were signed on March 17, 2014.

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[301] Base IRP, Volume I, Table 5-1.

[302] CEPR-RS-01-04(b).

[303] Provided as PREPA Response ROI DRR CEPR-AH-03-09_Attach 01.

[304] Provided as PREPA Response ROI DRR CEPR-AH-03-010_Attach 01.

[305] Made available in the IRP Process (CEPR-AP-2015-0002) in response to the Commission's 3rd ROI (March 1, 2016)

[306] Provided as PREPA Response ROI DRR CEPR-AH-03-010_Attach 01 through Attach 11.

[307] PREPA Response ROI DRR CEPR-AH-03-010_Attach 11.

b. Time Charter Party and LNG Storage and Regassification Agreement, signed March 17, 2014. This contract is PREPA's agreement to hire an FRSU from Excelerate for 15 years at a cost of about $51 million per year,[308] plus the cost of fuel and other charges.

c. Infrastructure Agreement, signed March 17, 2014. This contract is PREPA's commitment to pay for the construction of the offshore gasport facility, and represented a minimum $266 million cost at the time it was signed.[309]

d. Terminal Operation and Maintenance Agreement, signed March 17, 2014 with Aguirre Offshore Gasport, LLC, a subsidiary of Excelerate. This contract provides the personnel for operations and maintenance at the offshore terminal.

2. Alstom Caribe (now merged with General Electric, or GE). Contract to convert Aguirre steam units 1 & 2 to natural gas. The contract for Alstom was signed on November 8, 2013 – well before the contracts for the gasport facility were finalized or PREPA's limited notice to proceed was executed.[310]

3. General Electric. Conversion of the Aguirre Combined Cycle Units 1 & 2 to natural gas. According to PREPA, there is no current contract with GE for these services, "PREPA personnel have held informal conversations with GE,"[311] and "no RFP has been issued for the AOGP natural gas conversion for [the] Aguirre Combined Cycle [gas conversion]."[312] Nonetheless, on May 28, 2014, GE provided a $31.5 million proposal to PREPA for a low-NOx burner.[313] At some later point, GE provided PREPA a revised proposal including control equipment, amounting to $41 million.[314]

PREPA's disclosure of its proposal and contracting process for AOGP are lacking, and a review of the major contracts at AOGP reveals substantial concerns with respect to the forward-going commitments faced by PREPA irrespective of the Commission's decisions on AOGP. The authors asked for effectively every proposal, bid and RFP considered by PREPA with respect to any aspect of AOGP project construction or operation—whether disclosed or

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[308] Author's calculation: Time Charter, Paragraph 9.1 ("Hire")(b)(i) at $111,500 per day, and Schedule 4 Part 2 (i) at $29,016 per day.

[309] Infrastructure Agreement, Schedule 15.

[310] CEPR-AH-03-08(b)(i).

[311] CEPR-AH-05-12(a)(i-ii)

[312] CEPR-AH-05-12(c)

[313] CEPR-AH-05-12_Attach 02.

[314] CEPR-AH-05-12_Attach 01. There is no date, source or other context provided with this data sheet.

not. PREPA failed to provide many of its contracts, and in some significant cases could provide little evidence that a formal bid or contracting process had been executed. PREPA's timelines for contract costs and projects often could not be squared against the documentation provided. Below we detail six examples of problematic triggering events and inconsistencies in the contracting process for AOGP:

i. Infrastructure Agreement

The Infrastructure Agreement, signed between PREPA and Excelerate's subsidiary, Aguirre Offshore Gasport, LLC, sets up a series of triggering events that could lead to extensive commitments on the part of PREPA; these commitments could technically move forward despite the Commission's order to PREPA to cease spending until such time that the Commission authorizes the project. The Infrastructure Agreement requires that both a Limited and a Final Notice to Proceed (LNTP and FNTP, respectively) be executed by PREPA shortly after all permits are finalized and once financing has been secured. Once the FNTP is signed, the vendor is authorized to immediately begin work and is authorized to collect damages if PREPA then halts construction after the FNTP is signed. In addition, the FNTP triggers a commitment to hire the FRSU from Excelerate, and PREPA incurs substantial liquidated damages – $190 million – if the contract is then terminated.[315] The Infrastructure Agreement does provide PREPA the opportunity to avoid signing the FNTP if there is pending government action that seeks to restrain or prohibit the transaction,[316] but PREPA may, at its sole discretion (per the contract), waive that condition. For lack of a conditions precedent that specifically requires PREPA to have received regulatory authorization to proceed, PREPA may soon be in a position to make further commitments without the authorization of the Commission.

ii. Time Charter Agreement

The Time Charter agreement, a contract to hire Excelerate's FRSU for fifteen years, requires a daily fixed payment of $111,500,[317] or $40.7 million per year, and includes substantial liquidated damages to withdraw from the agreement once authorized. The contract contains a "hell or high water" provision, requiring that PREPA pay for the hire of the FRSU "without regard to (i) the amount of LNG delivered to EE for Regasification, (ii) whether or not LNG deliveries are actually made by PREPA or (iii) whether or not PREPA is able to receive or requires the use of Natural Gas from or beyond the Shore-side Natural Gas Delivery Point."

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[315] Time Charter, paragraph 62.69(b)

[316] Infrastructure Agreement 3.3(a) Conditions precedent…(v) "There is no pending or threatened action, suit or other proceeding brought by any governmental entity or other third party (A) challenging or seeking to restrain or prohibit the transactions contemplated by this Agreement or (B) that may otherwise have an adverse effect of the ability of PREP A to fulfill its obligations under this Agreement or to use the Facilities, in each case in any material respect;"

[317] Time Charter, paragraph 9.1(b)(i)

This contract represents a substantial—and nearly irrevocable—investment that is otherwise not disclosed by PREPA in filing this rate case.

iii. Aguirre Steam Conversion

PREPA identifies that nearly two-thirds of the costs to convert Aguirre Steam Units 1 & 2 are for contracts with Alstom Caribe, a subsidiary of Alstom Power.[318] Alstom Power, acquired by GE to form GE Power in November 2015, is a large multinational generation manufacturing and energy services company.

PREPA provided one $18.5 million Alstom contract, which appears to be for what PREPA characterizes as "boiler materials." This contract was executed in November, 2013[319] and nearly fully paid by January, 2015.[320] Disconcertingly, however, PREPA identifies another $37.1 million in expected Alstom contracts, including for installation and "additional materials," which are neither discussed nor disclosed. It is not clear if PREPA holds proposals or contracts with Alstom for this additional work, and if the identified future costs have any form of guarantee.

iv. Aguirre Combined Cycle Conversion

PREPA identifies $46 million in expected costs to convert the Aguirre Combined Cycle units to burn natural gas once AOGP is online.[321] These costs begin occurring in FY2017—*i.e.*, within the next nine months. Nonetheless, PREPA was unable to identify a formal RFP or bid process, indicating instead that PRPA has had "informal discussions with GE."[322] It is unclear why PREPA has identified GE as the conclusive vendor after only conducting "informal discussions." It is also not clear that the identified costs here are in any way guaranteed or stable. PREPA is exposed to substantial contract price risk. Having made commitments—and expenditures—at other Aguirre units and on the offshore gasport in preparation for the conversion, but having secured no price commitments at the combined cycle units, PREPA leaves itself exposed to the potential for price gouging from contractors.

v. AECOM

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[318] Author's calculation. See AH-01-01 Attach 01. Total cost of conversion for Units 1 & 2 at $87.5 million. Alstom contracts account for $55.6 million, or 64%.

[319] CEPR-AH-03-08(b)(i). Contract provided as PREPA Response ROI DRR CEPR-AH-03-08_Attach 14 (CONFIDENTIAL).pdf.

[320] CEPR-AH-05-11(a)(ii). Remaining payments were made in October 2015 once boiler materials were delivered for Aguirre Unit 2. CEPR-AH-03-08_Attach 10, PDF page 10.

[321] CEPR-AH-01-01 Attach 01

[322] CEPR-AH-05-12

PREPA identifies that in engaged the consulting service AECOM to provide environmental services, including the evaluation of Prevention of Significant Deterioration (PSD) for the Aguirre conversion to natural gas. This service, standard when a utility is considering a potential major modification to a power plant, would have helped identify, and possibly prepare, any permit requirements or changes required by the Puerto Rico Environmental Quality Board (EQB) or U.S. Environmental Protection Agency (EPA). AECOM is an established consultancy for these services, and these types of services are critical in determining what types of modifications may be demanded by environmental regulators if a large capital project is undertaken. Nonetheless, PREPA's disclosure of the contract is still problematic. The AECOM contract and two subsequent amendments were provided by PREPA,[323] but PREPA failed to provide the attachments that detail the scope of work for services, and PREPA's contention that "the contract is not currently active"[324] does not appear to comport with the expected annual spending schedule under this contract, wherein most of the cost is incurred in FY2017 and FY2018.[325]

vi. LT Automation

PREPA identifies LT Automation provided control system upgrades to the Aguirre Steam Plant, in a contract signed November 18, 2011.[326] In general, the changing anticipated fuel mix, firing patterns and startup procedure for Aguirre steam units would have likely required new control systems, and in general it is not unreasonable to expect an upgrade of these systems in older plants to increase efficiency when other upgrades are also being considered. However, the contract provided by PREPA only accounts for one quarter of the LT Automation contract spending - $6 million out of $24.5 million total. PREPA provided no documentation for the other components listed under the sub-header of LT Automation contracts.[327] PREPA has not accounted for a substantial amount of contract dollars spent at Aguirre.

PREPA's AOGP contracts reveal several substantial overarching concerns with the PREPA's contracting process in general, and specifically with regards to AOGP.

1. PREPA is unable to reasonably account for dollars spent upon request, a fact that should speak for itself with respect to regulatory oversight requirements. Under all

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[323] PREPA Response ROI DRR CEPR-AH-03-08_Attach 07, Attach 08 and Attach 09.

[324] AH-03-08(a)(ii)

[325] AH-01-01 Attach 01.

[326] AH-03-08(a)(v).

[327] While it is feasible that some of the contracts listed under the "LT Automation contracts" header are not strictly with LT Automation, and are instead only coordinated through LT Automation, we find PREPA's response to the requirement to provide the LT Automation contracts less than satisfactory or inappropriately narrow.

circumstances, PREPA should be able to provide an accurate accounting of contract dollars spent, the contract – including scope – under which the dollars were spent, and a reasonable accounting of the process that led to the provision of the contract.

2. PREPA's contracts do not contain any form of Conditions Precedent requiring regulatory authorization. To allow for proper regulatory oversight, PREPA's largest contracts should be brought before the Commission for authorization, and should contain conditions precedent allowing PREPA to terminate contracts that fail to receive Commission authorization.

3. PREPA's AOGP process is complex and requires multiple simultaneous moving parts, but contain no mechanisms for synchronization and appear poorly coordinated between different vendors. The fact that PREPA today verges on finalizing a high cost – and irrevocable – contract to receive natural gas at Aguirre within two years, but has not even secured a contract to convert a key set of generators (the combined cycle units) to natural gas is deeply problematic. Under these circumstances, PREPA has no guarantee for price, online date, or performance at one of the key generators that will receive the natural gas upon which PREPA has staked so much. Even at the Aguirre Steam units, PREPA only provided a modicum of the contracts for the natural gas conversion process, and the few contracts provided have no guarantee of performance once the conversion occurs. While PREPA has spent substantial effort on securing infrastructure, operations, and a regassificaiton vessel, the utility's contracts show little thought to ensuring that the generating units are prepared to receive the natural gas.

c. Financing AOGP

In the preparation of this case, PREPA assumed that it will be able to secure a federal loan guarantee from the U.S. Department of Energy ("DOE") under Section 1703, Title XVII of the Energy Policy Act of 2005.[328] PREPA's application to DOE responds to a 2013 solicitation for innovative (i.e. non-market) technologies,[329] and seeks a loan guarantee for 80% of the AOGP project costs,[330] including offshore, onshore, and gas conversion projects.[331] Under this program, the DOE would provide a guarantee, or backstop, on a loan taken out by PREPA from a third party bank. The DOE loan guarantee is not finalized yet, and PREPA's language

[328] 42 U.S.C. 16511–16514

[329] Solicitation No. DESOL-0006303

[330] PREPA Ex. 5.0 at 909-910. *Also* PREPA response to CEPR-AH-01-04_Attach 01.

[331] Federal Energy Regulatory Commission. February 2015. Aguirre Offshore GasPort Project: Final Environmental Impact Statement (FEIS). Docket Nos. CP13-193-000 and PF12-4-000. Section 1.2.5.

with respect to the status of the loan guarantee application is substantially hedged in testimony and discovery response.

In the Company's initial filing, the DOE loan guarantee is described in a single clause by a Navigant panel, and described as "the potential for financing of AOGP supported by the DOE loan guarantee program."[332] Asked for details about how the Company had calculated the financed cost of AOGP, PREPA provided a simple calculation and provided a disclaimer that "PREPA is not assumed to attempt or be able to obtain a construction loan. Currently, PREPA is assumed to issue debt under the DOE loan guarantee program at the end of FY2017, beginning of FY2018."[333] From PREPA's response, it is not clear if PREPA means that the rate case does not assume that a loan is procured, or that the loan guarantee is not specifically earmarked for the construction of AOGP. Neither of these explanations are sound. PREPA is, in fact, attempting to obtain a loan guarantee for construction, as affirmed by the U.S. DOE in the AOGP FEIS,[334] and the rate case does, in fact, assume that a loan is procured, deducting $413.4 million from FY2018 revenue requirements under the header "Investment Capex Financed (AOGP)."[335]

In the Company's supplemental filing, Mr. Quintana provides slightly more detail with respect to the loan guarantee application,[336] stating that the "fiscal component for qualification… could be a potential issue for PREPA," and that "PREPA and the DOE continue to maintain a dialogue about potential guarantees."[337] Further, Mr. Quintana indicates that a critical step in obtaining this loan guarantee is the execution of "a diligence process that would be carried out by a third party advisor and could cost several million dollars," but that "PREPA has not considered it appropriate to move forward with that step until it received an approved IRP."[338] Finally, Mr. Quintana hedges substantially on acquiring the loan

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[332] PREPA Ex. 5.0 at 909-910.

[333] Response to CEPR-AH-01-04(g)

[334] Federal Energy Regulatory Commission. February 2015. Aguirre Offshore GasPort Project: Final Environmental Impact Statement (FEIS). Docket Nos. CP13-193-000 and PF12-4-000. Section 1.2.5. "PREPA applied for a loan guarantee for the construction of the Aguirre Offshore GasPort Project (including the non-jurisdictional facilities described in section 1.4) a subsea pipeline connecting the Offshore GasPort to the Aguirre Plant, and conversion of multiple electricity-generating units and other modifications at the Aguirre Plant."

[335] Schedule F-3 REV

[336] Exhibit 13.00 at 156-183

[337] Exhibit 13.00 at 162-168

[338] Exhibit 13.00 at 168-171

guarantee, stating that "relying on [the] DOE loan guarantee is not the only path to affordable financing for the AOGP project, if it proceeds."[339]

d. Impacts of financing assumption in Rate Case

PREPA is seeking a DOE loan guarantee for 80% of the overall AOGP project cost. The Company "assume[s that it will] issue debt under the DOE loan guarantee program at the end of FY2017 [or the] beginning of FY2018."[340] PREPA's revenue requirements are impacted in two ways from this assumption set:

1. PREPA's capital cost schedule (F-3 REV) inaccurately allocates capital spending in all years to ensure that 80% of the costs are incurred in FY2018.
2. PREPA assumes that it will incur no capital costs for AOGP in FY2018, despite the relatively large spending anticipated in that year.

i. Capital cost schedule in F-3 REV inaccurately allocates AOGP capital spending

PREPA's capital cost schedule (F-3 REV) is organized to disclose PREPA's anticipated capital spending in FY2017, FY2018 and FY2019. Importantly, since PREPA assumes that it has no access to capital markets, capital listed in this schedule is on an "as-spent" basis rather than on an "in-service" basis. Therefore, one would generally expect that all capital projects listed in this schedule are shown on an as-spent basis. Because AOGP represents a very large fraction of PREPA's capital budget – 46% from FY2017 through FY2019, inclusive[341] – and PREPA proposes to capital on an as-spent basis into annual rates, it is critical that the proposed spending be as closely aligned as possible to PREPA's spending schedule. This is not the case for AOGP. Instead, PREPA appears to have allocated funds to FY2017 and FY2018 by how AOGP will be financed, with FY2018 funds representing the 80% project cost expected to be supported by the DOE loan guarantee, and the FY2017 funds representing the remainder of project costs not yet incurred and not under the 80% umbrella.

Table 14, below, illustrates how PREPA's budget process for AOGP was designed to place exactly 80% of budgeted costs in FY2018 – the exact amount PREPA anticipates being financed through the DOE loan guarantee program. The table also shows both how PREPA's current spending to date does not align with PREPA's reported budget in this rate case,[342]

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[339] Exhibit 13.00 at 177-179

[340] Response to CEPR-AH-01-04(g)

[341] Schedule F-3 REV, sum of line 6 ("Aguirre Offshore Gas Port (AOGP) Investment") as a fraction of the sum of line 10 ("Total Maintenance & Investment Capex").

[342] Note that actual spending from Pre-FY2015 through FY2016 approximates PREPA's reported budget for FY2016. This simplification indicates that PREPA's response to CEPR-AH-01-03 was factually incorrect. That request asked that PREPA "provide a detailed list, with descriptions, values

and how PREPA's spending in the first quarter of FY2017 indicates that PREPA is unlikely to meet their budget assessment for FY2017.

Table 14. AOGP budget and spending

	Pre-FY2015	FY2015	FY2016	FY2017	FY2018
AOGP Budget[343]			$47,014,472	$56,339,808	$413,417,119
% of whole			*9.1%*	*10.9%*	*80%*
Spending to date[344]	$22,422,611[345]	$22,546,328	$2,041,360	$4,173	$0
% of whole	*4.3%*	*4.4%*	*0.4%*	*0%*	*0%*

A reasonable interpretation of these inconsistencies is that what **PREPA's AOGP budget expectations are not reliable, are mislabeled, and are likely a distortion from PREPA's loose financing assumptions**. What PREPA labels as the FY2016 budget is, in fact, all spending incurred prior to July 2016. What PREPA labels as the FY2018 budget is the amount that the Company expects to finance through the DOE loan guarantee. What remains has been shuffled into the FY2017 budget, and evidence suggest it is unlikely to be spent this year, regardless of the Commission's Final Order on the IRP. Additional evidence regarding AOGP spending in FY2017 will be discussed later.

ii. PREPA assumes that no capital costs are incurred in FY2018 for AOGP

PREPA's anticipated capital revenue requirements in FY2018 are completely offset by an assumption that the Company will successfully obtain a loan guarantee from DOE in FY2018.[346] In PREPA's accounting, all AOGP capital expenses incurred in FY2018 are offset by the financing offer. This assumption is not, and cannot, be considered a "known and measurable change." Rather, PREPA's current plan is, in the absence of a Commission order requiring the Company to stop work, to continue in the construction and procurement of the AOGP project, regardless of its financing. Indeed, PREPA has made clear that, in its opinion, AOGP must be pursued as a fundamental component of the Company's MATS compliance

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and dates, of all FY2016 spending associated with AOGP." PREPA responded by citing to CEPR-AH-01-01 Attach 01, which indicates $47 million of spending in FY2016. However, CEPR-AH-05-11.a.ii-a.iv indicate that most of this spending was incurred in prior years.

[343] PREPA Response to CEPR-AH-01-01 Attach 01 (FY2016-FY2018) and F-3 REV (FY2017-FY2018)

[344] PREPA Response to CEPR-AH-05-11.a.ii, a.iv (Spending to date FY2015-FY2017). Answered on September 28, 2016.

[345] Author's calculation. PREPA Response to CEPR-AH-05-11.a.i through a.iv (Total spent to date minus reported spending in FY2015-FY2017)

[346] Schedule F-3 REV, line 11 (Investment Capex Financed (AOGP))

strategy.[347] PREPA's revenue requirements model assumes that PREPA pursues AOGP and obtains financing for the AOGP project at a 5% interest rate through the DOE loan guarantee. While the assumption of long-term spending at AOGP is consistent with PREPA's plans, contracts and the Commission's 27 September Order, the assumption of successful financing for AOGP is *not* known and measurable. The assumption of DOE-backed financing for AOGP distorts the cost implications of AOGP on PREPA's ratepayers, particularly under a formula rate mechanism (FRM) structure. If the Commission approves AOGP's capital costs as presented **and** allows for an FRM structure, but PREPA does not obtain AOGP financing, PREPA's customers will be saddled with extraordinary rates in FY2018.

4. Commission IRP Findings with respect to AOGP

a. Final IRP Order

On September 26, 2016 the Commission issued a Final Order on PREPA's 2015 IRP ("Final IRP Order") determining that it "cannot conclude that AOGP represents a least-cost, least-risk path for serving customers' needs and meeting Puerto Rico's energy policy goals based on the facts presented in this proceeding."[348] The Commission approved continued permitting, engineering and planning activities in the overall AOGP project, but subject to a restrictive $15 million spending cap.[349] The Commission required that PREPA expressly ask for permission to exceed the $15 million spending cap, and that permission would only be granted upon review of a sound economic analysis of AOGP.[350] The Commission required that "PREPA may request permission from the Commission to exceed the $15 million cap," but "shall accompany such request with a detailed economic assessment of the AOGP project" ("AOGP Economic Analysis")[351]

This report does not revisit the IRP's assessment nor the Commission's decision, instead focusing on the treatment of AOGP in this rate case, and the process used by PREPA to determine if constructing AOGP was a reasonable course of action. This report does seek to provide clarity and a pathway for PREPA to comply with the Commission's Order of 27 September to re-file this rate case in compliance with IRP findings.[352]

b. 27 September Order

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[347] PREPA's Motion for Reconsideration in the 2015 IRP Final Order. Docket CEPR-AP-15-002. Page 34. "AOGP and the conversions need to be approved as part of PREP A's MATS compliance efforts."

[348] Docket CEPR-AP-2015-002. Final Order. September 26, 2016. Paragraph 255.

[349] Docket CEPR-AP-2015-002. Final Order. September 26, 2016. Paragraph 254.

[350] Docket CEPR-AP-2015-002. Final Order. September 26, 2016. Paragraph 261.

[351] Final IRP Order B.1.a.(2)

[352] Docket CEPR-AP-2015-001. Order requiring revised testimony.

On September 27, 2016, the Commission required PREPA to re-file exhibits and testimony with respect to revenue requirements ("27 September Order"). The Order specifically required that PREPA's rate case reflect the Commission's findings that "spending on permitting, planning and engineering related to the Aguirre Offshore Gas Port ("AOGP") shall not exceed $15 million from the date of the issuance of the IRP Order," and further clarified that "the spending limit applies to the total combined spending associated with AOGP and the gas conversions."[353]

The plain language of this Order required that PREPA re-file its revenue requirement with a reflection of a $15 million cap on the AOGP project. PREPA's revised filing, received October 15, 2016, failed to make this adjustment.

The 27 September Order contained what could have been perceived as an inconsistent approach to the treatment of AOGP, an inconsistency harnessed by PREPA in explaining its failure to re-file in accordance with the Commission's requirements. First, the Commission required that the "spending on permitting, planning and engineering related to the Aguirre Offshore Gas Port *[sic]* ("AOGP") shall not exceed $15 million from the date of the issuance of the IRP Order." However, the Commission's required that PREPA's "submissions of [an updated financial model, projected capital spending and revenue requirements] also shall assume, for informational purposes only, that AOGP will become operational at a realistically achievable date." The $15 million cap and assumption of AOGP operations at a "realistically achievable date" could be perceived as inconsistent.

c. PREPA responsive testimony

PREPA's responsive testimony argued two primary points to exclude the $15 million cap, and did not address the commission's requirement for the AOGP Economic Analysis. First, that the 27 September Order requirement that PREPA conform to a $15 million budget cap at AOGP until further justification is outweighed by PREPA's belief, as expressed by PREPA witness Mr. Quintana, "that AOGP is, and will remain, justified and least cost" and that "the Commission will ultimately agree." Second, PREPA argued that "even if AOGP and the other generation projects in the north are not approved, PREPA *[sic]* other significant investments would have to be made rapidly." PREPA concluded that it "has no reason to believe that these alternative investments would be any less expensive than the investments currently reflected in its three year business plan."[354]

While PREPA correctly points out the ambiguity of the directive in the 27 September Order, its argument is specious and undermines PREPA's support of a Formula Rate Mechanism (FRM).

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[353] Docket CEPR-AP-2015-001. Order requiring revised testimony. Page 2.

[354] PREPA Ex. 13.00 at 106-116.

i. PREPA's argument that AOGP alternative spending is equivalent to the costs of AOGP itself is unsupported

Mr. Quintana's assumption that "other significant investments would have to be made rapidly" in the absence of AOGP is not supported by evidence in the IRP record nor in this rate case, and makes no attempt to rectify the costs of those alternative actions against the expected costs of AOGP. The Commission does not, and should not, simply approve capital costs on a rough and unsupported assertion that alternative investments to AOGP would be approximately the same cost as AOGP. Mr. Quintana effectively argues that the Commission should hand PREPA an open check for $470 million[355] on the assumption that even if the Company does not pursue AOGP it would find a way to use the capital for MATS compliance at an approximately equal cost. This argument belies the resource planning process, prudent utility practice, and reasonable ratemaking practice.

Navigant witness Mr. Hemphill, testifying on behalf of PREPA, testifies that "the IRP Order does not materially change, or change in a known and measurable way, PREPA's adjusted test year revenue requirement,"[356] and states that in FY2017 revenue requirements "the $56 million pertaining to AOGP… should not be removed."[357] Rather than note the $15 million capital cap, Mr. Hemphill instead cites to "the September 27 Order's directive that RPEPA should assume that AOGP and related projects are justified to the CEPR's satisfaction and are operational at a realistically achievable date."[358]

In choosing to cite only to the Commission's requirement that capital spending and revenue requirements should assume, for informational purposes only, that AOGP will become operational, Mr. Hemphill provides no avenue by which the Commission can realistically restrict PREPA's spending on the AOGP project in a meaningful way. The restriction of spending on AOGP is a key driver by which this Commission seeks to control costs while demanding action of PREPA. The Final IRP Order required that to exceed the $15 million budget cap at AOGP, PREPA would be required to file an improved economic assessment of the AOGP project. Rather than pursuing this avenue to demonstrate that AOGP is in the best interests of Puerto Rico ratepayers, PREPA has elected to challenge the Commission's findings and submits testimony indicating that the Commission's explicit disapproval of the AOGP project at this time have no bearing on the Company's current rate case. In the absence of an improved economic assessment, PREPA's plan to continue spending $56 million in FY2017 has no basis and directly contradicts the Commission's requirements.

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[355] $470 million: sum of FY2017 + FY2018 AOGP spending.

[356] PREPA Ex. 14.00 at 39-40.

[357] PREPA Ex. 14.00 at 52-54.

[358] PREPA Ex. 14.00 at 44-47.

ii. PREPA's failure to adjust AOGP-related revenue Requirements Undermines FRM

Mr. Hemphill's argument with respect to AOGP also undermines PREPA's proposed FRM. In supplemental testimony, Mr. Hemphill argues that "the FRM should afford the Commission a substantial and well-defined role in reviewing PREPA's forward-looking investment plans and budgets… This structure is designed to mesh with the IRP process to streamline the planning and approval of capital investment."[359] He continues that "the FRM would allow PREPA to file its capital investment budget in line with what already has been litigated and decided."[360] Unfortunately, the first indication of how PREPA would respond to a specific Commission finding with respect to the IRP and impacting the rate case is not indicative of this smoothly-functioning IRP finding and adjustment mechanism. Instead, PREPA has failed to account in its capital budget for the Commission's findings on the IRP in a litigated and decided case.

Finally, Mr. Hemphill recommends a FRM filing and adjustment schedule beginning in October 2017. Mr. Hemphill's first reconciliation sets rates for FY2019,[361] skipping any adjustments or decision-making process for FY2018. Indeed, his mechanism implies that PREPA's provisional rates would carry through the third quarter of FY2017, and the first permanent rates would be set for five quarters from Q3 FY2017 through the end of FY2018. Under this proposal, the Commission would be charged with deciding the entirety of the AOGP decision today and setting rates accordingly.

5. Recommendation with respect to AOGP capital

a. Options available to the Commission with respect to AOGP capital

PREPA's failure to provide updated revenue requirements for AOGP, as required by the Commission from the September 2016 IRP Final Order, places a burden on the Commission to enforce such a spending cap. In the absence of a final decision on AOGP, the Commission has three options with respect to the project:

1. Assume that PREPA's pre-existing commitments with respect to AOGP, and the hurdle of finding a MATS compliant alternative in a reasonable timeframe, are substantial enough that there is no real alternative option for AOGP. With such a finding, the Commission would cease examination of the decision-making process

[359] PREPA Ex. 16.00 at 66-73.

[360] PREPA Ex. 16.00 at 154-156.

[361] PREPA Ex. 16.00 at 206-207, also Ex. 16.01.

and focus instead on spending, financing, further contracting, and project management.

2. Maintain PREPA's revenue requirement with respect to AOGP for both FY2017 and FY2018 but require ongoing compliance filings to ensure the spending cap is not exceeded until justified under the AOGP Economic Analysis. Under this mechanism PREPA would effectively be entrusted to self-govern AOGP spending, and the Commission would require a true-up if AOGP is found imprudent.

3. Revise PREPA's revenue requirement with respect to AOGP for both FY2017 and FY2018, reducing FY2017 spending to the $15 million cap and shunting remaining funding into FY2018. This option provides the most stringent Commission control over the project and ensures PREPA responsiveness to the Commission's requirements for the AOGP Economic Analysis. It also risks increasing costs if PREPA's contracts are delayed while the Commission deliberates on AOGP.

In the authors' opinions, the first option – cease examination of AOGP – is not justified by the evidence presented by PREPA to date. The Commission's order with respect to the IRP was based on the finding that the economics of AOGP as opposed to the alternatives presented by PREPA were not compelling. The IRP, as prepared, suggested that there were real alternatives to AOGP that could meet compliance requirements, improve PREPA's flexibility and ability to integrate renewable energy, and utilize capital to improve PREPA's generation fleet, rather than shift fuel sources with the same generation fleet. New information presented by PREPA in this rate case indicate that there are substantial commitments that have been made, and may soon be made, by PREPA that reduce the Company's options; these commitments were not reflected in the IRP's analysis. Further, in the time that PREPA committed internally to the AOGP project it increasingly sidelined viable alternatives, including MATS-compliant new generation, environmental controls on existing generation, increased renewable penetration, a focus on smaller distributed generation, or the completion of a south coast gas pipeline. PREPA has presented little or no evidence that those options are not still viable. Further, PREPA's argument that a failure to move forward expediently on AOGP exclusively risks immediate and severe sanction from EPA[362] is not borne out by EPA's past settlements with non-compliant utilities. While conducting the AOGP Economic Analysis mid-stream is neither timely nor efficient, it is a necessary check on this substantial capital investment and long-term fuel commitment.

Maintaining PREPA's revenue requirement but requiring intensive compliance filings places an obligation on the Commission to ensure PREPA's spending remains in-check until the AOGP Economic Analysis is complete, and may not prevent PREPA from making incremental commitments even without the Commission's authority. PREPA's response to the

[362] PREPA's Motion for Reconsideration of Provisions of the Final Resolution and Order, October 13, 2016, CEPR-AP-2015-0002, paragraph 38.

Commission's Final IRP Order suggests that PREPA's primary mode on AOGP is defensive, rather than seeking to placate the Commission's concerns. In response to the order, PREPA (a) filed a motion for reconsideration, accusing the Commission of failing to understand the IRP analysis and seeking to undermine the credibility of the Commission's assessment,[363] and (b) declined to update revenue requirements as required by the Commission's post-order update.[364] PREPA has not filed an AOGP Economic Analysis, has not requested clarification on the requirements for such an analysis, nor asked for permission to continue spending. Had PREPA offered to placate the Commission's concerns, sought to file an economic analysis – even while contesting the Commission's findings, or even requested clarification, the Commission might have taken comfort in allowing PREPA governance over AOGP spending in FY2017. Given PREPA's continuing failure to provide full and complete information, allow the Commission the opportunity to audit its models and model assumption, and or even respond to the Commission's stated requirements, the Commission should not provide PREPA this governance latitude.

The only question remaining is if a Commission requirement to restrict FY2017 spending to $15 million at all AOGP-related projects will result in significant unnecessary costs at AOGP. Stalling projects, cancelling vendors, or missing contractual deadlines could result in increased costs, damages, or potential legal actions by vendors. Our lay review of PREPA's contracts suggests that there may be cases in which PREPA is exposed to increasing fees for incurred vendor costs, and may delay some procurement or authorizations. However, we find no specific major cost increases or damages because of the $15 million cap, unless PREPA signs the AOGP FNTP without Commission authorization. The Commission should require that PREPA not proceed to sign the FNTP until it offers express authorization.

In PREPA's Motion for Reconsideration on the IRP Final Order, the utility makes no mention of any legal or contractual barriers for meeting the $15 million cap. In other utilities, the risk of contractual liabilities is a primary concern for utilities faced with near-term requirements.

The Commission's $15 million cap, if applied to FY2017 expenditures, provides over a quarter (27%) of PREPA's anticipated AOGP budget in that year, and could cover AOGP permitting cost and permitting success fees, FY2017 payment for prior works conducted by Excelerate, and professional back office service fees.[365] In response to discovery, PREPA indicates that it has only spent $4,173 in the first quarter of FY0217, less than 0.01% of its anticipated budget for the year.

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[363] *Id.*, paragraphs 54 and 65.

[364] PREPA's Petition for Rate Review, Exhibit 13.0, Supplemental Direct Testimony of Javier Quintana Mendez, lines 100-119.

[365] CEPR-AH-01-01_Attach 01. Permitting Costs = $11.2 million, Permitting Success Fee = $1.2 million, Engineering Prior Works = $0.7 million, Professional Services = $0.5 million, PREPA permits = 0.02 million. Total = $13.6 million.

Overall, we expect that, barring the execution of the FNTP at AOGP, PREPA could meet the $15 million cap in FY2017 with minimal contract risk.

b. Recommendation

We recommend that the Commission revise PREPA's revenue requirement for FY2017 to reflect a $15 million spending cap at AOGP, reducing FY0217 revenue requirements by $41,339,807. To reflect the Commission's order that PREPA "shall assume, for informational purposes only, that AOGP will become operational at a realistically achievable date," we recommend increasing the FY2018 budget by the same $41.3 million increment to $454,756,927.

We recommend that the Commission order that PREPA withhold from signing a Final Notice to Proceed until it has submitted, and the Commission has approved, the AOGP Economic Analysis. PREPA should submit, or the Commission should require that PREPA submit, the AOGP economic analysis expediently.

E. Transmission and Distribution capital budget

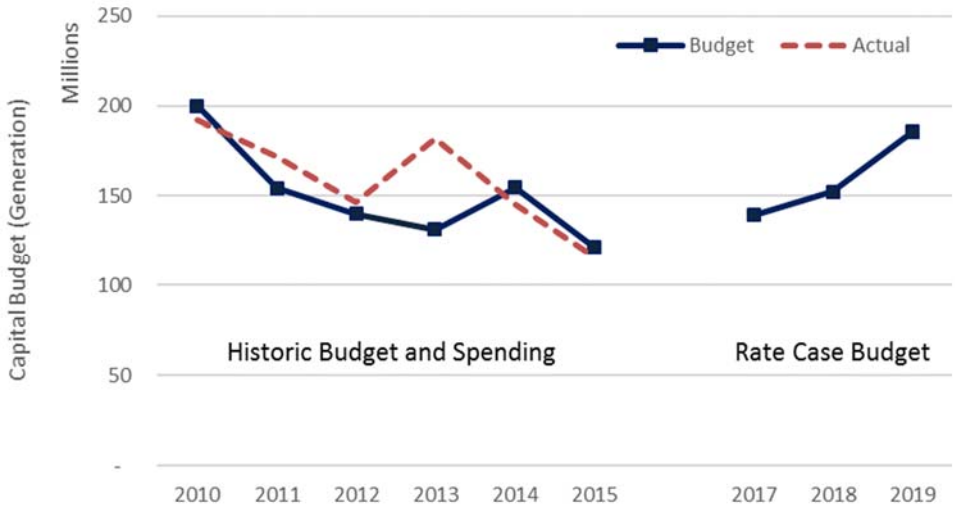
1. Overview

PREPA's transmission and distribution system serves over 1.6 million customers over the island of Puerto Rico. The transmission system links large central station generators in four locations on the north and south coasts through both aerial and underground wires, running through some of the most difficult terrain in the US, including mountains and wet tropical forests. The transmission and distribution system require constant upkeep, and financial and talent losses have led to what PREPA describes as severe deterioration, and what an external review clearly indicates is system fraught with reliability concerns.

We discuss PREPA's reliability issues in THE STATE OF PREPA'S SYSTEM, Chapter III (Page 26), noting the severe – and increasing – level of interruptions seen by PREPA's customers.

Historically, PREPA's spending on transmission and distribution has matched budgets fairly closely, with some exceptions (see Figure 23, below). The budget for the rate case is roughly in line with 2015 spending and budgets, and increases substantially thereafter.

Figure 23. Historic transmission and distribution budget and actual spending by fiscal year, 2010 to 2015;[366] rate case budget.[367]



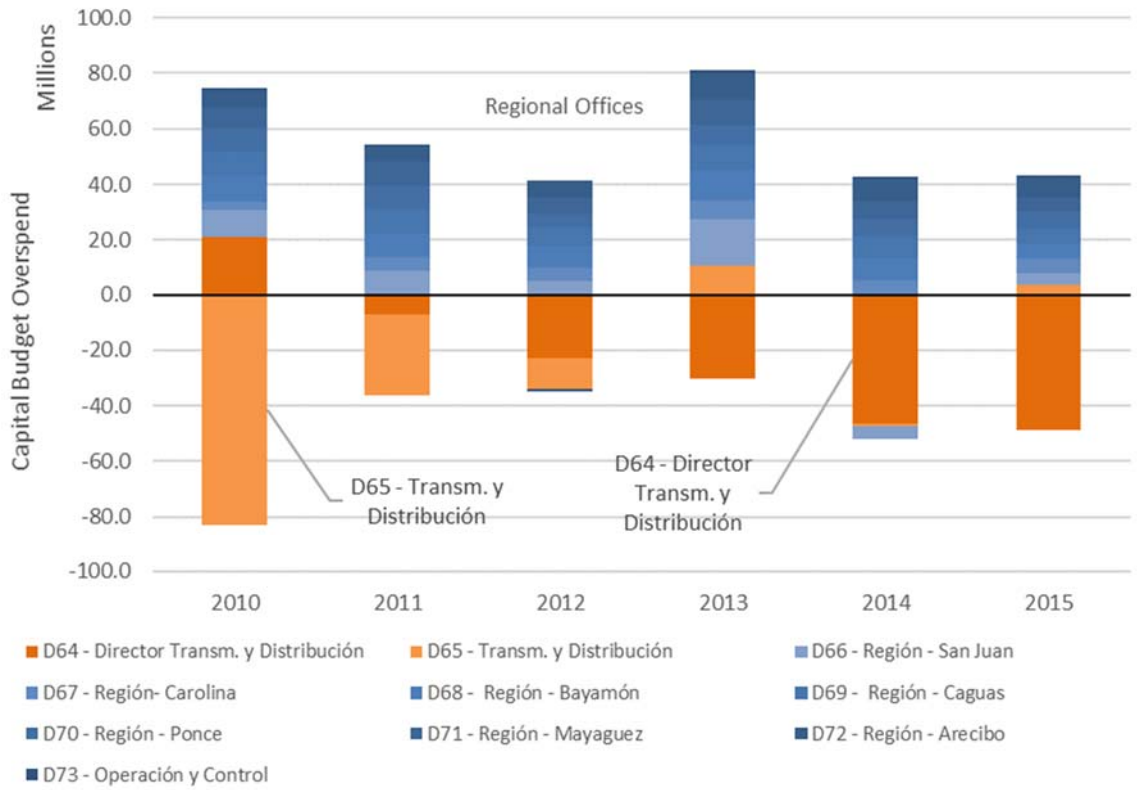
PREPA's historic transmission and distribution budgets and spending are harder to track than other directorates. PREPA allocates budgets to a central office via either the line item "transmission and distribution" (deepartment 65) or to the director of transmission and distribution (department 64). These central offices then allocate budgets to regional offices. In doing so, the utility creates a disconnect between budget request and the use of that budget, relying on the division to track and allocate appropriately.

Figure 24, below, shows the effect of this budgeting process on the assessment of budget use from 2010 to 2015 in the transmission and distribution directorate. Notably, every one of the regional offices appears to be overbudget on a year-by-year basis, while the central departments are approximately equally underbudget. A closer look at line-item spending reveals that those central departments are allocated large blocks of capital and use none of it.

[366] CEPR-AH-05-10 Attach 03

[367] Schedule F-3 REV

Figure 24. Historic over (under) spending in transmission and distribution



From one perspective, the allocation of budget to a central department may be an efficient mechanism of ensuring that budgets are met at the individual regional offices. On the other hand, it blurs the ability to (a) provide oversight and (b) ensure strategic deployment of funds across the transmission and distribution system relative to other demands on PREPA's system.

2. Transmission system capital budget

a. Overview

Some of the most comprehensive information about PREPA's transmission system comes from a 2013 report from URS on PREPA's assets. [368] The report summarizes PREPA's transmission system in 2013 as follows.

[368] URS June 2013 Annual Report ("URS 2013 Report"). PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013.

> The Authority's transmission system is an interconnected network of 230 kV, 115 kV, and 38 kV power lines that carry electrical power from the production plants to numerous distribution centers from where it is distributed to clients for consumption.
>
> At the close of fiscal year 2013, the transmission system was comprised of 2,478 circuit miles of lines: 375 circuit miles of 230 kV lines, 727 circuit miles of 115 kV lines, and 1,376 circuit miles of 38 kV lines. Included in the transmission system totals are approximately 35 miles of underground 115 kV cable, 63 miles of underground 38 kV cable and 55 miles of 38 kV submarine cable. In addition to the high voltage lines, the transmission system includes transformers at the generating plant substations, transmission centers for interconnection of different voltage systems and switch yards and gear for connection or separation of portions of the transmission system operating at the same voltage. High voltage transformers installed in the Authority's transmission system and its production plants have a total transformer capacity of 19,207 MVA.[369]

Note that we did not request an update on this mileage for the current transmission system. A new 230 kV line from Guayanilla to Arecibo has likely increased the total milage.

PREPA's transmission system, shown in Figure 25, below, is an overlay of a 230 kV system, a 115 kV system, and a 38 kV.[370] The 230 kV system essentially forms a ring around the island's less populous interior, connecting major cities and towns. In addition, PREPA maintains two substantial north-south corridors from Salinas (near Aguirre and the AES plant) to San Juan, and from Guayanilla (near EcoEléctrica and Costa Sur) to Arecibo and Manati on the north coast. The primary operational thermal generation in Puerto Rico is located on the south coast – EcoEléctrica, Costa Sur, Aguirre, and AES coal plant. The transmission system is designed to facilitate the flow of energy from these plants to the primary population centers in the north. Cambalache, on the north coast near Arecibo, and Mayagüez, on the west coast, provide peaking generation.

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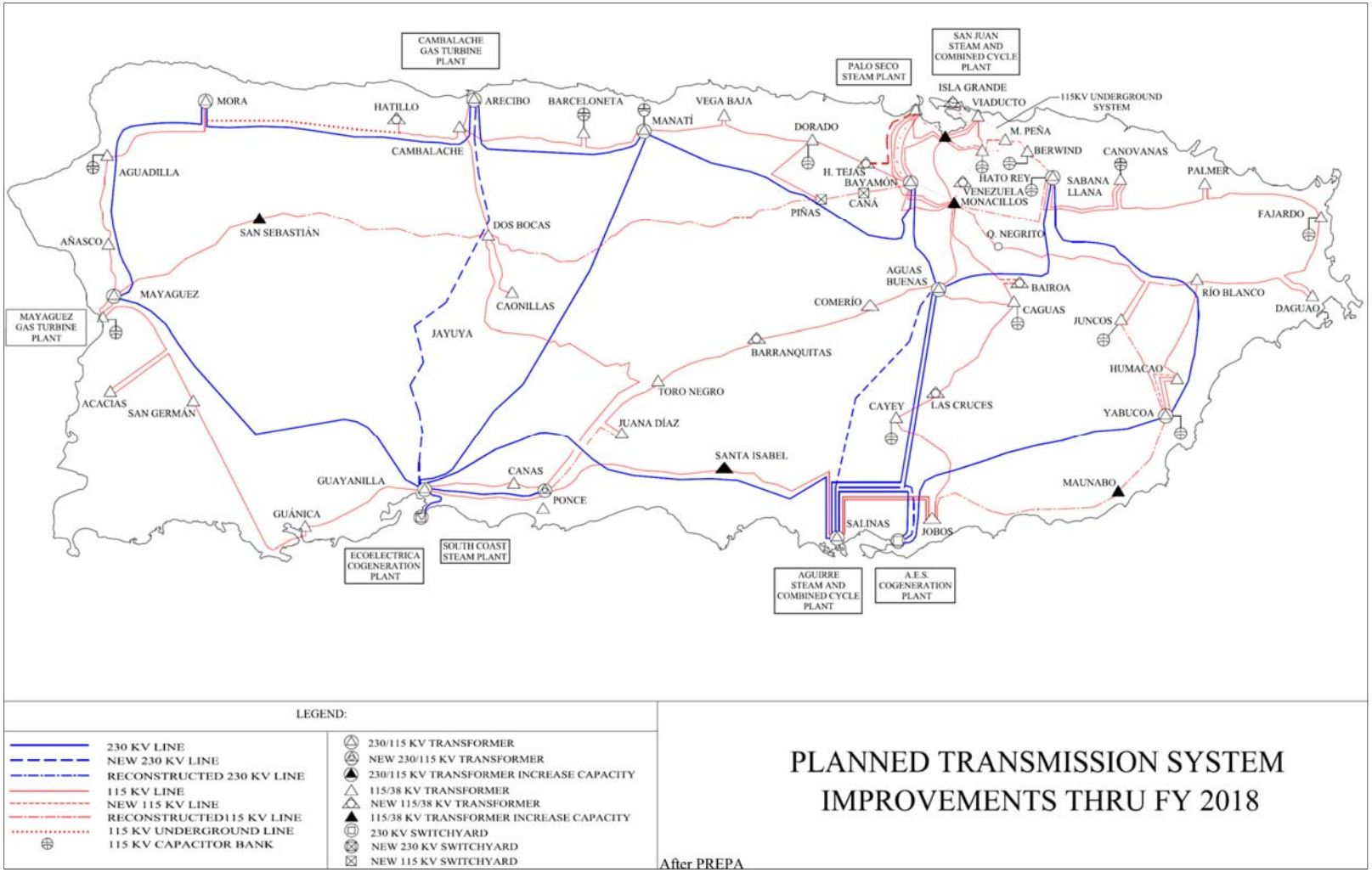
[369] URS 2013 Report, page 3.

[370] Transmission map is from URS 2013 Report, page 113. This map is vintage 2013 and provided for illustrative purposes only. The report and map are publicly available and was accessed through public channels on PREPA's website at http://www.aeepr.com/INVESTORS/DOCS/Financial%20Information/Annual%20Reports/Consulting%20Engrs%20Annual%20Report%20FY2013.pdf. PREPA provided a 2016 transmission map under confidential cover that, for illustrative purposes, can be considered similar in most aspects to the vintage 2013 map.

Figure 25. PREPA's Transmission System vintage 2013, from URS 2013 Report. Includes planned transmission through 2018, vintage 2013.



b. Transmission system capital budget

PREPA's transmission system capital budget amounts to $81.3 million in FY2017, spread over 100 separate line item projects.. Table 15, below, consolidates PREPA's transmission capital budget by sub-area and initiative.[371] The majority of FY 2017 spending – 68% - is concentrated in the 230 kV and 115 kV systems, with the vast majority of the budgets spent on line rehabilitation.

Table 15. Transmission system capital budget, millions FY2017-FY2019

	FY2017	FY2018	FY2019
230 kV System			
230 kV Line Rehabilitation	15.9	17.2	13.8
230/115 kV New Transmission Center & Increase Capacity	2.0	3.0	6.0
230 kV Switchyard New and Expansions	0.5	3.0	0.5
230 kV Total	**18.4**	**23.2**	**20.3**
115 kV System			
115 kV Line Rehabilitation	25.3	16.1	28.9
115 kV New Line	2.4	2.0	0.0
115/38 kV New Transmission Center & Increase Capacity	5.0	8.6	6.0
Capacitor Bank - Transmission	2.0	19.0	13.8
115 kV Switchyard New & Expansions	1.2	0.0	4.1
115 kV Underground System	1.5	14.0	9.3
Transmission Misc. Improv. Plant - Engineering	0.0	0.0	0.5
115 kV Total	**37.4**	**59.7**	**62.7**
38 kV System			
38 kV Line Rehabilitation	9.8	7.6	11.1
38 kV Switchyard New & Expansions	1.0	1.5	5.0
38 kV New Line	0.9	0.6	0.3
38 kV Underground System	0.3	0.3	1.0
Increase Line Capacity	0.6	0.6	0.0
38 kV Total	**12.5**	**10.4**	**17.4**
Other Transmission			
Transmission Misc. Improv. Plant - Engineering	7.2	6.3	1.0
Transmission Misc. Improv. Plant - Electric System	2.5	2.9	2.5
Transmission Pole Replacements	1.5	0.8	2.0
Breakers Uprating	0.8	0.5	0.5
Energy Management System	0.5	0.5	0.7
Other Transmission Plant	0.5	0.4	0.8
Grounding Mat Reconstruction	0.1	0.1	0.1
Other Transmission Total	**13.0**	**11.4**	**7.5**
Transmission Total	**81.3**	**104.7**	**107.9**

Overall, PREPA expects to spend on the order of $50,000 per mile of existing 230 kV transmission line on rehabilitation, and roughly the same amount on the 115 kV system. The

[371] Schedule F-3 REV

expected investment in the 38 kV system is far smaller, suggesting that either the 38 kV system is in better repair, or the PREPA is prioritizing the long-distance high capacity lines.

i. Transmission line capital budget

Half of the FY2017 dollars spent in transmission ($40.5 million) are targeted towards the repair of specific high capacity transmission lines. Specifically, PREPA seeks to repair the following corridors (FY2017 costs):[372]

- Two 230 kV lines (50900, 51000) from Aguirre to Aguas Buenas, just south of San Juan (south-north): $15.7 million
- 115 kV line (37800) from Jobos near AES to San Juan (south-north):[373] $13.4 million
- 115 kV line (37400) from Arecibo to San Juan (east-west): $4.4 million
- 115 kV line (36100) from Lago Dos Bocas towards Piñas, on the outskirts of San Juan. (east west): $7.0 million

As in all of PREPA's other capital projects, these are the "as-incurred" costs, rather than the full cost of each project. Assessing the full cost of each project, it becomes apparent that PREPA expects to spend about $600,000 per mile on the 230 kV system and, on average, about $700,000 per mile on the 115 kV system.

PREPA's projects include the replacement of structures, towers, and foundations, and replacement of insulators. These costs appear to be in line with utility estimates for similar projects.

The largest component of the 38 kV capital budget is allocated to the rehabilitation of the 38 kV system. There are 24 specific projects with FY2017 budgets that fall under this umbrella, only one of which exceeds one million dollars. We did not request detailed budget justifications from PREPA for projects under one million in FY2017, and therefore are unable to provide insight on the specifics of these projects, aside from their general descriptions as "improvements" and "increase capacity." They are consistent with PREPA's indication of the state of the system. The only project in excess of one million in FY2017 is a reconstruction of seven miles of line (PID 15610) near Mayaguez. This project replaces rotting wooden poles with steel, effectively re-building the line. The dollar cost is consistent with utility estimates for similar projects.

i. Other transmission projects

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[372] Schedule F-3 REV.

[373] This is the only project listed that also includes new transmission line segment along a five mile corridor near Caguas, south of San Juan.

Most of PREPA's non-line-specific costs are scattered across other initiatives, most of which are relatively low cost on a per-item basis, and therefore difficult to assess without an engineering audit. The only substantial additional line items in FY2017 are listed under "Transmission Misc. Improv. Plant - Engineering" and are primarily allocated towards the construction of two new control rooms at two major switchyards in San Juan: Monacillo and Viaducto. We have no specific basis for comparison or work plan for these control rooms, but assess the costs as within line for this scale of project.

3. Distribution system capital budget

a. Overview

The 2013 URS Report on PREPA's assets provides a reasonable overview of PREPA's distribution system:

> As of June 30, 2013, the Authority's distribution system consisted of approximately 31,550 circuit miles of distribution lines (with operating voltages ranging from 4.16 to 13.2 kV) and 333 substations (with a total installed capacity of 5,018 MVA). The distribution system has more than 1,800 circuit miles of underground lines. The Authority has 22 portable transformers with a total capacity of 349.6 MVA to substitute for existing transformers during maintenance or outages; similarly, the Authority has two portable capacitor banks each rated at 18 MVAR. There are 813 privately owned substations (with a total installed capacity of 3,266 MVA). The distribution system also includes approximately 1,485,200 client meters.[374]

Of the 31,550 circuit miles of distribution lines, PREPA indicated that approximately 24 percent of the lines are at 13.2kV, 24% of the lines are at 8.32 kV, and the remaining overhead lines are at 4.16 kV.[375] In a discovery response, PREPA indicated that over 16,000 circuit miles are primary voltage.[376] Primary voltages are carried to transformer to be stepped down to secondary voltages delivered to customers. In more recent updates, PREPA has indicated it does not have Information on the percentage of poles carrying primary and secondary

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[374] URS June 2013 Annual Report ("URS 2013 Report"). PREPA Exhibit 3.02(D) Consulting Engineers Report. Fortieth Annual Report on the Electricity Property of the Puerto Rico Electric Power Authority, June 2013. Page 17

[375] *Id.* Page 55.

[376] CEPR-AH-02-01

lines.[377] In addition, as of PREPA has approximately 3,100 circuit miles underground, three-quarters of which is 13kV.[378]

The Company reported 333 substations in the URS 2013 Report,[379] and lists approximately the same number in response to discovery.[380] According to the URS 2013 Report report:

> The Authority has standardized on two sizes of permanent substations based on the transmission system supply voltage. This standardization expedites the engineering, procurement, and construction cycle, increases flexibility in potentially utilizing equipment as spares, and provides a cost effective installed capacity margin for load growth. In situations where the Authority needs additional substation capacity on an interim basis or with short lead times, the Authority installs temporary substations that are standardized unitized metal clad equipment, which can be relocated as required[381]

The entire PREPA distribution system is divided into seven regions with 26 Technical Districts. [382] PREPA deemed a map of the distribution system as voluminous and critical energy infrastructure.[383] We attempted to review the Company's geographic information system (GIS), but were unable to access PREPA's virtual private network (VPN) despite requests to PREPA for technical support. Thus, we do not have a good visualization of the regional and district detail for the PREPA distribution system.

Like the transmission system, PREPA has stated that its distribution system is in a poor state of repair:

> In general, PREPA Distribution system is in operational state or condition, but with reliability concerns, due to aging of the components. Still a high percentage of overhead (OH) distribution circuits are attached to wood poles in deteriorated conditions, with OH cables gages inappropriate to serve the electrical load in a reliable and qualitative manner. Taking a look to the underground (UDG) Distribution circuits, a significant number of them have been replaced in "temporary" way by OH circuits thru street lights poles, to reestablish electrical service to customers when outages cannot be fixed

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[377] CEPR-PC-02-034

[378] CEPR-JF-02-06(a). Author's calculation.

[379] URS 2013 Report. Page 51.

[380] CEPR-PC-02-028(a).

[381] URS (2013) PFD 000055

[382] CEPR-AH-02-06

[383] CEPR-PC-02-039

> repairing the UDG conductor. Most of the UDG circuits in residential communities (Urbanizations) with more than 30 years of existence are direct burial, which accelerate the cable deterioration and prevent from replace cables in reasonable time and avoid repeated interruptions in the future. This, also increases the reconstruction and maintenance costs when intervention is required. In addition to the Distribution Electrical network (OH &UDG), the sites (substations) where main power distribution transformers resides, are in advance state of deterioration. Most of the components need to be replaced and perform continuous maintenance to grounds and buildings.[384]

Given PREPA's description of the "deteriorated" condition of its distribution system, it is no surprise that PREPA's reliability metrics are poor and indicate a system that experiences frequent and longer duration outages (see "Low reliability for PREPA customers," Section III.B, page 32).

b. Distribution system capital budget

PREPA's distribution system capital budget amounts to $74 million in FY2017, spread over 108 separate line item projects in PREPA's diverse distribution network.. Table 16 below, consolidates PREPA's distribution capital budget by sub-area and initiative.[385] Note that this is not broken down by directorate and includes spending under both the transmission and distribution directorate as well as the customer service directorate (marked with asterisk).

[384] CEPR-AH-02-01(f)

[385] Schedule F-3 REV

Table 16. Distribution system capital budget, millions FY2017-FY2019

	FY2017	FY2018	FY2019
13.2 kV System			
Improvements to the 13.2 kV Aerial Distribution System	1.9	1.9	2.2
Construction and Extension of 13.2 kV Aerial Feeders	4.0	3.8	5.5
Improvements to the 13.2 kV Underground System	2.7	6.4	4.4
Improvements to the 13.2 kV Underground System (Blankets) (00917)	1.3	1.0	1.5
Construction and Extension of 13.2 kV Underground Feeders	0.6	0.6	0.7
13.2 kV Total	**10.4**	**13.5**	**14.1**
8.32 kV System			
Improvements to 4.16 kV - 8.32 kV Aerial System (Blankets) (00968)	20.0	15.3	23.0
Improvements to 4.16 kV - 8.32 kV Aerial System (Other)	3.9	3.8	5.4
Construction and Extension of 4.16 kV - 8.32 kV Aerial Feeders	0.5	0.2	0.3
Improvements to the 4.16 KV - 8.32 KV Underground System	6.8	5.3	9.3
Construction and Extension of 4.16 kV - 8.32 kV Underground Feeders	0.3	0.3	0.3
8.32 kV Total	**31.5**	**24.9**	**38.2**
4.16 kV System			
Construction and Extension of 4.16 kV - 8.32 kV Aerial Feeders	0.6	0.5	0.9
4.16 kV Total	**0.6**	**0.5**	**0.9**
Substations, Drops, and Meters			
Purchase of Meters and Metering Equipment*	12.5	12.5	12.5
New Customer Extensions and Drops (Blankets) (01035)	6.0	3.0	8.0
Street Lighting	5.5	3.3	7.0
Line Extension to Serve New Customers	1.1	1.6	1.6
Rehabilitation of Substations	1.9	1.3	1.3
Miscellaneous Substations Improvements	0.2	0.1	0.2
New Distribution Substations	0.0	0.5	4.0
Purchase and Installation of Breakers and Sectionalizers	0.6	0.4	0.7
Purchase Step - Voltage Regulators	0.2	0.1	0.2
Replacement of Residential and Commercial Services*	0.4	0.4	0.4
New Services Drops Installation - Commercial*	0.9	0.9	0.9
Special Transformers	0.6	0.6	0.7
Distribution Line Voltage Converter	0.4	0.3	0.5
Distribution Lines Capacitors	0.1	0.1	0.2
Distribution System Automation	0.5	0.3	0.7
Distribution System Expansion	0.0	0.0	0.2
Distribution Total	**30.8**	**25.1**	**39.1**
Other			
Improvements to 4.16 kV - 8.32 kV Aerial Distribution System	0.3	0.3	0.3
Improvements to the 13.2 kV Underground System	0.5	0.3	0.6
Distribution Total	**73.9**	**64.5**	**93.1**

* Falls under Customer Service directorate

There are notable features of PREPA's distribution budget. In general, we can gather that the vast majority of the spending is on the rehabilitation of the existing distribution system, substations, feeders, and lines. Some of the most substantial spending is allocated to "blankets" which are simply pools that get used on an as-needed basis for repairs, maintenance, and replacement parts in the widespread system. Overall, the distribution department allocates $27.3 million, or over one-third, of its budget to unspecified blankets estimates. Another $12.5 million, or 17 percent, is allocated to new meters and meter

equipment. The large remainder of PREPA's distribution budget is targeted towards street lighting, and both above and below-ground substation and feeder rehabilitation.

c. Distribution network capital spending

While nearly 85 percent of PREPA's distribution capital budget is allocated towards non-meter issues, we were unable to assess the accuracy or need for the vast majority of the 105 non-meter projects. Of the 78 distribution projects that had FY2017 spending and were not either explicitly blankets or meters, the average FY2017 cost was well under one million dollars and the median cost was a quarter of a million.

PREPA did not provide justification for the individual projects or explanations beyond general "required improvements," and thus it is nearly impossible to assess the prudence, value, or reasonableness of these projects.

It is difficult to even judge the validity of the distribution budget against historic spending because in prior years as PREPA's records of past capital spending do not appear to be broken into the same categories as in forward-looking spending.

PREPA's distribution staff did thoroughly answer questions during the October 20 Conference Call regarding the nature of the expenditures they seek to make, and indicated that (a) the capital was absolutely required simply to begin a service restoration program and (b) that the capital budgets were likely lower than were required to establish reasonable service.

d. Meter capital spending

In FY2013, PREPA indicated that its system contained approximately 1,485,200 client meters.[386] In response to discovery, PREPA noted that its number of meters currently is 1,620,401 installed meters and includes both active and inactive meters.[387]

In its FY2017 through 2019 budgets, PREPA has requested $10.6 million per year to purchase new meters. PREPA describes its budget request for future meter acquisitions as:

> PID 16677 - $10.6M - Acquisition of Meters Secondary Lines. The amount budgeted in PID 16677 is for acquisition of meters for residential customers. These amounts do not include maintenance or operating expenses. PREPA plans to maintain its replacement plan with an emphasis in equipment upgrades. The estimated amount of meters to be acquired for FY2017 is 29,000 meters. The estimated cost is $200/meter plus communication

[386] URS 2013 Report, page 17

[387] CEPR-JF-02-05

> infrastructure, if we consider the cost of the installation of new technology (AMI) the additional cost is around $198/meter[388]

For comparison, PREPA replaced 47,296 meters in FY2014, 40,111 meters in FY2015, and 21,133 meters in FY2016.[389] In FY2017, PREPA anticipates replacing 29,000 meters. If the replacement cost for meters is $200/meter and the number of meters being replaced is 29,000; then the FY2017 meter acquisition cost would be $5.8 million *or $4.8 million less* than the budget request made by PREPA. For FY2018 and FY2019, PREPA anticipates replacing 20,000 meters, which at $200 per meter would cost $4 million per year or $6.6 million less than the dollars budgeted for each fiscal year.[390]

The apparent difference between the budget request and the calculated amount appears to be the continued implementation of smart meters ("AMI") by PREPA. These meters are substantially more expensive than PREPA's current generation of meters and require substantial infrastructure to be useful. According to PREPA, these new meters would cost approximately $398 per meter, a substantial increase on a per-meter basis and a questionable use of PREPA funds at this time.

i. Moving from Advanced Meter Readers to Smart Meters

Electric meters can be generally categorized into three types: radial meters, AMR meters, and smart meters.

Electromechanical meters contain a metal disc that spins with energy use. The amount that the dial turns indicates the energy consumed. These meters require human meter readers to view each individual meter at its location to obtain billing data.

Automated Meter Reading (AMR) meters have one way communications capabilities to transfer energy consumption data to readers or databases remotely, either via wire or radio frequencies. These meters obviate a need for a meter reader to manually attend a meter. Utilities can obtain information from AMR with either hand-held devices or vehicle driven readers. PREPA indicates that its AMR meters transmit data back through the distribution system.

> The system being installed utilizes a proprietary technology that communicates between meters and remote controllers by superimposing a

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[388] CEPR-AH-02-06

[389] CEPR-JF-02-05

[390] URS 2013 Report. Page 48.

> frequency modulated signal on the Authority's existing distribution lines between the client meter and the Authority's substation.[391]

In addition, PREPA notes that its AMR meters also:

> Beginning in fiscal year 2011 the Authority has been installing meters with an integral disconnect/connect feature. These meters have greatly reduced the time required for customer service disconnections and reconnects for short term clients or in problematic locations.[392]

Advanced Metering Infrastructure (AMI, or "smart meters"): Smart meters are capable of two-way communicates between individual meters and the utility. The two-way communications have the capability of providing interval data at a level of time scale granularity unavailable to radial and AMR meters. However, smart meters require both the communication, data storage, and data analysis infrastructure to support the vast amounts of data required.

To date, PREPA has indicated that it started AMR meters installed in 2000 and completed its AMR installation in 2013.[393] AMR meters have a typical lifespan of 15-20 years.[394] PREPA has not provided a meter replacement program for its existing meter except for introducing AMI meters into its system.

ii. PREPA's justification for smart meter infrastructure

PREPA indicates that its system contains approximately 13,000 smart meters based on the ability to conduct two-way communications with between the meters and PREPA.[395] In 2015, PREPA initiated a pilot program to install 30,000 smart meters in two phases that were summarized in two PowerPoint presentations, Proyecto Piloto de Metros Inteligentes (July 2015) and Proyecto de Metros Inteligentes (September 2016).[396] The July 2015 presentation provided an overview of PREPA's goals (translated):

> Develop the necessary specifications to develop a system that:
>
> - Gathers the necessary data to raise the specifications of the optimal system for ESA

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[391] CEPR-JF-02-05

[392] URS (2013) PFD 000063

[393] URS (2013) PFD 000062

[394] https://www.vectren.com/assets/cms/livesmart/pdfs/amrfactsheet.pdf

[395] CEPR-PC-08-03 part e.

[396] CEPR 161020 Request No.8 Attachment 1 and Attachment 2

- Improve the efficiency of the electrical system
- Significantly improve the service offered to customers, such as SAIDI, SAIFI, CAIDI and thus reduce the need for management in the commercial offices and Customer Service Center (telephones)
- Automatic remote disconnect and disconnect, to improve service and to allow service cut-off, improving cash flow[397]

PREPA's goals in pursuing smart-grid technology are similar to those of other utilities embarking on Smart Grid implementation. In the July 2015 presentation, PREPA compares their pilot program to state of Hawaii,[398] but does not provide context for including the state – as opposed to any other state that has also tested smart grid technology.

Utilities have generally found it difficult to justify smart grid technology on a cost effectiveness basis and in this case Hawaii may have served as a faulty example for PREPA. On March 31, 2016, the Hawaiian Electric Companies filed a smart meter implementation plan in Docket 2016-0087. The Hawaii plan would involve 467,000 meters across five of the Hawaiian Islands. The filed analysis indicated that the deployment cost of $413 million would likely exceed the $345 million in estimated benefits for the project.[399] It is unknown if Hawaii will proceed with full smart grid implementation since the Hawaiian Electric Companies own analyses indicate that the project as currently envisioned are not cost-effective.

Yet more substantially, the slide deck reveals a deeply faulty justification for the project: a perception of excess cash flow in the customer service department. The slide states that "PREPA annually allocates $10 million to the meter replacement program. This plan contemplates using this fund to implement the replacement of the network."[400]

It is inconceivable that at a point where PREPA's system is actively failing, any department would look at their budget as inviolable unless the initiative is absolutely necessary for the safe, reliable and efficient operation of the system. PREPA's second presentation, from July 2016, clearly indicates that the smart meter program would not be expected to provide cost savings, and is a distraction from PREPA's immediate requirements.

iii. Smart Meter Pilot

[397] CEPR 161020 Request No.8 Attachment 1: Slide 3

[398] CEPR 161020 Request No.8 Attachment 1: Slide 32

[399] Hawaiian Electric Companies. Application. Table 2, Page. 8. March 31, 2016. Docket 2016-0087.

[400] CEPR 161020 Request No.8 Attachment 1: Slide 5

In the September 2016 draft presentation, PREPA indicated that it spends approximately $10 million per year on replacement meters and that PREPA wanted to use some of the funding for smart meters.[401]

The draft presentation indicates that starting in June 2015, PREPA ordered 15,000 smart meters from a company, Caribbean Metering Systems (CMS).[402, 403] PREPA reports that it had received 10,216 meters, data collector devices, and network support.[404] In total, PREPA's estimated total cost for the Phase I pilot was $7.5 million or approximately $500 per meter.

The next phase of the Smart Meter Pilot project is to expand the existing pilot project by another 15,000 smart meters. For this phase, PREPA has estimated that the costs will be $4.675 million or $311 per meter.[405] PREPA anticipates that meter costs will decrease from $223.62 per meter in the first phase to $193 per meter for the second phase. In addition, PREPA has estimated that it will not need additional data concentrators that were installed during Phase I.

The results of PREPA's pilot indicate that it had not achieved some of its goals.

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[401] CEPR 161020 Request No.8 Attachment 2: Slide 8

[402] CEPR-JF-02-05

[403] CEPR 161020 Request No.8 Attachment 2: Slide 8. PREPA has included the cost of the 4,784 smart meters still pending installation.

[404] CEPR 161020 Request No.8 Attachment 2: Slide 8

[405] CEPR 161020 Request No.8 Attachment 2: Slide 9

Table 17. Findings from PREPA CMS Smart Meter Pilot: September 2016

Goal	Findings
Improve meter reading effectiveness	99% target, 93% observed[406]
Improve process to resolve non-payment	Reduced times to process delinquent accounts through automatic disconnection
Reduction in energy theft	Observed theft in 169 out of 6,844 meters installed. Based on deployment of 250,000 meters, PREPA determined that smart meters would not economically viable.[407]
Durability of meters	PREPA needed to return 88 meters and several meters had minor issues.[408]
Quality of meters received from vendor	PREPA noted that 5,840 meters or *57 percent* of the 10,216 meters received were rejected and returned for recalibration. PREPA noted that the manufacturer is working on improving quality control.[409]
Measuring Service Quality	PREPA noted that it needed to improve server infrastructure and technical support from the supplier.[410]

The summarized findings indicate that PREPA is not ready for a more significant deployment of smart meters. First, PREPA's estimates of the CMS project for years two (2) through eleven (11) would cost approximately *$18-20 million per year* for the installation of 250,000 smart meters or a replacement of 17 percent of PREPA's 1.4 million customer meters.[411] If one includes the $12.175 million of spending (spent and planned) on the initial smart meter pilot, this suggests a cumulative project cost of $192 to $212 million for 250,000 meters. On a per meter basis, the 250,000 meters would cost $768 to $848 per meter. With respect to the estimated annual costs of $18 to 20 million for years 2 through 11, PREPA has not provided any specific details of the scope and justification of the additional work to expand smart meters. Furthermore, PREPA has not provide a summary of the plan or costs of the 250,000 smart meter deployment or any other future deployment plans.

406 406 CEPR 161020 Request No.8 Attachment 2: Slide 14

407 CEPR 161020 Request No.8 Attachment 2: Slide 14

408 CEPR 161020 Request No.8 Attachment 2: Slide 15

409 CEPR 161020 Request No.8 Attachment 2: Slide 15

410 CEPR 161020 Request No.8 Attachment 2: Slide 16

411 CEPR 161020 Request No.8 Attachment 2: Slide 14

There is no evidence that PREPA's system will actually be benefited in the near or mid-term by the deployment of smart meters, and smart meters do little to mitigate a generation, transmission, and distribution system that simply fails to operate reliably.

Another concern highlighted in the findings from the initial pilot project is the quality of the meters delivered to PREPA. Of the 10,216 meters delivered to PREPA as of September 2016, over half of the meters needed to be returned for re-calibration. Even if one assumes that no more of the 15,000 Phase 1 meters will fail, it still results in an initial rejection rate of 39 percent. These rejection rates should raise serious questions about the contracts and experience of both the smart meter vendor and supplier.

PREPA itself has noted that it needs to evaluate complimentary technologies to address the topological challenges of the island. A cellular communication network will not be able to communicate it mountainous terrain since the communication requires a line of sight path. As part of the evaluation, PREPA is considering the need to pilot a 10,000 smart meter deployment with radio-frequency communications technology.[412]

iv. Smart Meter Recommendations

Based on the results of the initial pilot project, we recommend the following:

1. PREPA discontinue any additional work beyond the contracted 30,000 smart meters.
2. PREPA provide a detailed business case including costs and benefits to justify the need for smart meter deployment.
3. The business case should provide detail of the scope and scale of deployment including but not limited to technological issues that will need to be addressed by PREPA.
4. The business case also needs to address budget allocations since a smart meter project will divert funding and management focus from other pressing needs faced by PREPA.

4. Recommendations with respect to Transmission and Distribution Capital

We make the following recommendations with respect to transmission and distribution capital:

[412] CEPR 161020 Request No.8 Attachment 2: Slide 18

1. We recommend that the Commission approve the full FY2017 transmission system capital budget as requested by PREPA.
2. We recommend that the Commission require PREPA to cease further smart meter or AMI purchases until a strategic plan justifying the need for AMI is produced by PREPA and approved by the Commission.
3. We recommend that the Commission reduce PREPA's meter budget (PID 16677) from $10.6 to $5.8 million for FY2017 to reflect the anticipated cost of continuing PREPA's normal AMR acquisitions.
4. We recommend that the Commission approve the full FY2017 distribution system capital budget for all items except secondary line meters (PID 16677).

F. Other capital – Transportation and Computer Equipment

1. Overview

The last component of PREPA's capital budget are allocations for vehicles ($19.4 million) and computer equipment ($13.1 million). In this assessment, we focused on the state of PREPA's generation fleet and transmission, and have relatively little information about these anticipated expenditures. This section summarizes the information that we do have available.

2. Vehicles

a. Auto fleet

PREPA requests a budget of $16 million in FY2017 for vehicle replacement (PID 13713). We requested detail on PREPA's anticipated spending, and were provided a list of 132 vehicles that PREPA is seeking to acquire.[413] Most of the replacement vehicle fleet is oriented towards the purchase of bucket or boom trucks – the trucks commonly used for line work with a bucket and boom. About half the trucks are earmarked for the transmission and distribution directorate ($12.5 million). Another 40 trucks are earmarked for meter readers in client services ($2 million), and another 24 pickup and vans are targeted for the generation directorate ($946,500). The executive directorate acquires the remaining eight vehicles including one boat, which we assume is for offshore work (total $467,000).

PREPA maintains a fleet of 3,593 vehicles, of which approximately 1/3 are SUVs or basic pickup trucks. Another third of the vehicles are either trailers or highly specialized vehicles (such as bulldozers, cats, trenchers and loaders), the remaining vehicles are either bucket

[413] CEPR 161020 Request No 10 Attach 01

trucks or other line vehicles. While the number of SUVs, Jeeps and pickup trucks seems somewhat extraordinary for the number of employees at PREPA, the budget for these classes of vehicles are relatively small.

b. Helicopter

PREPA requests $3 million for a replacement helicopter in FY2017.

The National Transportation Safety Board ("NTSB") reports that on July 24, 2015 a helicopter owned by PREPA crashed in shallow water near Vega Baja. The NTSB reports that the helicopter was engaged in electrical power distribution construction, and had a mechanical failure mid-flight. The pilot successfully descended and none of the three crew were injured, but the NTSB reported that the "main rotor struck the helicopter's tail boom, separating it from the fuselage."[414] The crashed helicopter, an MD Helicopter 369 is a light utility craft. A cursory review of similar craft suggests that a $3 million price tag is within reason, but we have not made a thorough review of the validity of this cost.

3. Computer equipment

PREPA requests $13.1 million for various computer equipment, data management systems, and new network equipment. PREPA has divided their request into 18 sub-categories under the executive directorate, all but two are under $1 million. The most substantial request is a near-term (FY2017) data center migration to PREPANetwork for $8 million ($6.3 million in FY2017).

We have no specific knowledge of these initiatives or the basis of the cost. The primary concern in this case could be the inappropriate use of an affiliate (PREPANetwork). However, we have no reason to believe that this initiative is inappropriate. Maintaining an effective data management system and computer network will be critical to continued data collection, statistical analysis, and reporting.

4. Recommendations with respect to transportation and computer equipment

We recommend that the Commission approve the full FY2017 transportation and computer equipment budget.

G. Recommendation

[414] NTSB Report ERA15LA280.
http://www.ntsb.gov/_layouts/ntsb.aviation/brief.aspx?ev_id=20150724X55322&key=1

We provide below a summary of our recommendations on PREPA's capital budget request.

1. We recommend the Commission approve PREPA's FY2017 capital spending at Aguirre, Palo Seco, and San Juan Steam Plants.
2. We recommend that the maintenance contract at San Juan Combined Cycle be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $12 million in FY2017 from capital to O&M.
3. We recommend that the Commission approve the other capital expenses at San Juan and Aguirre Combined Cycle Units.
4. We recommend that the Commission examine the MHPS-PR contract and the performance of MHPS-PR to determine if the contractor is meeting performance expectations for maintenance service at San Juan CC.
5. We recommend that the Commission require PREPA to file notice of any long-term contract with service providers with a potential net present value of $25 million value or higher.
6. We recommend that the maintenance contract at Cambalache be removed from the capital budget and reassigned as an annual maintenance expense, a reassignment of $4 million in FY2017 from capital to O&M.
7. We recommend that the Commission examine the Camabalache contract and the performance of Alstom to determine if the contractor is meeting performance expectations for maintenance service at Camabalache.
8. We recommend that the Commission require PREPA to provide strategic plans for San Juan and Palo Seco steam plants, including the following elements, at a minimum: maintenance plan, MATS compliance plan, an investment plan for maintaining (or not) San Juan 7-10 and Palo Seco 1 & 2, and a reliability study – i.e. what strains are placed on the system in the presence or absence of the San Juan and/or the Palo Seco steam units.
9. We recommend that the Commission require PREPA to track and report on projects at San Juan 7-10 and Palo Seco Units 1 & 2, regardless of if these units are considered limited use.
10. PREPA's next long-term planning exercise should evaluate the extent to which the "limited use" units should be maintained and contribute to peak requirements on an economic basis.
11. We recommend that PREPA track capital dollars spent at each "limited use" facility separately then the units that are expected to be maintained. For Costa Sur, PREPA should track and report on projects at Units 3 & 4. Further, PREPA's long-term

modeling should consistently assess if these limited use facilities are available for peak purposes, and if not, assess the value of maintaining units that neither contribute to peak purposes or provide energy to the system. PREPA's lack of maintenance spending at these units is inconsistent with its continued peak use of the facilities.

12. We recommend that the Commission revise PREPA's revenue requirement for FY2017 to reflect a $15 million spending cap at AOGP, reducing FY0217 revenue requirements by $41,339,807. To reflect the Commission's order that PREPA "shall assume, for informational purposes only, that AOGP will become operational at a realistically achievable date," we recommend increasing the FY2018 budget by the same $41.3 million increment to $454,756,927.

13. We recommend that the Commission order that PREPA withhold from signing a Final Notice to Proceed until it has submitted, and the Commission has approved, the AOGP Economic Analysis. PREPA should submit, or the Commission should require that PREPA submit, the AOGP economic analysis expediently.

14. We recommend that the Commission approve the full FY2017 transmission system capital budget as requested by PREPA.

15. We recommend that the Commission require PREPA to cease further smart meter or AMI purchases until a strategic plan justifying the need for AMI is produced by PREPA and approved by the Commission.

16. We recommend that the Commission reduce PREPA's meter budget (PID 16677) from $10.6 to $5.8 million for FY2017 to reflect the anticipated cost of continuing PREPA's normal AMR acquisitions.

17. We recommend that the Commission approve the full FY2017 distribution system capital budget for all items except secondary line meters (PID 16677).

18. We recommend that the Commission approve the full FY2017 transportation and computer equipment budget.

19. We recommend the Commission require PREPA to present the results of its investigation into the Aguirre September 21st 2016 outage to this Commission and disclose its budget requirements from that event.

VI. FUEL AND PURCHASED POWER BUDGETS

A. Summary of issue and findings

In this chapter, we discuss PREPA's budgets for fuel and purchased power. Together, these budgets represent $1.47 billion in FY2017 – approximately half of PREPA's FY2017 revenue requirement.[415] At present, both of these components of PREPA's system costs are compensated through the use of adjustable riders, meaning that PREPA's revenues adjust to ensure sufficient collection for these costs even as fuel prices change throughout the year. As such, the values presented in the rate case are not strict "budgets" in the same sense as the other line items of PREPA's revenue requirement, but rather are expected spending levels. PREPA presents these budgets with the explicit understanding that its spending is expected to differ, potentially by a large margin, as fuel costs change.

In the interest of setting realistic rates and appropriately managing the expectations of ratepayers, the Commission must decide if PREPA's fuel and purchased power budgets are reasonable to within an acceptable margin. If the Commission decides these budgets are reasonable, no change will be required. If the Commission decides that PREPA's fuel and purchased power budgets are not reasonable, it must then decide whether or not to order adjustments to these budgets and, if so, in what amounts.

Below, we discuss the grounds of PREPA's fuel and purchased power budgets, describe how PREPA formulated these budgets, and critique both the methodology and the results. Our conclusion is that PREPA's use of production cost modeling with PROMOD is appropriate for determining fuel and purchased power budgets in the short term, and that PREPA is generally successful at forecasting its spending on purchased power from thermal generators but is subject to significant uncertainty in the online dates of new renewable energy projects. In addition, we conclude that PREPA's fuel price forecasts were unrealistically low and therefore an adjustment to the fuel budget is necessary. We recommend an addition to the fuel budget of $461,305,000.

B. PREPA's use of fuel

PREPA's own generation fleet consists almost exclusively of fossil-fired generators.[416] Apart from two units at the Costa Sur plant, all of PREPA's thermal generators burn either

[415] PREPA's Petition for Rate Review, Schedule A-1 REV. Author's calculation.

[416] Base IRP, Volume I, Table 3-1. In addition to its approximate 5 GW of operational fossil-fired capacity, PREPA operates 60 MW of hydropower generation.

distillate[417] or residual fuel oil.[418] In general, PREPA's combined cycle and gas turbine units burn distillate oil while its steam units burn residual fuel oil. Costa Sur units 5 and 6 burn a blend of natural gas and residual oil.

As discussed in the Commission's Final Order on the IRP,[419] and demonstrated in Schedule A-1 REV, PREPA's costs are dominated by fuel expenses. Historically, PREPA has spent between one and two billion dollars a year on fuel alone.[420] Over time, the composition of PREPA's fuel mix has shifted. In FY2011, #6 fuel oil represented ninety percent of the fuel burned by PREPA at its units (on the basis of MMBTU of fuel), with the remainder made up solely of distillate oil.[421] PREPA started burning natural gas at Costa Sur units 5 and 6 in FY2012, and the fuel has since come to represent 27 percent of PREPA's total fuel use.[422] Use of distillate has also increased to approximately one-fifth of PREPA's fuel mix, while PREPA's reliance on residual fuel oil has declined and now represents only half of the fuel burned by PREPA.[423] These changes are shown in the figure below.

[417] Distillate fuel oil is one common name for the No. 2 grade of fuel oil. It is also sometimes referred to as diesel fuel by PREPA and others.

[418] Residual fuel oil is one common name for the No. 6 grade of fuel oil. It has a higher viscosity than No. 2 fuel oil and may contain higher levels of impurities.

[419] IRP Final Order, Section II(E).

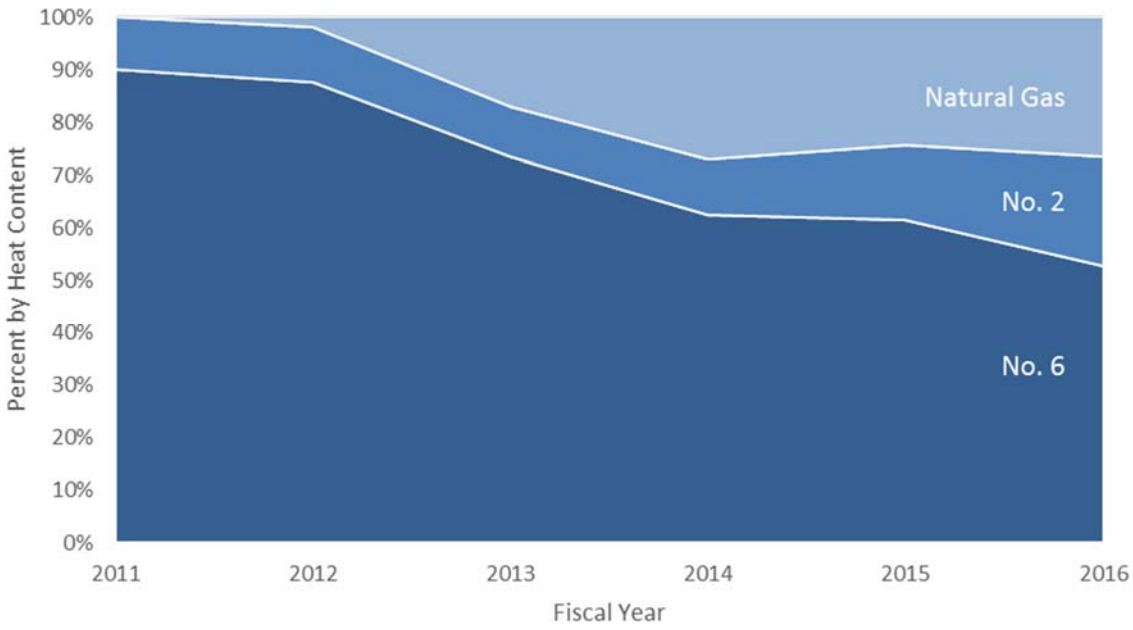
[420] PREPA Ex. 14.02.xslm, "Inputs" tab, line 25 ("Fuel Oil Adjustment").

[421] Author's calculation, based on values provided in PREPA's responses to CEPR-AH-06-05(b)(v) of the Commission's Fourteenth ROI (November 7, 2016; refer to CEPR-AH-06-05 Attach 01.xlsx) and CEPR-AH-06-01(d) of the Commission's Fourteenth ROI (November 3, 2016). PREPA consumed a total of approximately 147,700,000 MMBTU of fuel in FY2011, of which approximately 133,00,000 was No. 6 fuel oil with No. 2 fuel oil making up the remainder.

[422] Author's calculation, based on values provided in CEPR-AH-06-05 Attach 01.xlsx and CEPR-AH-06-01(d). PREPA consumed a total of approximately 139,600,000 MMBTU of fuel in FY2011, of which approximately 73,600,000 MMBTU was No. 6 fuel oil, 28,900,000 MMBTU was No. 2 fuel oil, and 37,100,000 MMBTU was natural gas burned at Costa Sur.

[423] *Id.*

Figure 26. Composition of PREPA's fuel mix over time, on a heat content basis.



Notably, PREPA's total fuel consumption has also declined by approximately five percent since FY2011, in accordance with PREPA's falling sales.[424] If PREPA constructs new units which have lower heat rates and burn primarily distillate or natural gas, we would expect its fuel mix to shift yet further. However, neither PREPA nor the Commission expect the composition of PREPA's generation fleet to change substantially in FY2017 and as such we would expect total fuel consumption to follow a roughly similar pattern, in terms of amounts of individual fuels and amount of fuel as a whole, as seen in FY2016.

C. PREPA's Power Purchase and Operating Agreements (PPOAs)

In addition to its own units, PREPA buys electricity from two fossil-fired plants and a variety of renewable units owned by third-parties. PREPA has contractual agreements with these third-parties, known as Power Purchase and Operating Agreements, or PPOAs. PREPA's costs for purchased power are largely dependent on the structures of its contracts with its PPOA counterparties, which themselves vary widely.

PREPA's two fossil PPOAs are with EcoEléctrica, which operates a 507 MW, natural gas-fired combined cycle plant, and AES, which operates a 454 MW coal-fired steam plant.[425] PREPA's contractual terms with AES are straightforward. As described by the utility, PREPA pays AES for the energy it produces and the dependable capacity it provides, as well as compensating

[424] *Id.*

[425] Base IRP, Volume I, Table 3-1.

AES for its startup-related costs after any shutdown of the unit that was requested by PREPA.[426] All of these costs are set on a yearly basis.[427] PREPA's energy payment to AES is comprised of two components: a modified fuel pass-through and a charge for variable operations and maintenance costs.[428] AES' per-kWh energy price is fixed every year, subject to a guarantee from PREPA that the unit will be dispatched at a capacity factor of at least 50 percent.[429] Similarly, the capacity price represents both capital (debt) and fixed operations and maintenance costs at AES.[430]

PREPA's contract with EcoEléctrica is somewhat more complex. It includes a capacity payment and a base energy charge (both of which are structured similarly to the AES contract, although unlike the AES energy charge, the EcoEléctrica base energy charge is adjusted based on the unit's heat rate at different levels of output).[431] Like in its agreement with AES, PREPA has also agreed to pay charges related to unit start-up assuming that PREPA requested the preceding shut-down. However, unlike the AES contract, the EcoEléctrica contract contains a provision that PREPA will pay an "excess energy payment" for generation above a 76 percent capacity factor.[432] On a Conference Call, PREPA clarified that the 76 percent capacity factor limit is set on a monthly basis, that EcoEléctrica sets the excess energy rate unilaterally, and that the excess energy rate can change on a weekly basis.[433] These provisions make it impossible for PREPA to accurately predict its spending at EcoEléctrica during a yearly budgeting process unless PREPA commits to dispatching the unit at a capacity factor of less than 76 percent in any given month – which, as we discuss below, PREPA does not do.

In addition to its thermal PPOAs, PREPA has active contracts with several renewable energy providers. This includes two wind farms, a landfill gas-fired generator, and four solar farms, totaling approximately 157 MW of capacity.[434] PREPA's contracts with renewable generators generally contain a base energy price with a yearly escalator and a REC price.[435] The

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[426] PREPA's response to CEPR-AH-06-03(c) of the Commission's Fourteenth ROI (October 26, 2016).

[427] *Id.*

[428] *Id.*

[429] *Id.*

[430] *Id.*

[431] PREPA's response to CEPR-AH-06-02(b) of the Commission's Fourteenth ROI (October 26, 2016).

[432] *Id.*

[433] October 20 Conference Call.

[434] PREPA's response to CEPR-AH-03-02(a) (PUBLIC) of Commission's Seventh ROI (August 31, 2016). Refer to CEPR-AH-03-02 Attach 01.xlsx

[435] *Id.*

problems associated with PREPA's existing renewable energy contracts were discussed at length in the Commission's Final Order on the IRP[436] and will not be rehashed here.

We note, however, that it should be very easy to PREPA to forecast its spending on renewable PPOAs with a high degree of accuracy, as the contract prices are known in advance and PREPA must pay for all of the energy generated at these units regardless of whether or not it is used to serve load.[437] Indeed, this high level of certainty is one of the main financial benefits of renewable energy contracts, as compared to reliance on units whose variable cost of generation may change significantly and abruptly given changes in fuel prices. Importantly for PREPA, since the prices of liquid fuels are generally volatile, such changes occur quite frequently, exposing ratepayers to the vagaries of the global oil market.

D. PREPA's fuel and purchased power budgeting process

There are several key inputs required for and steps involved in PREPA's fuel and purchased power budgeting process:

First, PREPA must prepare, or have prepared on its behalf, a forecast of load and a forecast of fuel prices over the period of time covered by the budget. These prices are then used to predict both how much of each fuel type PREPA expects to burn and what PREPA expects the total cost to be of the fuel that it uses.

Second, PREPA must assemble relevant cost data related to its PPOA contracts and performance and operational cost data related to its units (as discussed further in LOAD FORECAST, Chapter IV, Page 41).

Finally, PREPA can then use these cost inputs in a model that determines an optimal (*i.e.*, lowest cost while still satisfying demand) dispatch pattern for all units on PREPA's system, including PPOA units. This model is called a "production cost model" as it forecasts the costs of production in detail.

In order for PREPA's fuel and purchased power budgets to be reasonable and realistic, each of these steps must be conducted rigorously. We examine each step in the sections below.

1. Fuel forecasts

For the purposes of this rate case, PREPA relied on fuel price forecasts prepared by Siemens in February of 2016.[438] These same forecasts were also used in the IRP case to prepare the

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[436] IRP Final Order, Section F.

[437] *Id.*, Section F(3).

[438] PREPA's response to CEPR-AH-03-03(a)(i) of the Commission's Seventh ROI (August 26, 2016).

Updated Fuel IRP.[439] PREPA asked Siemens to prepare these forecasts "due to the downturn of the oil and other fuel prices in the second half of year 2015."[440] At the Technical Hearing on the IRP, Siemens said that these forecasts represented a "lower bound" on the expected trajectory of fuel prices.[441] However, PREPA's use of these forecasts to prepare its budgets in this rate case belies that assertion.

In the Final Resolution and Order on the IRP, the Commission commented on these forecasts, and found they were significantly below contemporaneous forecasts from credible public forecasts.[442] When compared with several months of actual data, we note that this conclusion from the Final Order has been borne out over the recent past. We compare here PREPA's predictions of prices for natural gas traded at Henry Hub and prices of West Texas Intermediate crude oil to actual values. PREPA uses these "fundamental" prices as indices to predict and determine its PREPA's actual fuel prices;[443] indices relate to prices at global trading hubs and are not impacted by factors specific to Puerto Rico.[444]

As shown in the figure below, actual fuel prices started to diverge from PREPA's Base IRP forecast in July of 2015. However, natural gas prices started to rebound in June of 2016, which was before the start of FY2017 but after the initial filing of PREPA's rate case. WTI prices, meanwhile, increased starting in February of 2016 – the same month in which the lower-bound forecast was prepared, and several months before PREPA filed its rate case with this Commission. As of this writing, actual WTI prices are approximately twice what PREPA had predicted. Considering that fuel oil is the dominant fuel type burned by PREPA, this observation raises concerns that PREPA's reliance on an unrealistically low fuel price forecast has led it to severely underbudget for fuel in this rate case.

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440 CEPR-AH-03-01(a)(ii).

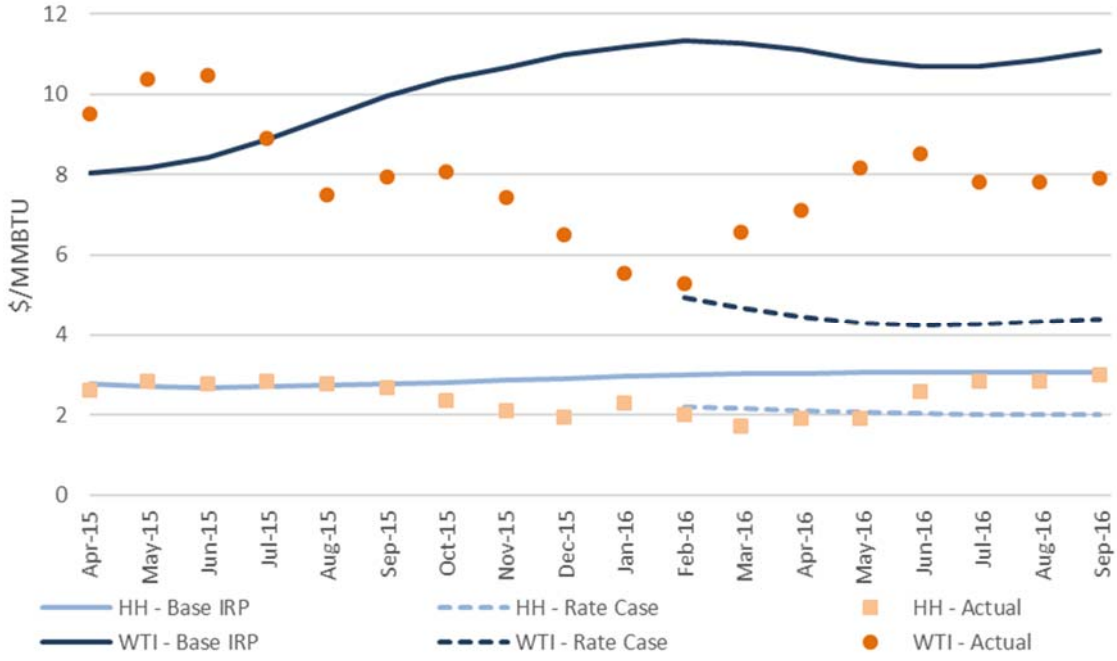
441 CEPR-AP-2015-0002, Technical Hearing, April 6, 2016, Nelson Bacalao, 00:14:15 of part 5 of the hearing recording.

442 IRP Final Order, Section 4(B)(1).

443 Base IRP, Volume III, Section 2.3.3.

444 IRP Final Order, Section 4(B)(1).

Figure 27. PREPA's fuel price forecasts as compared to actual values.[445]



2. PPOA contract terms

In order to represent PREPA's contract terms with its PPOA providers in PROMOD, PREPA makes several adjustments and assumptions. PREPA's representation of renewable contracts is straightforward: PREPA folds both the energy and REC charges associated with these contracts into a single cost for energy.[446] PREPA appears to model projects with a set capacity factor—for example, the modeled capacity factor of all existing solar projects is 21 percent.[447]

PREPA's representation of its fossil PPOAs is somewhat more complex. What PREPA pays for as an "energy charge" at AES, they model with two components: a fuel cost and a variable

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[445] Base IRP values from Base IRP, Volume III, Appendix G. Rate case values from CEPR-AH-03-03. Actual values from the Energy Information Administration (EIA). Henry Hub and WTI actual monthly clearing prices are available at https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm and http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=rwtc&f=D respectively. WTI prices in $/bbl were converted to $/MMBTU using an assumed heat content of 5.719 MMBTU/bbl, also sourced from EIA (https://www.eia.gov/forecasts/aeo/pdf/appg.pdf).

[446] PREPA's response to CEPR-JF-01-22 of the Commission's Sixth ROI (PUBLIC; August 23, 2016). Refer to CEPR-JF-01-22 Attach 01.xlsx.

[447] *Id.*; author's calculation.

operations and maintenance (O&M) cost.[448] PREPA models the capacity charge at AES as a combination of a fixed O&M cost and a capital cost that is added in a post-processing step.[449]

PREPA's representation of EcoEléctrica is similar. According to PREPA's description, it captures the shift in pricing from the base to the excess energy charge by modeling EcoEléctrica as having limited access to a set quantity of fuel priced at the base energy charge level, with the total energy content of that fuel being equivalent to the amount of energy produced by generation at EcoEléctrica up to a capacity factor of 76 percent.[450] After that supply of fuel is expended, the unit has access only to a more-expensive fuel, priced to represent the expected level of the excess energy charge.[451] We consider this to be a reasonable methodology for representing PREPA's actual contract terms with EcoEléctrica. However, because the excess energy charge is not set in advance, we consider the modeled cost of this second fuel to be, at best, an educated guess on PREPA's part.

Altogether, we find no cause for concern in the methodology outlined above. We can confirm that the budgeted energy charges at AES and EcoEléctrica are equal to the total FY2017 fuel and variable O&M charges at these units, adjusted for inflation, and that the budgeted capacity charges are equal to the total fixed O&M and capital charges, adjusted for inflation.[452]

3. Use of PROMOD and concerns associated therewith

As mentioned in SECTION, above, PREPA uses a production cost model called PROMOD to forecasts its dispatch and costs over the coming year. PREPA's fuel and PPOA budgets are, in essence, taken directly from PROMOD, as confirmed by PREPA on the Oct. 20 Conference Call.[453]

There are several difficulties inherent in modeling dispatch of PREPA's system, which has relatively few units and relatively high forced outage rates. In particular, PREPA asserts that it dispatches steam units on a must-run basis based on unit availability while units fired on distillate are dispatched in merit order based on the variable costs of different units.[454] This requires PREPA to use high minimum run times in modeling its steam units, as identified by

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[448] *Id.*

[449] *Id.*

[450] October 20 Conference Call.

[451] *Id.*

[452] CEPR-JF-01-22 Attach 01.xlsx

[453] October 20 Conference Call.

[454] PREPA's response to CEPR-JF-01-12(c) of the Commission's Sixth ROI (PUBLIC; August 23, 2016).

several intervenors in the IRP proceeding,[455] which may cause strange or distortionary results (such as modeled underutilization of PREPA's more economic and flexible units due to the need to avoid decommitment of inflexible steam units). These difficulties notwithstanding, PROMOD is an industry-standard model and we find it to be an appropriate tool for PREPA to use for the purpose of forecasting spending in the year ahead.

Regardless of our acceptance of PREPA's general methodology, we have observed several inconsistencies between PREPA's PROMOD outputs and data or attestations provided by PREPA elsewhere. We are concerned that these inconsistencies indicate inaccuracy in PREPA's PROMOD outputs, in assertions PREPA has made to the Commission and other authorities, or both. We describe these inconsistencies below.

a. Assumed fuel blend at Costa Sur does not comport with historical patterns

As described above, units 5 and 6 at the Costa Sur plant burn a blend of No. 6 fuel oil and natural gas. In the IRP, PREPA asserted that this blend was natural gas-dominant:

> Costa Sur 5&6 ST units burn natural gas and No. 6 fuel oil in a dual fuel firing scenario. Costa Sur 5 burns 80 percent of natural gas and 20 percent of No. 6 fuel oil and Costa Sur 6 burns 75 percent of natural gas and 25 percent of No. 6 fuel oil.[456]

This assumption was used in PROMOD: PREPA modeled Costa Sur unit 5 as modeled as burning exactly 80 percent natural gas (on a heat basis) in every month, while Costa Sur unit 6 burns exactly 75 percent natural gas in every month.[457] Depending on the relative generation of the two units, this equates to approximately a 76 to 78 percent natural gas content in the fuel burned at the plant as a whole over the course of FY2017.

While PREPA may be correct about the fuel mix that will be burned at Costa Sur in the future, the actual fuel mix burned at the plant is heavier on fuel oil than the levels claimed by PREPA above. On a monthly basis, the plant has only exceeded 75 percent natural gas in its fuel mix in brief excursions since early in calendar year 2015. Apart from these spikes in gas usage, Costa Sur's fuel mix has hovered around 70 percent natural gas, significantly below the levels assumed by PREPA in the modeling used for budget purposes (Figure 28). Indeed, if the fuel mix at the plant in FY2017 actually conformed to the values offered by PREPA, it would result in the highest percentage of natural gas in the plant's mix since FY2013 (the first full year in which the plant had dual-fuel capability).

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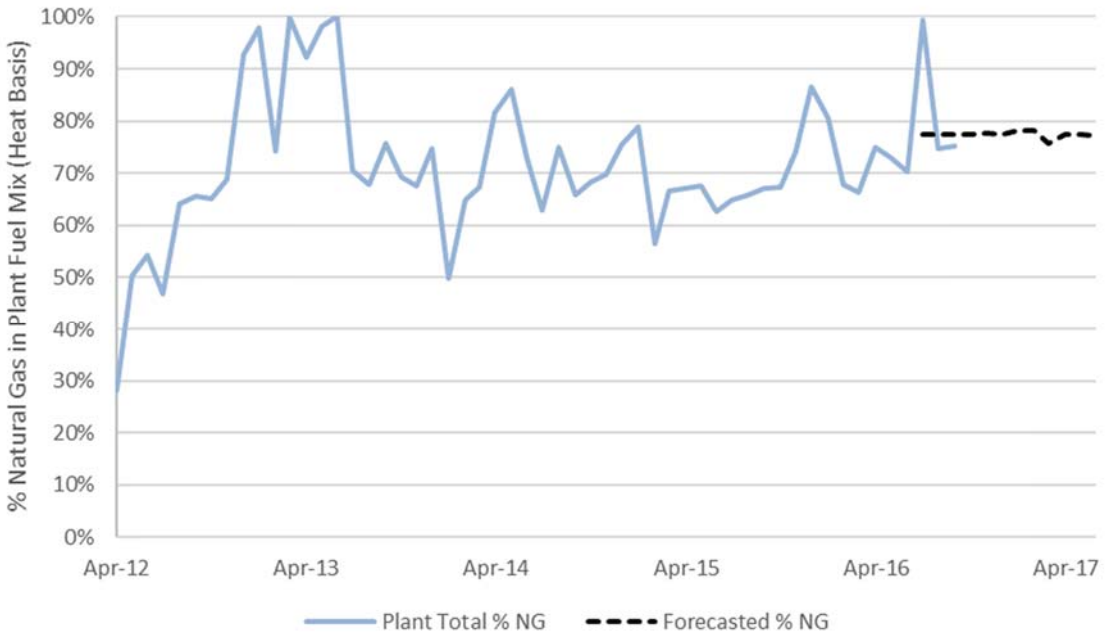
[455] IRP Final Order, Appendix B.

[456] Base IRP, Volume I, Table 3-1, note (2).

[457] Author's analysis of data contained in CEPR-JF-01-22 Attach 02.xlsx.

Figure 28. Historical and modeled fuel mix (% natural gas by heat content) burned at Costa Sur units 5 and 6.[458]



We find that the fuel mix burned at Costa Sur is highly uncertain and is likely to be more fuel oil-heavy than PREPA's modeling shows. We have no evidence with which to explain the volatility of the fuel mix at the plant. However, we also have no evidence with which to adjust the total amounts of fuel burned at the plant that were output by PROMOD. A shift in the assumed fuel mix at the plant would change its assumed variable cost of generation and potentially its economics relative to the rest of PREPA's fleet. Therefore, an entirely new PROMOD run would be necessary to predict total fuel consumption at the plant given a different fuel mix assumption. Although the current modeling may under-predict fuel costs slightly, we believe such changes would be small and easily handled through the fuel charge adjuster alone. Therefore, we recommend no adjustment to fuel mix assumptions pertaining to Costa Sur values at this time.

b. PREPA plans to significantly exceed the "base energy charge" generation level at EcoEléctrica

As described above, PREPA is exceptionally vulnerable to variations in the excess energy price charged by EcoEléctrica. The main way that PREPA can avoid potentially high charges is by restricting EcoEléctrica's generation to a 76 percent capacity factor or below on a monthly basis. Doing so appears to make good sense: in FY2016, the average excess energy

458 Historical values from PREPA's response to CEPR-AH-06-01(d)(iii) of the Commission's Fourteenth ROI (November 3, 2016). Forecasted values are author's calculation based on values provided in CEPR-JF-01-22 Attach 02.xslx.

price charged by EcoEléctrica was higher than PREPA's average cost of generation at all of its units except the Aguirre CCs, gas turbines, and Cambalache.[459] While we recognize that the relative economics of PREPA's units can shift on a monthly or even a weekly basis given the structure of PREPA's contract with EcoEléctrica, this comparison is still indicative of the risks of relying on EcoEléctrica above the excess energy threshold. If this pattern holds, it would be prudent for PREPA to resist dispatching EcoEléctrica above a 76 percent capacity factor except as a close-to-last resort to meet unusually high demand. Indeed, PREPA asserted during the Oct. 20 Conference Call that this would be its strategy and that it has been successful in doing so in the recent past.[460]

This assertion does not appear to be entirely factual. Over the 84 months of FYs 2010 through 2016, there were 58 months in which EcoEléctrica was dispatched at a capacity factor of higher than 76 percent.[461] Dispatch was noticeably lower in FY2016, however, with EcoEléctrica's generation meeting or exceeding the excess energy threshold in only half of the year. PREPA's PROMOD outputs show that PREPA's budget is based dispatch of EcoEléctrica at very high levels: EcoEléctrica is modeled as being dispatched below a 76 percent capacity factor in only one month and is dispatched at a capacity factor of 95 percent or above for most of the year.[462] Table 18, below, summarizes these results.

Table 18. Historical and modeled EcoEléctrica capacity factors by month.[463]

	2010	2011	2012	2013	2014	2015	2016	2017*
July	97%	90%	72%	85%	78%	93%	80%	88%
August	92%	94%	82%	87%	91%	88%	72%	95%
September	89%	93%	85%	88%	92%	90%	49%	95%
October	92%	97%	80%	86%	91%	96%	60%	99%
November	88%	91%	82%	84%	83%	89%	79%	59%
December	90%	66%	81%	87%	85%	77%	84%	97%
January	68%	81%	43%	72%	53%	76%	76%	96%
February	27%	60%	79%	11%	41%	62%	79%	95%
March	73%	56%	80%	90%	69%	33%	76%	83%
April	85%	75%	75%	87%	98%	49%	77%	96%
May	96%	74%	81%	90%	97%	67%	76%	99%
June	90%	88%	86%	90%	97%	81%	65%	99%

*FY2017 values are forecasted

[459] Author's comparison of average production costs as provided in PREPA's response to CEPR-AH-03-07(e) of the Commission's Seventh ROI (PUBLIC; August 31, 2016) and average FY2016 excess energy cost as provided in CEPR-AH-06-02(e)(iv).

[460] October 20 Conference Call, 2:30:00.

[461] Author's calculation based on values provided in CEPR-AH-06-02(e)(i).

[462] CEPR-JF-01-22 Attach 02.xlsx

[463] Shaded cells denote values above 76%. Historical values from CEPR-AH-06-02(e)(i). FY2017 forecasted dispatch from CEPR-JF-01-22 Attach 02.xlsx

We assume that this modeling reflects PREPA's belief that EcoEléctrica's excess energy charges in FY2017 will be lower, relative to PREPA's variable cost of generation, than they were in FY2016. However, we have no evidence supporting this belief. More importantly, PREPA (to our knowledge) has no evidence supporting this belief, as EcoEléctrica can apparently charge PREPA whatever excess energy price it deems fit.

We have two main concerns proceeding from this observation: first, we note that PREPA's modeled reliance on EcoEléctrica above the excess energy threshold increases the uncertainty of PREPA's purchased power and fuel budgets. PREPA cannot know in advance what the cost of that excess energy will be. Indeed, PREPA's assertion that the excess energy charge would be "around $9/MMBTU"[464] was based on PREPA's relatively low dispatch of EcoEléctrica. At a higher dispatch level, we see no reason that that price expectation would hold true. If PREPA's actual dispatch shifts away from EcoEléctrica and towards its own units, we would expect the PREPA's fuel spending to be higher than the budget set forth in the rate case and its purchased power spending to be lower. If PREPA does actually dispatch EcoEléctrica at such high levels, PREPA's purchased power spending could increase substantially as compared to its stated budget.

Second, considering the low availability and inflexibility of many of PREPA's units, we are concerned that PREPA would not be able to rapidly commit sufficient capacity with only several days' notice if EcoEléctrica decided to charge very high spot prices. If EcoEléctrica observes that PREPA does not have enough units in good working condition to replace its excess energy, it might decide to charge PREPA extremely high prices. PREPA, and the ratepayers of Puerto Rico, would be left with little recourse. This concern highlights the extent to which PREPA's PPOA with EcoEléctrica is unfavorable to PREPA.

c. Some renewable energy contracts appear to be misrepresented

Due to the structures of PREPA's renewable PPOAs and the simplicity of representing these structures in PROMOD, it should be straightforward to reconcile average cost of generation (total cost divided by total generation) of PREPA's renewable PPOAs with the reported contractual costs of these units. In general, our expectation in this matter holds true: most units modeled by PREPA do have modeled costs that are consistent with the contractual costs reported by PREPA. However, there are three exceptions, as noted in the table below.

[464] October 20 Conference Call

Table 19. Modeled and reported renewable energy contract costs.

Facility	Reported Energy Cost* ($/MWh)	Reported REC Cost* ($/MWh)	Reported Total Cost** ($/MWh)	Modeled Total Cost† ($/MWh)	Note
AES Ilumina	159	35	194	194	
Blue Beettle III	143	20	163	163	
CIRO One Salinas (CIRO Group	137	35	172	172	
Desarrollos del Norte Inc. dba Atenas Solar Farm	145	15	160	160	
Fonroche Energy	150	25	175	175	
Xzerta-Tec Solar I	150	15	165	165	
GCL Solar Energy (Caribe Planeta Solar LLC; Guayama Solar Energy)	141	30	171	171	
Horizon Energy	143	35	178	178	Energy cost not escalated from online year (CY2015)
Irradia Energy USA	144	23	167	167	
Oriana Energy LLC (Yarotek)	150	30	180	180	
Pattern Santa Isabel	131	26	157	157	
Punta Lima (Go Green PR)	131	13	143	156	Modeled cost not consistent with stated contract cost
San Fermín Solar Farm	150	35	185	185	Energy cost not escalated from online year (CY2014)
Windmar Renewable Energy	162	35	197	197	

*CEPR-AH-03-02 Attach 01.xlsx
**Sum of reported energy and REC costs.
‡Author's calculation based on values in CEPR-JF-01-22 Attach 02.xlsx

For two of the projects (Horizon Energy and San Fermín Solar Farm), PREPA appears to have modeled the energy cost as if it had not changed since the units came online in calendar years 2015 and 2014, respectively. This is unrealistic, considering that PREPA asserted that both units have a contractual 2 percent per year escalation of energy costs.[465] For the third project, the Punta Lima wind farm, we are simply unable to reconcile the costs provided in discovery[466] with the modeled value.[467]

We have no explanation for these deviations. We recommend that in light of this lack of clarity, the Commission require PREPA to immediately update, and keep updated whenever changes occur, a version of the spreadsheet provided in response to CEPR-AH-03-02.[468] This

[465] CEPR-AH-03-02 Attach 01.xlsx

[466] *Id.*

[467] As calculated by the author from values in CEPR-JF-01-22 Attach 02.xlsx.

[468] CEPR-AH-03-02 Attach 01.xlsx; specifically, "PPOAList" tab.

spreadsheet should tabulate the names, owners, contract numbers, initial energy costs, current energy costs, initial REC costs, current REC costs, any relevant escalators, and the first operational date (actual or anticipated) of the project.

As these deviations would have only a minor impact on PREPA's purchased power budget, we do not recommend that PREPA be required to correct them at this time.

E. Evaluation of PREPA's purchased power and fuel budgets

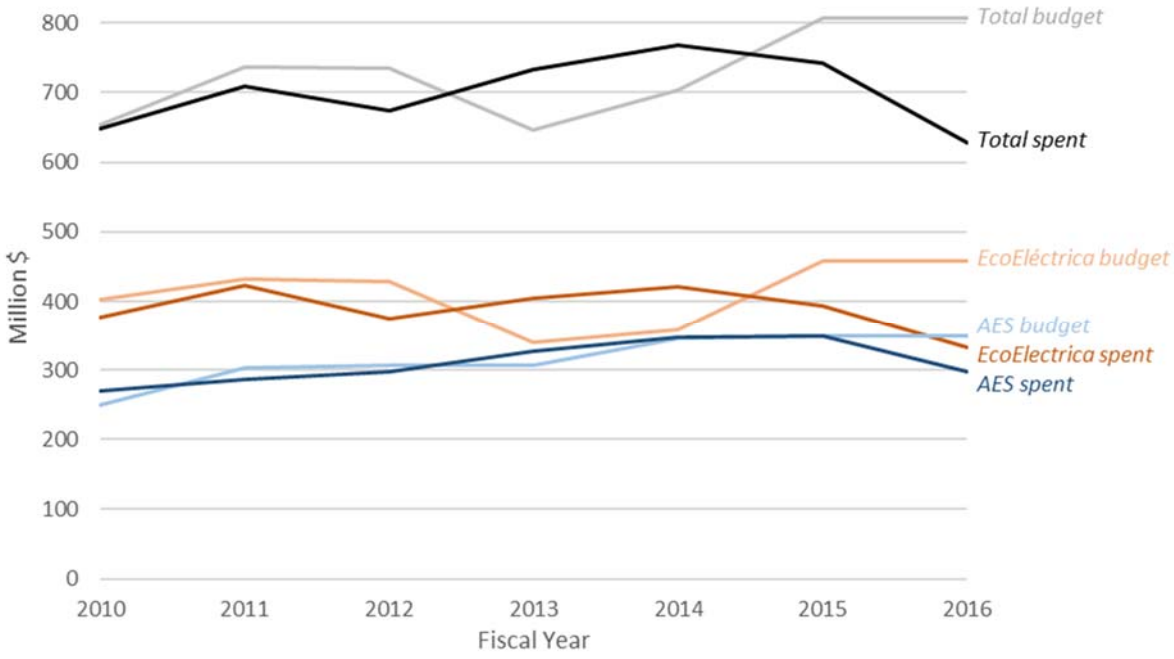
1. Purchased power

a. Historically, PREPA has been able to predict its purchased power spending with acceptable accuracy

We examined PREPA's actual and budgeted spending on fossil PPOAs since FY2010 to evaluate whether PREPA has been able to successfully predict its purchased power spending in past years. In general, we find that PREPA's fossil purchased power spending has been commensurate with its budgets. PREPA is able to forecast its spending at AES with a higher degree of accuracy than its spending at EcoEléctrica, which is within our expectations given the differences in contract structures between the two agreements. As such, when PREPA over- or under-spends its PPOA budget, the deviations are largely due to spending (or lack thereof) at EcoEléctrica. This pattern is shown clearly in Figure 29.[469]

[469] Note that budget deviations in FY2016 are generally not informative as PREPA's FY2016 budget was identical to its FY2015 budget (PREPA's response to CEPR-AH-05-01 of the Commission's Eleventh ROI, October 19, 2016).

Figure 29. Budgeted and actual spending on PREPA's PPOAs with AES and EcoEléctrica, FYs 2010 through 2016.[470]



Historically, PREPA's spending at AES has been within four percent of its budget expectations, with PREPA over-budgeting as often as it under-budgets.[471] PREPA's spending at EcoEléctrica, by contrast, deviates by its budgets by 12 percent on average and as much as 19 percent in the past five FYs.[472] Over- or under-spending at EcoElectric is, as we would expect, driven primarily by the energy budget: PREPA's spending on energy at EcoEléctrica has deviated from its budgets by overages of as much as 54 percent and by underspends of as much as 24 percent since FY2010.[473] These are large deviations, representing tens of millions of dollars of difference between PREPA's budgets and its actual spending.[474] While these fluctuations in spending are balanced by PREPA's relative certainty regarding its capacity budget at EcoEléctrica and its total budget at AES, they also highlight again the vulnerable position in which PREPA finds itself due to its contract terms with EcoEléctrica.

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[470] EcoEléctrica values from CEPR-AH-06-02(e)(ii), (e)(iii), (e)(iv), and (f). AES values from CEPR-AH-06-03(e)(i), (e)(ii), and (f). Totals are sum of values for AES and EcoEléctrica.

[471] Author's calculation, based on values presented in CEPR-AH-06-03(e)(i), (e)(ii), and (f). Averages are irrespective of FY2016.

[472] Author's calculation, based on values presented in CEPR-AH-06-02(e)(ii), (e)(iii), (e)(iv), and (f). Averages and maximum value are irrespective of FY2016.

[473] *Id.*

[474] *Id.*

In total, PREPA's spending on fossil PPOAs has hewn to within ten percent of its budgets throughout the recent past, with the exception of FY2013 (when PREPA overspent its budget by 13 percent) and FY2016 (in which PREPA did not prepare a new budget and simply used values from FY2015).[475] In the aggregate, we find this to be an acceptable level of certainty and would not expect significantly more accuracy from PREPA's forecasts given the contract terms mentioned above.

With regards to PREPA's renewable PPOAs, we again note that the main uncertainty regarding PREPA's spending on operational projects pertains to the actual output of these units rather than the costs thereof. As above, we find that PREPA's representation of renewable contract terms is generally accurate. Therefore, our overall conclusion regarding PREPA's PPOA budgets is that PREPA's actual spending is expected to be within approximately ten percent of its budgets and that this is an acceptable level of deviation considering the way in which PREPA collects revenues related to PPOA spending.

b. PREPA's purchased power budget is close to actual spending in FY2017 so far

Our expectation in this matter is borne out by an examination of PREPA's actual spending on PPOAs so far in FY2017. PREPA has released two monthly reports for FY2017, covering the months of July and August (of calendar year 2016).[476] PREPA's spending on PPOAs in these months has been under its budgets, as summarized in the table below.

Table 20. PREPA's budgeted versus actual spending on purchased power in FY2017.[477]

	Budget ($000)	Spent ($000)	% Over (+) / Under (-) Budget
July	70,165	59,024	-16%
August	72,239	60,206	-17%

While these deviations are somewhat larger than they have been historically, we see no cause for concern, for two reasons: first, the deviations we analyzed above are on an annual basis and we would expect monthly values to be somewhat more volatile. Second, these results indicate that PREPA may have overbudgeted somewhat for PPOAs. Since the deviation is not extreme, the more conservative response is to allow any overpayment from ratepayers to be compensated through adjustments of the PPOA rider rather than to risk underpayment by adjusting the budget downwards.

[475] Author's calculation, based on values presented in CEPR-AH-06-02(e)(ii), (e)(iii), (e)(iv), and (f) and CEPR-AH-06-03(e)(i), (e)(ii), and (f).

[476] Exhibit Fisher and Horowitz, Exhibit 03.

[477] Values from PREPA's July and August 2016 monthly reports.

Recently, PREPA also prepared an updated budget for PPOA spending (and fuel, as discussed further below) in response to a question from Commission advisors.[478] This budget originates from a new PROMOD run based on different fuel price forecasts (as discussed further below) and incorporates three months' worth of actual values (in other words, one additional month as compared to the table above). PREPA's total expected spending on PPOAs in this updated budget differs by only one percent from the value presented in PREPA's original filing in this rate case. This is an insignificant difference that is easily within the range of expectations and would not be expected to lead to any form of rate shock. As such, we believe it would be more straightforward to simply maintain PREPA's PPOA budget in the rate case as filed.

Table 21. PREPA's as-filed and most recent PPOA budget expectations.

	Rate Case*	Response to Oct. 31 Call Q9**	% Increase (+) / Decrease (-)
EcoEléctrica	$387,433,152	$403,363,647	4%
AES	$305,139,587	$309,015,491	1%
Renewables	$135,820,274	$107,094,044	-21%
Total	$828,393,012	$819,473,181	-1%

*PREPA's Petition for Rate Review, Schedule A-6 REV.
**CEPR 161031 Request No. 9 Attach 01.xslx.

c. PREPA faces significant uncertainty regarding the online dates of new renewable energy projects

When pressed on the differences between the PPOA budget originally presented in the rate case and that prepared in response to the query from Commission advisors (as shown in the table above), PREPA responded that there are two factors explaining the deviations: first, the "realities of dispatch" led to small changes in expected spending on fossil PPOAs.[479] Second, and more concerningly, not all of the renewable energy projects from which PREPA expected to purchase power in FY2017 have actually come online.[480] We understand this to be the main cause of the 21 percent drop in PREPA's expectations regarding spending on renewable PPOAs.[481] Although we requested more information on this topic, it was not provided in time to be incorporated into this report.

PREPA's uncertainty with regards to the status of its contracts with pre-operational renewable energy projects was a major point of contention in the IRP proceeding and was

[478] PREPA's response to the Request 9 of the Commission's October 31 Conference Call ROI (November 14, 2016). Refer to CEPR 161031 Request No. 9 Attach 01.xslx.

[479] CEPR-AP-2015-0001, November 15, 2016 Conference Call.

[480] *Id.*

[481] Author's calculation, based on values in Schedule A-6 REV and CEPR 161031 Request No. 9 Attach 01.xlsx.

discussed at some length in the Commission's Final Order on the IRP.[482] We are dismayed that PREPA faces such a high level of uncertainty with regards to these contracts that its expectations regarding spending on renewable energy can change by over a fifth, representing almost $30 million in spending, in less than six months. This occurrence only underscores the Commission's concerns with regards to PREPA's large number of outstanding contracts for unrealized renewable energy projects.

d. No adjustment of the purchased power budget is necessary at this time

Considering the evidence analyzed above, we find no compelling cause to adjust PREPA's total PPOA budget at this time. We recommend that the Commission maintain PREPA's PPOA budget as originally filed, with the understanding that the relative proportions of PREPA's actual spending that occurs at EcoEléctrica, AES, and renewable projects may deviate from the values presented in Schedule A-6 REV.

We also recommend that the Commission order PREPA to prepare an updated, comprehensive database (in spreadsheet form) of its renewable energy contracts, as described above. The Commission should also require PREPA to update it at regular intervals with regards to its most current expected online dates of each contracted project. These reporting requirements should be considered supplemental, rather than replacing the requirements set forth in the Final Order on the IRP.[483]

2. Fuel

a. PREPA has significantly underbudgeted for fuel

i. Evidence for underbudgeting

The deviation between PREPA's fuel forecasts and actual fuel prices suggested to us that PREPA had likely underbudgeted for fuel. As such, we sought to compare PREPA's actual fuel spending in FY2017 thus far to its fuel budget. As portended by the gap between forecasted and actual fuel prices, we found a significant deviation between PREPA's budgeted and actual spending. We examined PREPA's budgeted and actual fuel spending in the same July and August monthly reports mentioned above. We found that PREPA's fuel spending in the first two months of FY2017 was *double* its expected outlay. We summarize these deviations in TABLE below. We therefore conclude that PREPA's FY2017 fuel budget significantly understates its likely spending on fuel in FY2017. Unlike PREPA's spending on PPOAs, these deviations are notable and indicate a need for adjustment.

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[482] IRP Final Order, § IV(F)(4).

[483] IRP Final Order, § VII(B)(1)(i).

Table 22. PREPA's budgeted versus actual spending on fuel in FY2017.[484]

		Actual spending				
	Budget ($000)	**No. 2 ($000)**	**No. 6 ($000)**	**NG ($000)**	**Total ($000)**	**% Deviation over Budget**
July	53,062	54,190	38,905	20,106	113,201	113%
August	56,455	43,615	43,213	23,755	110,583	96%
July + August	109,517	97,805	82,118	43,861	223,784	104%

ii. Motivation for adjustment

Although PREPA has taken pains in rebuttal testimony to point out that it is guaranteed to recover its actual costs on fuel due to the structure of the fuel adjuster clause,[485] we still believe this to be a worthwhile exercise. PREPA's attestation that increases in fuel costs have "no effect on rates"[486] is certainly false from the point of view of PREPA's consumers. PREPA has underbudgeted for fuel by approximately 60 percent, indicating that the actual cost of the fuel adjuster clause is likely to be significant above what PREPA has purported in its rate case petition. We are concerned that such a significant deviation would lead to surprises for ratepayers, which lies counter to the ratemaking principles of stability and predictability.

Moreover, PREPA used its unrealistically-low fuel values throughout its rate case filing. As discussed by Commission advisor Paul Chernick, these values impact PREPA's calculation of marginal costs and calculation of its cost of service. The significant and wide-reaching impacts of the deviation between PREPA's fuel budget and a realistic expectation of PREPA's spending on fuel mean that a correction is of paramount importance for this case. Therefore, we recommend that the Commission order an adjustment to PREPA's fuel budget to bring its filed rates more in line with realistic spending expectations.

b. Calculation of a more realistic FY2017 fuel budget

In light of these deviations, we used several methods to calculate a more realistic expectation for PREPA's spending on fuel in FY2017. We will note here explicitly that all of these methods are meant to provide back-of-the-estimates estimates only and were calculated with the best

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[484] Values from PREPA's July and August 2016 monthly reports (Exhibit Fisher and Horowitz 04). We assumed that PREPA's listed spending on "Gas" fuel refers to No. 2; "Oil" fuel refers to No. 6; and "Natural Gas" refers to natural gas burned at Costa Sur.

[485] PREPA's Petition for Rate Review, Exhibit 23, Rebuttal Testimony of Francis X. Pampush, Lucas D. Porter, and Dan T. Stathos. lines 728-731.

[486] *Id.*, line 730.

data available to us. We do not endorse any of these methods for PREPA's budgeting processes in the future.

The three methods we used to estimate realistic FY2017 fuel spending,[487] and the results of those estimates, are elaborated below.

i. Method 1: Proration by individual fuels

In the first method, we examined what percentage of PREPA's spending on each fuel it uses has occurred in the months of July and August in FYs 2010 through 2016. For each fuel, we found the average percentage of spending that occurred in July and August of these years. We then divided spending by fuel by these percentages to arrive at a by-fuel prorated expectation of total spending in FY2017. Mathematically, this proration is justified by observing that, for any given portion of a year:

$$S_{part} / S_{full} = f_{part}$$

where S_{part} is spending in a given part of the year, S_{full} is spending over the course of the full year, and f_{part} is the fraction of spending that occurred in the identified part of the year. Therefore:

$$S_{part} / f_{part} = S_{full}$$

The percentages of annual fuel spending that occur in July and August by fuel and for PREPA's system as a whole are summarized in the table below.

[487] Regarding this analysis as a whole, we will note here the assumption that PREPA provided historical values in nominal dollars (*i.e.*, these values were not corrected for inflation). Because our analyses in this section rest on ratios or percentages of dollars spent in the same year as one another, correcting for inflation would not impact our results.

Table 23. Historical percentages of annual spending on fuel occurring in July and August.[488]

	Percent of Annual Spending Occurring in July and August			
FY	**No. 2**	**No. 6**	**NG***	**Total**
2010	21%	14%	-	15%
2011	13%	15%	-	15%
2012	15%	19%	0%	18%
2013	19%	20%	11%	19%
2014	23%	17%	18%	18%
2015	25%	21%	23%	22%
2016	15%	26%	19%	21%
Average	19%	19%	18%	18%

*NG = natural gas. PREPA began burning natural gas at Costa Sur in FY2012. The average percentage for natural gas is therefore for fiscal years 2013-2016 only.

Using this method as applied to the by-fuel July and August spending shown in TABLE above, we estimated expected spending by fuel to be approximately $527 million for No. 2 fuel oil; approximately $435 million for No. 6 fuel oil; and $249 million for natural gas, suggesting a total fuel budget of $1.211 billion before performance-related savings are taken into account.

ii. Method 2: Proration by total-system fuel spending

In this method, we prorated PREPA's total system spending on fuel rather than prorating by individual fuel. This method returns slightly different results than Method 1 because the percentages of spending in July and August by fuel are not identical to one another or to the percentage of total system spending on fuel in July and August. This method does not produce an estimate of total spending by fuel and allows for possibility that the relative ratios of PREPA's spending on different fuels may shift throughout the year.

Using this method, we estimate PREPA's total FY2017 spending on fuel to be $1.225 billion before performance-related savings are taken into account.

iii. Method 3: Expectation of spending based on short-term price forecasts and PREPA's effective multiplier on fuel indices

Method 3 uses a different conceptual framework than Methods 1 and 2. Rather than predicting PREPA's full-year spending from spending in FY2017 thus far, we predict it based on the historical relationship between fuel indices (Henry Hub and West Texas Intermediate) and PREPA's actual fuel prices as incurred. We divided PREPA's actual fuel prices on a monthly basis by historical settled Henry Hub (HH) and West Texas Intermediate

[488] PREPA's responses to CEPR-AH-06-01(d) and CEPR-AH-06-04(a) of the Commission's Fourteenth ROI (November 3, 2016 and October 25, 2016, respectively).

(WTI) prices as recorded by the Energy Information Administration.[489] We averaged these values for FYs 2015 and 2016, finding that on average PREPA pays 3.49x HH prices for natural gas on a $/MMBTU basis, and pays 1.7x and 1.2x WTI prices for distillate and residual fuel oils, respectively, on a $/bbl basis.[490]

We then multiplied these inflators by expected HH and WTI prices from the 8 November edition of EIA's Short-Term Energy Outlook (STEO), which is published monthly.[491] STEO prices are short-term, look-ahead forecasts with values for one year past the publication date. Although they cannot be used for long-term planning purposes, STEO forecasts are a reliable source of forecasted fuel prices for the near-term. By multiplying STEO forecasts by our estimate of PREPA's average inflators, we arrived at a short-term forecast of PREPA's likely prices for delivered fuels over the course of FY2017.

Finally, we multiplied these expected fuel prices by PREPA's monthly forecasted fuel consumption as reported in its PROMOD outputs[492] to arrive at expected monthly spending on a by-fuel basis. We emphasize here that inputting different fuel prices into PROMOD would certainly result in changes to the dispatch levels of PREPA's units, thereby altering expected fuel consumption. However, we note again that this method is meant to provide a back-of-the-envelope estimate of PREPA's total spending on fuel rather than an exact prediction of spending by fuel. PREPA's PROMOD outputs provide natural gas consumption in cubic feet. We assumed a heat content of 1050 BTU/ft^3 for natural gas to allow use of a fuel forecast in $/MMBTU, while we used total barrels of fuel oil consumption and a per-barrel fuel price forecast for fuel oil.[493]

Through use of this method, we arrived at estimated FY2017 spending levels of approximately $257 million on No. 2 fuel oil, approximately $650 million on No. 6 fuel oil, and approximately $341 million on natural gas, resulting in a total estimated FY2017 fuel

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[489] Monthly Henry Hub prices are available online at: https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm. Monthly WTI prices are available online at: http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=rwtc&f=D.

[490] Author's calculation, based on HH and WTI prices from EIA as well as data from CEPR-AH-06-05 Attach 01.xslx and CEPR-AH-06-01(d).

[491] STEO data is available online at: http://www.eia.gov/beta/steo/.

[492] CEPR-JF-01-22 Attach 02.xlsx

[493] We assumed this value because it appears to be what PREPA used in modeling: we were able to recreate PREPA's natural gas fuel price forecast (which is in $/MMBTU) exactly by first multiplying monthly natural gas consumption in cubic feet by this value and then dividing monthly expenditures on natural gas by the result. However, we note that it contradicts PREPA's assumption in the IRP of a 1,000 BTU/ft^3 heat content for natural gas, as set forth in Table 5-2 of Volume I of the Base IRP. We are unable to explain the discrepancy.

budget of approximately $1.248 billion, before performance-related savings are taken into account.

Our results from all three methods, as well as PREPA's original fuel budget, are shown in the table below. To avoid false precision, we have rounded by-fuel values to the nearest thousand and total fuel budgets to the nearest million.

Table 24. PREPA's as-filed FY2017 fuel budget and author's calculations of estimates of expected spending.

	No. 2	No. 6	NG	Handling/Others	Total
Budget as Filed*	168,314,322	387,448,919	202,010,094	5,921,743	763,695,078
Expected					
Method 1	527,219,000	434,726,000	249,079,000	-	1,211,000,000
Method 2	-	-	-	-	1,225,000,000
Method 3	257,468,000	650,429,000	340,520,000	-	1,248,000,000

*Schedule A-6 REV.

iv. Other parties' calculations of revised fuel budgets

Both PREPA[494] and the panel of Tom Sanzillo and Catherine Kunkel (on behalf of ISCE-PR)[495] have presented updated estimates of what these parties believe PREPA will spend on fuel in FY2017. PREPA's estimate was presented in response to a direct request from Commission advisors,[496] while Sanzillo and Kunkel described their estimate of PREPA's budget shortfall in testimony.[497] For simplicity, we interpreted Sanzillo and Kunkel's assertion that "PREPA's actual [fuel] cost for 2017 [may] be as much as $400-$500 million more than the proposed budget"[498] as proposition of a $450 million increase in PREPA's proposed budget.

Meanwhile, PREPA presented a new total fuel budget as output from a new PROMOD run, as discussed above. PREPA's new estimation of its FY2017 fuel budget is $1,222,696,925.[499] We note that this PROMOD run was based not on a new and updated set of fuel price forecast but rather on a set of *older* fuel price forecasts than those used in PREPA's original petition.[500] These forecasts were also prepared by Siemens, in December of 2015.[501]

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[494] CEPR 161031 Request No. 9 Attach 01.xlsx

[495] CEPR-AP-2015-0001, testimony of Tom Sanzillo and Cathy Kunkel on behalf of ICSE-PR.

[496] CEPR 161031 Request No. 9 Attach 01.xlsx

[497] Testimony of Tom Sanzillo and Cathy Kunkel on behalf of ICSE-PR at lines 305-307.

[498] *Id*. at line 306.

[499] CEPR 161031 Request No. 9 Attach 01.xlsx

[500] November 15 Conference Call.

[501] *Id.*

We find PREPA's choice to go back to a prior forecast rather than preparing (or having prepared on its behalf) a new forecast to be nonsensical. As the deviation between PREPA's Base IRP and Updated Fuel IRP/rate case forecasts and real values (shown in FIGURE above) should make quite clear, fuel prices are volatile and difficult to predict with accuracy. The most recent and up-to-date data should be used whenever possible. The problem with the forecasts originally used in this proceeding is not the date on which they were prepared. Rather, Siemens intentionally prepared those forecasts as a "lower bound" on expected fuel prices,[502] and it was clearly inappropriate for PREPA to use them for budgeting purposes. Lower and upper bound sensitivity forecasts are of crucial importance for evaluating a utility's risk to fluctuations in fuel prices, but they are not suitable for use in short-term planning and budgeting. Instead, PREPA should have used its most recent expectation of the base case—the most likely—trajectory for fuel prices.

The fact that it has been almost a year since PREPA's last base case fuel price forecast is equally concerning. Because PREPA's costs are dominated by fuel, it behooves the utility to maintain an up-to-date understanding of the likely future prices of that fuel, regardless of how the utility is compensated for its fuel spending. We recommend that the Commission require PREPA to prepare fuel price forecasts, or have forecasts prepared on its behalf, at least biannually. We further recommend that the Commission require PREPA to submit a comprehensive description of the forecasting methodology and data sources used by itself or its advisors for the Commission's review as part of its initial filing in the next major rate- or planning-related case it brings before this Commission.

v. Suggested adjustment

We summarize the results of all the various budget estimation methods described above in TABLE. We observe that, in general, the difference between these various methods is small: there is general agreement among all parties (including PREPA) that PREPA's fuel budget for FY2017 was too low by approximately 60 percent or between $400 and $500 million.

Table 25. Comparison of proposed adjustments to PREPA's FY2017 fuel budget.[503]

		Increase from Filed Budget	
Party	**Estimated Budget* ($)**	**$**	**%**
PREPA (As-Filed)**	763,695,078	-	-
Fisher and Horowitz			
Method 1	1,211,000,000	447,304,922	59%
Method 2	**1,225,000,000**	**461,304,922**	**60%**
Method 3	1,248,000,000	484,304,922	63%
PREPA (New)†	1,222,696,925	459,001,846	60%
Sanzillo and Kunkel‡	1,213,695,078	450,000,000	59%

*Estimated budgets are prior to expected savings from performance improvements.
**Schedule A-6 REV

[502] IRP Technical Hearing, April 6, 2016, Nelson Bacalao.

[503] Suggested adjustment is bolded.

†CEPR 161031 Request No. 9 Attach 01.xlsx
‡Author's calculation based on testimony of Tom Sanzillo and Cathy Kunkel on behalf of ICSE-PR at lines 305-307.

We recommend that the Commission adopt our second proposed method as it results in the median estimate of the three methods described above. This method suggests an adjusted fuel budget, before performance savings, of $1,225,000,000 in total for No. 2 fuel oil, No. 6 fuel oil, and natural gas burned at Costa Sur. We therefore recommend that the Commission adjust PREPA's fuel budget upwards by $461,305,000.

We do not recommend that the Commission adopt PREPA's revised budget for two reasons: first, our calculation, although back-of-the-envelope, is based on current short-term forecasts, while PREPA's is based on a forecast that is almost a year out of date. We cannot endorse the use of such stale data. Second, because we are not recommending that the Commission update any of the other values that may arise from a new PROMOD run, the new fuel budget would proceed from a dataset that is inconsistent with the rest of the proposed revenue requirement.[504]

vi. Status of fuel-related performance improvement savings

Throughout its rate case petition, one of the forms of "known and measurable changes" described by PREPA is savings expected from improvements in PREPA's performance. In other words, PREPA has presented budgets that are, in theory, predicated on the assumption that PREPA's operations are exactly as efficient as they were in the test year. These concepts are described in more depth by other of the Commission's advisors.[505] For our purposes, it is important only to note that PREPA has presented a fuel budget that is comparable to its past spending and claimed that it will in actuality spend less than that budget due to improved corporate performance. PREPA's expected savings due to fuel-related performance improvements amount to $107,726,711 in FY2017.[506]

During the October 20 Conference Call, PREPA described these savings as "run-rate," meaning that they have already been partially realized, and stated that it expects the full value of the savings to be realized over the course of the year. In discovery from the Commission, PREPA confirmed that it expects the slightly more than the full value of the fuel-related performance savings claimed in the revenue requirement to be achieved in

[504] We recognize the difficulty in claiming both that the fuel price forecast used in PREPA's original PROMOD run is unsuitable and in recommending that the Commission continue to rely on the outputs of this run regardless. Simply stated, PREPA has not provided a PROMOD run based on fuel price forecasts of an acceptable vintage and quality. Left with only unsatisfactory alternatives, we have chosen the simplest.

[505] Refer to the report of Commission advisors Ralph Smith and Mark Dady.

[506] PREPA Ex. 14.02.xlsm, "Inputs" tab, cell H27.

FY2017.[507] We therefore see no reason to adjust PREPA's claimed performance savings and have maintained these savings in our calculation of an adjusted FY2017 fuel budget.

F. Recommendation

1. Fuel budget

We recommend that the Commission adjust PREPA's FY2017 upwards by $461,305,000, for a total FY2017 fuel budget of $1,117,273,289 after savings from performance improvements.

2. Fuel price forecasts

We recommend that the Commission require PREPA to prepare fuel price forecasts, or have forecasts prepared on its behalf, at least biannually. We also recommend that the Commission audit PREPA's fuel price forecasting methodology, which the Commission should require PREPA to submit as part of its initial filing in the next major rate- or planning-related case PREPA brings before this Commission.

3. Purchased power budget

We recommend no change to the FY2017 budget for purchased power.

4. Renewable energy contract structures and status updates

We recommend that the Commission require PREPA to establish a database, in spreadsheet form, of its contracts with renewable energy providers as described above. We further recommend that the Commission require PREPA to update this database in a regular and timely fashion.

[507] PREPA's response to CEPR-RS-05-17(d) of the Commission's Twelfth ROI (October 11, 2016).

VII. OPERATING EXPENSE BUDGET

A. Summary of issue and findings

In this chapter, we address PREPA's budget for spending on operations expenses other than fuel and purchased power. PREPA's operational budget includes the majority of its planned spending on labor,[508] as well as its planned spending on the materials and services needed to operate its plants, maintain its transmission and distribution system, and function as a company. In its revenue requirement, PREPA presents both the labor and non-labor operational budget, as well as a breakdown of total operational spending by function area.[509]

The Commission must decide if the PREPA's total operations budget, and the allocations thereof into labor and non-labor and functional area expense budgets, is reasonable. In particular, the Commission must ascertain whether PREPA's operations budget is sufficient but not excessive to allow PREPA to operate a safe and reliable electric system. If the Commission decides that PREPA's operations budget and the breakdowns thereof are reasonable, no change will be required. If the Commission decides that PREPA's operations budget is not reasonable, it must then decide whether or not to make adjustments to that budget.

Below, we discuss the significance of the operations budget, describe the evidence supporting that budget (or lack thereof), and comment on several concerning patterns observed in PREPA's historical spending and FY2017 budget. We come to several conclusions regarding PREPA's operations budget:

1. First, and most importantly, we conclude that PREPA's operational spending has not been consistent with operation of a safe and reliable system since at least FY2014. This point is of crucial importance for this rate case as a whole and we emphasize its significance below. PREPA's operational spending has been restricted in recent years and the performance of both the generation and transmission systems have declined accordingly, according to both our own analysis and explicit statements from PREPA to this effect. We are concerned that, even before FY2014, PREPA's

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[508] Approximately 14 percent of PREPA's historic labor spending has been related to capital projects (author's calculation based on values provided in PREPA's response to CEPR-JF-01-24(a) of the Commission's Fourth ROI, August 23, 2016, PUBLIC; refer to CEPR-JF-01-24 Attach 02.xlsx through CEPR-JF-01-24 Attach 05.xlsx). However, PREPA's capital-related labor budget is convolved with its overall capital budget and difficult to audit. Our analysis does not address capital-related labor spending explicitly or separately from overall capital spending.

[509] PREPA's functional areas include generation, customer billing, administrative and general, and transmission and distribution. Transmission and distribution listed independently in the financial model but are grouped together in historical records provided by PREPA, so it is not clear whether or not these directorates are considered to be one single or two separate functional areas by PREPA.

budgeting process encouraged austerity to the point that PREPA must spend sufficiently on its operations such that it can operate a safe and reliable system on a going-forward basis.

2. Second, we find that PREPA made so little documentation of the process and values underlying the budget available to Commission advisors that we have no choice but to consider the budget and the allocation thereof to be, in effect, unsupported. Most especially, we find that the allocation of operational expenses by functional area is likely to bear little, if any, relationship to the breakdown of PREPA's actual FY2017 operational spending.[510]

3. Third, we observe that a major component of PREPA's operational spending occurs in its Administrative and General (A&G) functional area, and that spending in this area has increased in recent years for unexplained causes. We recommend that the Commission investigate this issue further in its pending investigation regarding PREPA's performance.

4. Finally, through comparison with historical spending and operational patterns, we propose a series of reallocations, recategorizations, and corrective adjustments to better align PREPA's operational budget with its apparent needs for operating a safe and reliable system.

B. Constituent elements of PREPA's operating expenses

PREPA's non-fuel operating expense budget[511] for FY 2017 totals $559,752,076.[512] This value is comprised of spending on labor and other operational and maintenance expenses. PREPA provided the labor and non-labor components of the operations budget in Schedule A-2 REV. As is the case with fuel, PREPA prepared both a base budget and a proposed actual budget after taking into account expected savings from performance improvement initiatives. We calculate that PREPA would expect its total operations spending to be $662,502,076 if no

[510] This conclusion has major implications for PREPA's cost of service study, as it may call into question one of the bases of PREPA's cost allocation. This subject is discussed by Commission advisor Paul Chernick.

[511] PREPA presents values for both its "Total Labor & Other Operating Expenses" and its "Total Non-Fuel O&M Expense" in Schedule A-1 REV. The difference between the two is a single line item entitled "CILT Subsidy Recovery Required in Base Rate." CILT and subsidies are the purview of Commission advisor Paul Chernick and we do not address them in this report. Instead, our analysis here focuses on the value described as "Total Labor & Other Operating Expenses."

[512] Sum of FY2016 Non-Fuel O&M Expenses, Schedule E-6 REV.

performance-related savings were achieved.[513] PREPA estimated its FY 2017 performance savings at a value of $102,750,000.[514]

Below, we describe the constituent elements of PREPA's operating expenses, which can generally be categorized as either labor- or non-labor-related. We also review how PREPA's operational spending has changed over the course of the recent past.

1. Labor expenses

As presented in PREPA's financial model, labor expenses consist of salaries[515] as well as spending on pensions[516] and benefits.[517] Salaries and wages have historically made up roughly two-thirds of PREPA's operational labor spending.[518] PREPA expects spending on labor in FY 2017 to be $434,937,821 before savings expected from performance improvements,[519] of which 64 percent is expected to be spent on salaries.[520]

PREPA's operational labor budget comprises its compensation for all of the workers that are involved in PREPA's day-to-day operations. Compensation for PREPA's administrative and executive staff, as well as all of its customer service employees, is contained in this value. PREPA's operational labor budget also includes compensation for linesmen, meter readers, and the plant workers that operate and maintain PREPA's generating units.[521] Indeed, of the 6,694 employees included in PREPA's FY2017 operational labor budget, 63 percent[522] are workers in the Generation and T&D directorates.[523] Without the labor of these employees

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[513] *Id.*; author's calculation.

[514] *Id.*

[515] We understand this heading to refer to compensation of both salaried and wage workers.

[516] We understand this heading to refer to pension fund deposits on behalf of current employees, rather than payments to current retirees.

[517] PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 58-59.

[518] *Id.*, author's calculation (FY2010-2016 average of "Salaries" values as a percentage of "Total Operating Expense Labor Costs" is 64%).

[519] Schedule A-2 REV.

[520] Author's calculation based on values provided in PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 58-59.

[521] Author's inference based on values provided in PREPA's response to CEPR-AH-06-13 of the Commission's Fourteenth ROI (November 4, 2016). Refer to CEPR-AH-06-13 Attach 01.xlsx.

[522] Author's calculation based on values provided in PREPA's response to CEPR-MC-01-03(a) of the Commission's Fourteenth ROI (November 1, 2016).

[523] We note here that because employee compensation rates are not identical for all positions, this statistic does not indicate that 63 percent of PREPA's labor *spending* is devoted to the Generation and T&D directorates.

(which must certainly be compensated), PREPA's system would simply cease to operate correctly or at all—as we shall see below. Although PREPA may be able to improve the efficiency of its use of staff, there is no way for PREPA to operate a safe and reliable electric system without sufficient spending on employee labor.

2. Non-labor expenses

PREPA's pre-savings non-labor operations budget, which it labels as "Unclassified division expenses" in Schedule A-2 REV, is $227,564,256.[524] This budget is further elaborated in PREPA's financial model, where it is revealed as comprising ten different categories of spending. The table below summarizes these categories and their budgeted amounts for FY2017.

Table 26. PREPA's proposed spending on non-labor expenses by category of spending.[525]

Category of Spending	Amount Budgeted in FY2017	Percent of FY2017 Non-Labor Operations Budget
Additional Safety Upgrades	$4,432,500	2%
Materials	$32,863,721	14%
Transportation, Per Diem, and Mileage	$33,753,326	15%
Property & Casualty Insurance	$20,200,000	9%
Restructuring	$28,000,000	12%
Retiree Medical Benefits	$22,220,000	10%
Security	$21,210,000	9%
Banking Services	$14,140,000	6%
Maintenance and Utilities	$17,957,800	8%
Other Miscellaneous Expenses*	$32,786,908	14%
Total	**$227,564,255**	**100%**

*According to PREPA's business plan, miscellaneous expenses consist primarily of rent, legal fees, utilities, and professional services.[526]

Apart from only a few particular exceptions, we will not discuss these categories in depth.[527] We note, however, that this budget includes some costs that are essential to PREPA's operations.[528] For example, all of the cost of all the physical goods needed for the routine,

[524] Schedule A-2 REV.

[525] PREPA Ex. 14.02.xslm, "Inputs" tab, lines 69-79.

[526] PREPA Ex. 3.02, p23.

[527] As a note, we observe that PREPA's non-fuel operations budget does not include any spending on fines or penalties, for example on penalties related to non-compliance with MATS or the Puerto Rico Renewable Portfolio Standard. PREPA confirmed during the October 20 Conference Call that no such fines were included in the revenue requirement despite the fact that PREPA is currently in non-compliance with multiple applicable policies.

[528] This statement does not imply, however, that *all* of the spending included in this category is essential to PREPA's operations.

day-to-day maintenance of PREPA's plants and wires is contained in this budget.[529] This budget also covers the cost of the transportation needed for PREPA's employees to travel to its lines[530] (which are sometimes located in remote or difficult-to-access areas[531]) for maintenance and repair purposes. As above, although PREPA may be able to improve the efficiency of its use of materials and services, sufficient operational spending is necessary for PREPA to operate a safe and reliable electric system.

3. Expenses by functional area

In addition to the breakdown into labor and non-labor expenses provided by PREPA in the financial model and Schedule A-2 REV, PREPA's operational budget is also broken down by functional area in Schedules A-1 REV and E-6 REV. As described below, the methodology used by PREPA (or its advisors) to calculate these by-area values was *ad hoc* at best. As stated, PREPA's functional area operational budgets for FY2017 are summarized in the table below.

Table 27. PREPA's proposed allocation of operational expenses by functional area.[532]

Functional Area	Amount Budgeted in FY2017	Percent of FY2017 Operations Budget
Generation	$122,410,515	22%
Transmission	$34,222,179	6%
Distribution	$169,277,149	30%
Customer Service/Billing	$84,944,941	15%
Administrative and General	$148,897,292	27%
Total	**$559,752,076**	**100%**

A sound presentation of anticipated operations spending by functional area is of great importance to this Commission, as it is through these values that the Commission can judge the extent to which PREPA is planning for adequate levels of maintenance activities at its generating units and T&D infrastructure. Ideally, generation and T&D operational budgets would be supported by PREPA with a strategic plan and clear documentation detailing planned maintenance and operational activities, expected staffing requirements, expected spending levels, and any buffer amounts held in reserve in case of unplanned occurrences. Generation expenses, in particular, should be straightforward for the Commission to reconcile with PREPA's planned generation levels by plant. Customer service and A&G budgets should be similarly supported with a clear elaboration of staff and funds that must be committed for both ongoing activities, new programs, and special internal initiatives.

[529] Author's inference based on values provided in CEPR-AH-06-13 Attach 01.xlsx.

[530] *Id.*

[531] PREPA's response to CEPR-AH-02-01(e) of the Commission's Sixth ROI (PUBLIC; August 29, 2016).

[532] Schedule E-6 REV.

Unfortunately, this is ideal is far from what PREPA presented to the Commission in its rate case petition.

C. PREPA's FY2017 operating budget is effectively unsupported

As described above, while the documentation provided by PREPA in support of its capital budget is thin, we can at least observe that PREPA's total capital budget is the sum of a large number of individual projects or budget items. PREPA enumerated these projects on an item-by-item basis in Schedule F-3 REV. Furthermore, we can trace the origins of PREPA's fuel and purchased power budgets directly to outputs from PROMOD. For PREPA's operational budgets, we have no such support. In this section, we discuss the information we were provided by PREPA with regards to its FY2017 operational budget. We describe the calculation of the operational budget within the financial model, the calculation of the by-functional-area sub-budgets tabulated above, and the unsatisfactory nature of PREPA's responses to requests for additional support.

1. Presentation of PREPA's operating budget in PREPA's rate case

The operational budget, as presented in Schedules A-1 REV, A-2 REV, and E-6 REV, is the result of a calculation based on four sets of inputs in the financial model. PREPA used these inputs to calculate (1) expected labor spending; (2) expected non-labor spending; (3) expected savings from performance improvements; and (4) the breakdown of its labor budget by functional area.

PREPA calculated its labor budget simply as the sum of two hardcoded values, labeled "Salaries" and "Pension & Benefits."[533] The sum of these lines is labeled "Total Operating Expense Labor Costs."[534] The Salaries and Pension & Benefits values for FY2017 are not the result of any supporting calculations within the financial model.[535] In Schedule F-4, PREPA describes how it calculated its budgets for these categories:

> Salaries are forecast based on projected number of employees and hourly wages, and assuming the average employee works 1,950 hours a year. Headcount for 2016 is estimated to be 6,710 employees, declining to 6,395

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[533] PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 58 and 59.

[534] *Id.*, line 60.

[535] PREPA supplied some additional details regarding these values in its response to CEPR-RS-06-07 of the Commission's Fourteenth ROI (October 21, 2016). Refer to CEPR-RS-06-07 Attach 01.xslx. However, these details are scant. For example, rather than containing a single value for salaries, this document contains a calculation of total payroll expenses as the sum of hardcoded values for salaries and overtime. It is not clear from this calculation how PREPA calculated its budget for either salaries or overtime. Moreover, this document contains no further information regarding the breakdown of PREPA's planned spending by functional area.

> employees by 2019 and staying constant for the balance of the forecast period. Retirements are assumed based on employees with more than 24 years of service, with no additional attrition assumed. Salaries are based on hourly salaries of PREPA in March 2015; and grow by 1% per year from 2017 onwards.
>
> Employee benefits are calculated as 63.19% of Base Salary beginning in FY 2016. Benefits increase 1% annually from FY 2017 through FY 2019 and are held constant at 66.19% thereafter. Benefits calculated for overtime are calculated in the same manner as they are calculated for salaries. PREPA's pension funding is forecast to stay constant from the historical to the forecast period.[536]

PREPA did not provide any supporting workpapers showing these calculations, nor did PREPA provide a breakdown of employees and labor spending by functional area.

PREPA calculated its labor budget as the sum of values in the categories listed in TABLE above. With the exception of the value for the category labeled "Additional Safety Upgrades," the by-category values are the product of hardcoded values for FY2016 and hardcoded inflators. The by-category values for FY2016 are not the result of any supporting calculations within the financial model and were presented by PREPA without further documentation. The inflators for FY2017 are all equal to one percent, except the inflator for the "Restructuring Fees" category, which is twelve percent. These inflators are not the result of any supporting calculations. PREPA mentioned its assumption that its non-labor operational expenses (apart from restructuring fees) would increase at a rate of one percent per year in Schedule F-4[537] but it did not attempt to justify this assumption.

PREPA calculated its total expected savings from performance improvements as the sum of hardcoded values for several different performance initiatives. Those performance initiatives with forecasted savings reflected in the FY2017 revenue requirement are related to increasing disconnection costs; theft recoveries and reduced T&D losses; PREPA's automotive fleet and shops; procurement and inventory management; medical benefit savings; and headcount reduction.[538] The expected savings values are not the result of any supporting calculations within the financial model. Although PREPA describes these performance initiatives in Schedule F-4,[539] it does not explain therein how it calculated expected savings values.

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[536] Schedule F-4, IV(A) and (B).

[537] *Id.*, IV(D).

[538] PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 65 and 92

[539] Schedule F-4, VI(B)-(D).

The total operational expense budget for FY2017 is the sum of labor expenses, non-labor expenses, and performance improvement savings.[540]

2. Financial model breakdown of expenses by area is *ad hoc*

PREPA did not present any hardcoded budgets for by-area operational expenses. Instead, PREPA calculated functional area budgets in a manner that it described thusly: "functional expense is based on audited FY14 allocations."[541] From an executional standpoint, what this statement means is that PREPA found the percentage of total (labor and non-labor) spending for which each functional area was responsible in FY2014 and then simply multiplied its total FY2017 operational budget by these percentages to arrive at by-area operational budgets.[542]

We find this method to be unsatisfactory. As elaborated upon below, these values have no inherent relationship to the operational activities planned to occur in FY2017 in each of PREPA's functional areas. It is not in fact clear to us whether or not PREPA considers these budgets to be binding on or even applicable to its functional areas, or whether these by-area values are simply a construct for the purposes of the revenue requirement calculation within the financial model.

Statements from PREPA have only increased our uncertainty. When asked whether or not PREPA expects the proportions by functional area of its total operational expense spending to remain constant over time at FY2014 levels, PREPA's advisor replied that, at present, PREPA "does not have an expectation for how these proportions will change"[543] We do not know whether PREPA meant this statement to apply to FY2017 or only to future years.

On a clarification call, PREPA asserted that it budgets for operations spending on a by-department basis.[544] PREPA's advisor then admitted that the mechanism it used to allocate total operational expenses by functional area in its revenue requirement may not relate in any way to its actual budgeting process.[545] PREPA's advisor asserted that PREPA did the best that it could to provide operational expenses broken down by functional area, implying that

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[540] PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 489-493. PREPA does not present this value explicitly but included it implicitly in the formulae underlying the by-area values in Schedule E-6.

[541] Schedule E-6 REV.

[542] PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 489-493. Hardcoded FY2014 operational spending by functional area is in column E; the percentage of expenditures spent by each functional area is in column J. Column H contains the product of these percentages and PREPA's total operational budget.

[543] PREPA's response to CEPR-AH-02-09(c) of the Commission's Sixth ROI (August 25, 2016).

[544] October 20 Conference Call, Ernesto Ramos, 3:41:00.

[545] October 20 Conference Call, Lucas Porter, 3:45:40.

PREPA had not, in fact, ever prepared a by-department operational budget for FY2017—or that, if it had, it had not provided this budget to its advisors.

Moreover, we simply disagree with the assertion that PREPA's calculation is the best possible mechanism for allocating FY2017 operational expenses among its functional areas given the apparent lack of a bottom-up, by-area budget. If nothing else, we find it improper to mix data from two separate years in the way that PREPA did: PREPA calculated labor expenses as inflated from FY21016 values but allocated these expenses according to FY2014 proportions. This method implicitly asserts that there were no "known and measurable" changes in the distribution of operational spending by functional area between FY2014 and FY2016—an assertion that we know to be false, based on the historical spending patterns explored below. Alternatively, we can interpret PREPA's methodology as asserting that any changes in the breakdown of operational expenses by functional area that did occur between FY2014 and FY2016 will be reverted for FY2017; this would be an unusual claim and PREPA has certainly not presented evidence to this effect. The most likely, but least satisfactory, explanation is that PREPA means to assert neither of these statements, but rather employed an *ad hoc*, poorly-justified calculation in the preparation of one of the most major elements of its revenue requirement.

There are at least two more serious deficiencies with this approach: PREPA's method inherently assumes that the same proportions are valid for both labor and non-labor spending *and* that that they are valid for PREPA's planned savings from performance improvements. We find that neither assumption is true, and that PREPA could have easily corrected these assumptions given the information we are confident was available to it. We discuss these faulty assumptions below.

We also describe an unexplained deviation between the FY2014 values used by PREPA in the financial model and those provided in historical records. We are unable to justify or reconcile this deviation.

a. Proportion of labor spending by area differs from that of non-labor spending by area

PREPA prepared separate and independent labor and non-labor expense budgets, as described above. However, its allocation of operational expenses by functional area is based on a single set of percentage values as applied to *total* spending. This method is only valid if either: (1) the percentage of operational labor spending in each functional area is the same as the percentage of non-labor operational spending in each functional area; or (2) the ratio of labor expenses to non-labor expenses has remained constant since FY2014, such that the total proportional breakdown of labor and non-labor spending in each functional area also remains constant.

We found that neither of these conditions is true. An examination of the breakdown of FY2014 operational spending by functional area *and* expense type (labor or non-labor)

demonstrates that the functional areas claim very different proportions of labor and non-labor spending.

Table 28. Percentages of FY2014 labor and non-labor operational expenditures by functional area.[546]

Functional Area	% of FY2014 Labor Spending	% of FY2014 Non-Labor Spending	% of FY2014 Total Operational Spending
Generation	22%	23%	22%
Transmission	7%	4%	6%
Distribution	34%	20%	30%
Customer Service	17%	10%	15%
A&G	20%	45%	27%

In particular, we note that while the proportions of labor and non-labor spending represented by generation expenses are similar to one another, T&D spending takes up a much greater proportion of labor spending than non-labor spending. Conversely, A&G expenses dominate non-labor spending but are a relatively small proportion of labor spending. These differences highlight the risks in PREPA having relied on a single factor to allocate a total budget comprised of both labor and non-labor elements.

If, however, PREPA's labor and non-labor spending had inflated (or deflated) at the same rate since FY2014, these differences would be immaterial as the ratio of labor to non-labor spending would be identical in FY2017 to its value in FY2014. In reality, however, PREPA's labor and non-labor budgets have shifted in opposite directions since FY2014, as we demonstrate in the table below.

Table 29. Comparison of PREPA's FY2014 actual operational spending and FY2017 proposed budgets.

	FY2014 Actual*	FY2017 Budgeted**	% Change, FY2014 to FY2017
Labor	530,797,419	434,937,821	-18%
Non-Labor	203,319,764	227,564,256	12%
Total	734,117,183	662,502,076	-10%

*Corrected values as provided by PREPA in CEPR-AH-02-08(b).
**PREPA Ex. 14.02.xlsx, "Inputs" tab, lines 60 and 79.

We note that PREPA's labor and non-labor budgets have not just changed at different rates, but rather the labor budget has decreased as compared to FY2014 spending, while the non-labor budget has increased. This has resulted in a significant change in the fraction of total operational spending represented in by labor expenses, which was 72 percent in FY2014[547] but is budgeted at only 66 percent in FY2017.[548]

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[546] PREPA's response to CEPR-AH-02-08(b) of the Commission's Sixth ROI (August 25, 2016).

[547] Author's calculation based on values provided in CEPR-AH-02-08(b).

[548] Author's calculation based on values provided in PREPA Ex. 14.02.xslm, "Inputs" tab, lines 60 and 79.

Because the proportions of spending by area are not the same of labor and non-labor expenses, and the breakdown of total spending into labor and non-labor components has changed since FY2014, PREPA's proposed allocation of spending by functional area is likely invalid. We are unsure as to why PREPA used only a single percentage for total spending to allocate its operational budget by functional area, considering that it clearly had access to total labor and non-labor spending amounts in historical years. Based on these observations, we propose a reallocation of PREPA's operational budget by functional area in SECTION below.

b. Allocation of performance improvement-related savings by area is not conceptually sound

PREPA calculated its allocation of operational funds by functional area using a total operational budget that included expected savings from performance improvements.[549] In doing so, PREPA implicitly assumed that its savings from performance improvements (if realized[550]) would be spread across its functional areas in the same proportions as its labor and non-labor spending. This assumption is nonsensical. In many cases, the performance improvements PREPA listed in the financial model and Schedule F-4 are likely to have impacts that disproportionately affect spending in one particular functional area. For example, PREPA categorizes over half of its annual spending on materials as a generation expense.[551] However, PREPA's allocation method inherently and without basis assumes that only 22 percent of its expected $37,500,000 of savings related to "Procurement and Inventory"[552] will be realized as a reduction in generation expenses.[553] Similarly, PREPA claims an expectation of $10 million in savings related to (additional) headcount reductions.[554] Without a summary of where within PREPA's organization it expects these headcount reductions to occur, we cannot put credence in PREPA's assumption that these

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[549] PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 489-493. The value for performance improvement savings is one of three terms that are added together before being multiplied by the by-area allocation factors described above.

[550] We do not comment on the status of PREPA's expected operational performance improvement savings in this report. However, that topic is covered in the report of Commission advisors Ralph Smith and Mark Dady.

[551] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xlsx. Between FY2010 and FY2016, generation expenses accounted for, on average, 59 percent of PREPA's spending under the description "Materials and supplies gen (warehouse)" and 55 percent of PREPA's spending under the description "Materials Blankets."

[552] PREPA Ex. 14.02.xlsm, "Inputs" tab, line 98.

[553] Separately, we question the realism of PREPA's assumption that its procurement and inventory-related savings will exceed the entirety of its spending on materials in FY2017.

[554] PREPA Ex. 14.02.xlsm, "Inputs" tab, line 103.

savings can be apportioned among its functional areas in exactly the proportions it has assumed for total spending.

We also note that, for some of the performance improvement savings claimed by PREPA, casting these initiatives as reductions to expenses may be inappropriate. Most notably, PREPA convolves savings from "Theft recoveries and reduced T&D loss." If PREPA were to increase its reliance on distributed energy resources or improve the power quality on its transmission lines, it may very well see reductions in transmission- and distribution-related losses, which we would expect to see mainly as a reduction in generation, fuel, and purchased power expenses (as it would reduce the overall quantity of energy PREPA would need to generate to serve demand). However, in Schedule F-4, PREPA describes this initiative not as an improvement to the actual efficiency of delivering power to customers, but as a reduction in "non-technical losses," a term that PREPA uses to describe theft of electricity.[555] Rather than a *decrease* in spending, PREPA describes this initiative as resulting in an *increase* in collections.[556] We therefore believe that PREPA mis-categorized this line item.

Because we have scant data with which to adjust PREPA's allocation of performance improvement savings, we do not attempt to do so. Rather, we base our analysis of PREPA's operational budget below solely on PREPA's pre-savings budget values.

c. FY2014 values are not consistent with historical records

In seeking to compare PREPA's operational budgets with its historical spending patterns, we compared FY2017 values to historical records provided by PREPA in discovery. In doing so, we found an unexplained inconsistency in the by-functional-area breakdown of FY2014 values. As described above, PREPA included a hardcoded breakdown of FY2014 operational spending by functional area in the financial model.[557] PREPA provided a table further dividing these values into labor and non-labor FY2014 spending by functional area in response to discovery.[558] PREPA also provided two separate workbooks with records of historical operational spending in more granular detail, including listing expenses by both functional area[559] (or directorate) and type (labor or non-labor) or kind of expense.

We summed both labor and non-labor expenses by area from these historical records and found inexplicable deviations from the values PREPA used in the financial model to calculate its FY2017 allocations. While the total values for labor and non-labor spending are relatively close, the functional area totals differ by millions or tens of millions of dollars. We show these

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[555] Schedule F-4, VI(B)(3).

[556] *Id.*

[557] PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 489-493, column E.

[558] CEPR-AH-02-08(b).

[559] CEPR-AH-06-13 Attach 01.xslx.

deviations in the table below. PREPA provided historical values in the attachment to CEPR-AH-06-13.[560] The values in PREPA's response to CEPR-AH-02-08[561] match those in the financial model.[562]

Table 30. Deviations between PREPA's FY2014 operational spending as reported in different ROIs.[563]

		Labor	
Functional Area	**CEPR-AH-06-13**	**CEPR-AH-02-08**	**Deviation**
A&G	$101,879,925.16	$104,705,353.46	-$2,825,428.30
Customer Service	$102,254,632.64	$91,969,357.40	$10,285,275.24
Generation	$139,665,830.89	$114,439,783.74	$25,226,047.15
T&D	$186,997,009.81	$219,682,924.47	-$32,685,914.66
Total	$530,797,398.50	$530,797,419.07	-$20.57
		Non-Labor	
Functional Area	**CEPR-AH-06-13**	**CEPR-AH-02-08**	**Deviation**
A&G	$116,444,612.75	$90,574,065.76	$25,870,546.99
Customer Service	$13,474,708.09	$19,436,287.49	-$5,961,579.40
Generation	$39,551,514.63	$46,102,118.00	-$6,550,603.37
T&D	$32,414,853.27	$47,207,293.15	-$14,792,439.88
Total	$201,885,688.74	$203,319,764.40	-$1,434,075.66
		Total	
Functional Area	**CEPR-AH-06-13**	**CEPR-AH-02-08**	**Deviation**
A&G	$218,324,537.91	$195,279,419.22	$23,045,118.69
Customer Service	$115,729,340.73	$111,405,644.89	$4,323,695.84
Generation	$179,217,345.52	$160,541,901.74	$18,675,443.78
T&D	$219,411,863.08	$266,890,217.62	-$47,478,354.54
Total	$732,683,087.24	$734,117,183.47	-$1,434,096.23

These deviations call PREPA's allocation of operational budgets by functional area even further into question,[564] as the percentages of total spending by functional area are very different between the two records. We tabulate those percentages below; we emphasize that due to the size of PREPA's operational budget, a one percent difference in allocation is equal to several million dollars.

[560] *Id.*; these values match those found in CEPR-JF-01-24 Attach 02.xslx through …Attach 05.xslx for years FY2012 through FY2015.

[561] CEPR-AH-02-08(b).

[562] With the exception that PREPA's value for total non-labor spending in FY2014 is incorrect in the "Inputs" tab of the financial model, as explained in PREPA's response to CEPR-AH-02-08(a). This error does not impact the calculations of expenses by area in Schedule E-6.

[563] Values in PREPA's response to CEPR-AH-02-08 match those in the financial model.

[564] We note also that these deviations raise additional concerns regarding the quality and consistency of PREPA's recordkeeping.

Table 31. Allocation of FY2014 operational spending by functional area as reported in different ROIs.

Functional Area	% of Total Spending CEPR-AH-06-13	CEPR-AH-02-08
A&G	30%	27%
Customer Service	16%	15%
Generation	24%	22%
T&D	30%	36%
Total	100%	100%

In our analysis below, we rely only on the FY2014 values from detailed historical records, rather than using the values set forth by PREPA in the financial model.

3. PREPA failed to provide supporting documentation for the operations budget, even after several requests

The labor and non-labor components of the operational budget values presented by PREPA in the financial model are cited to the "AlixPartners business plan" and "Milliman Actuarial Study."[565] PREPA was asked by Commission advisors to provide additional support or a more complete budget several times during this proceeding. In response to a request for the FY2017 operational budget,[566] PREPA simply provided a PDF version of the same values found in the financial model, with no additional supporting information—and then PREPA provided this same document again two months later, in response to a second ROI for its operational budget.[567]

Commission advisors also asked for a "detailed breakdown" of the values used by PREPA in its calculation of operational labor expenses, "including the workbook(s) that generated *all* hard-coded values."[568] In response, PREPA provided detailed workbooks showing anticipated and actual spending levels, by directorate and division, with descriptions, for its entire operational budget (including fuel, purchased power, labor, and non-labor expenses). These workbooks would have been satisfactory for our purposes—except that PREPA only provided workbooks for FYs 2012 through 2015,[569] despite the fact that the financial model has hardcoded labor expense values for every year through FY2035. Because they pertain

[565] PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 94-103.

[566] PREPA's response to CEPR-RS-03-05 of the Commission's Sixth ROI (August 15, 2016). Refer to CEPR-RS-03-05_Attach 01.pdf.

[567] PREPA's response to CEPR-RS-06-12 of the Commission's Fourteenth ROI (October 21, 2016). Refer to CEPR-RS-06-12 Attach 01.pdf.

[568] CEPR-JF-01-24; emphasis added.

[569] We note that PREPA did not label the workbooks provided in this response with the year to which they pertain. We were only able to identify the applicable years by reconciling values from these workbooks with values contained in CEPR-AH-06-13 Attach 01.xslx.

neither to FY2017 nor to FY2016 (the year on which PREPA's based its non-labor operational expense values), none of the workbooks provided in response to this ROI can be used as support for PREPA's FY2017 operational budget.

Finally, Commission advisors asked PREPA directly for documentation supporting how it developed and capped its operational budget in FY2017.[570] PREPA responded with a two-page description, in prose, of multiple elements of its revenue requirement. The entirety of the description of how PREPA's non-labor operational budget was developed reads:

> Budget was developed by directorate based on FY16 actuals with adjustments made for known and measurable changes. Adjustments were made for known performance improvement initiatives for FY17.[571]

PREPA did not provide any supporting workpapers in response to this query.

We are very concerned by this lack of documentation. Given the lack of supporting information supplied by PREPA thus far, we are unable to ascertain whether or not PREPA actually developed budgets by functional area for FY2017. We consider it entirely possible that the entirety of PREPA's operational budgeting process for non-labor costs was, as presented in the financial model, to take actual spending levels from FY2016 and inflate them by one percent. This is simply not a satisfactory methodology. We find it problematic for PREPA to have based its budgeted values on spending from a year in which PREPA had no approved budget,[572] as we have no assurances that the lack of an approved budget did not cause distortionary effects in PREPA's actual spending. We are unable to conclude with certainty that PREPA's budget as presented reflects its actual planned operational and maintenance activities in its various functional areas, because we have absolutely no evidence to that effect pertaining to either FY2017 or FY2016.

Moreover, as we discuss below, however, PREPA's operational spending in FY2016 was simply not sufficient to enable it to operate a safe and reliable system. Instead, PREPA has been operating on a skeleton crew focused on reactive, rather than preventative, maintenance. While we understand that PREPA's budget in general is based on a test year with "known and measurable changes," we would have hoped that operating a safe and reliable system was one known and measurable change that PREPA intended to make from FY2016 to FY2017.

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[570] CEPR 161020 Clarification Call Request No. 9.

[571] *Id.*

[572] CEPR-AH-05-01. Because PREPA's board did not approve a new budget prior to the start of FY2016, PREPA automatically adopted the FY2015 budget.

D. PREPA's operating budget is not consistent with historical patterns or with operation of a safe and reliable system

Given the lack of information provided to us by PREPA regarding the basis for its FY2017 operational budget, our main avenue of analysis for evaluating this component of the revenue requirement is through comparison with PREPA's historical spending on operations. In this section, we discuss our analysis of PREPA's operational budgets and expenditures for FYs 2010 through 2016 and comment on the patterns we observe therein.

1. PREPA's operational spending fell sharply between FY2013 and FY2016

a. Declines in operational spending

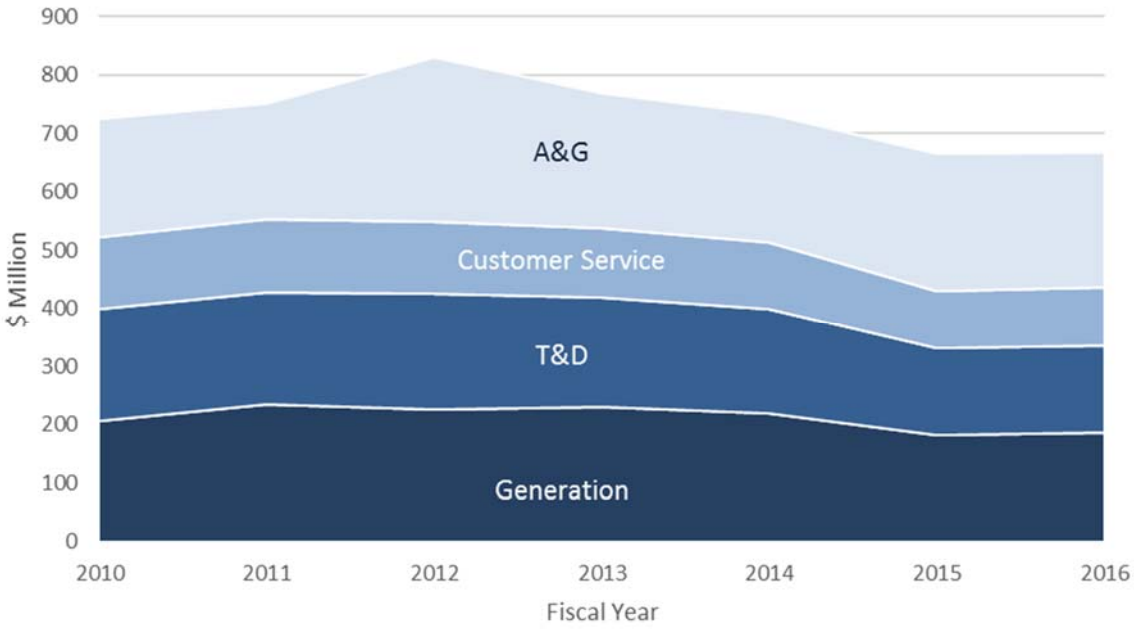
PREPA's operational spending has declined in recent years,[573] from a high of approximately $829 million in FY2012[574] to only $667 million in FY2016.[575] PREPA's overall operational spending pattern is shown in FIGURE.

[573] Regarding all historical values in this chapter, and our analysis based thereon, we will note here that we assumed PREPA provided historical values in nominal dollars (*i.e.*, these values were not corrected for inflation). For the sake of simplicity, we did not convert historical dollars into a consistent dollar-year. However, readers should note that when we identify declines in PREPA's operational spending, these declines are likely to be greater in real terms. We will continue to note this point in footnotes below as appropriate.

[574] CEPR-AH-06-13 Attach 01.xslx, "FY2012 Variance" tab.

[575] *Id.*, "FY2016 Variance" tab.

Figure 30. PREPA's total operational spending by functional area, FYs 2010-2016.[576]



As can be seen from the figure above, spending on customer service, transmission and distribution (T&D), and generation have all fallen by significant amounts, with an especially sharp drop from FY2014 to FY2015. Meanwhile, A&G spending has actually increased somewhat. We do not know what caused the large spike in A&G spending in FY2012, but offer below some commentary on the increase in A&G spending from FY2014 to the present.

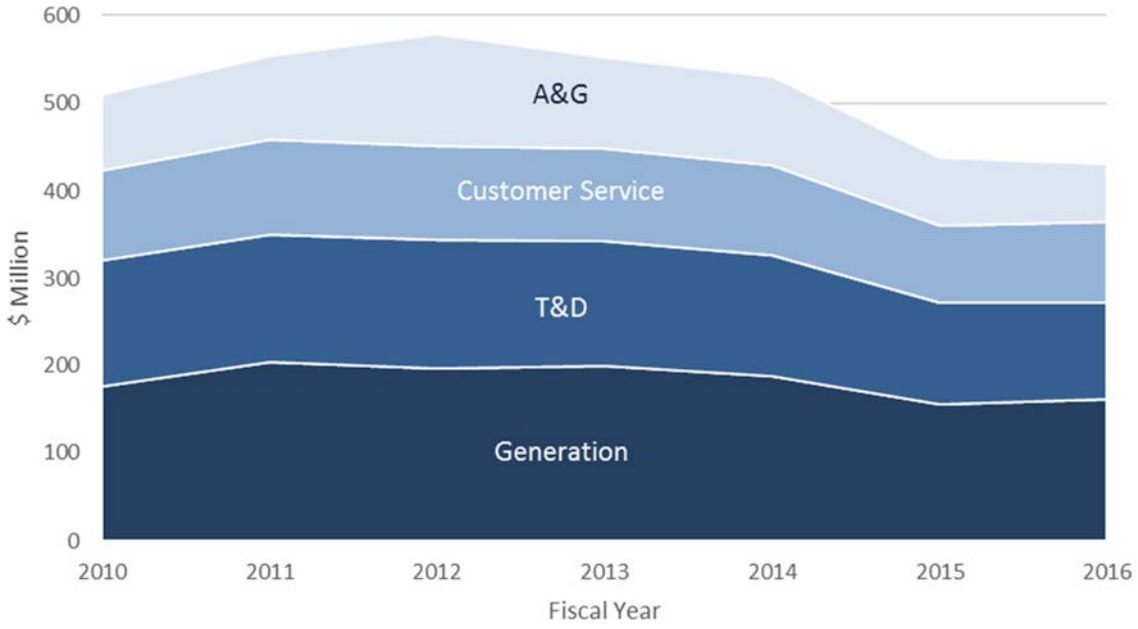
PREPA's historical labor spending has followed a similar pattern to its total operational spending, as shown in FIGURE. Labor spending was approximately constant for the generation, customer service, and T&D areas from FY2010 to FY2014[577] Thereafter, PREPA cut its labor spending in every area. However, the most severe cuts were experienced in generation: the FY2016 generation budget is 23 percent below the area's budget in FY2010, representing cutbacks of almost $33 million in generation-related labor spending.[578]

[576] CEPR-AH-06-13 Attach 01.xslx.

[577] Effectively, declining in real terms.

[578] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xslx.

Figure 31. PREPA's operational labor spending by functional area, FYs 2010-2016.[579]



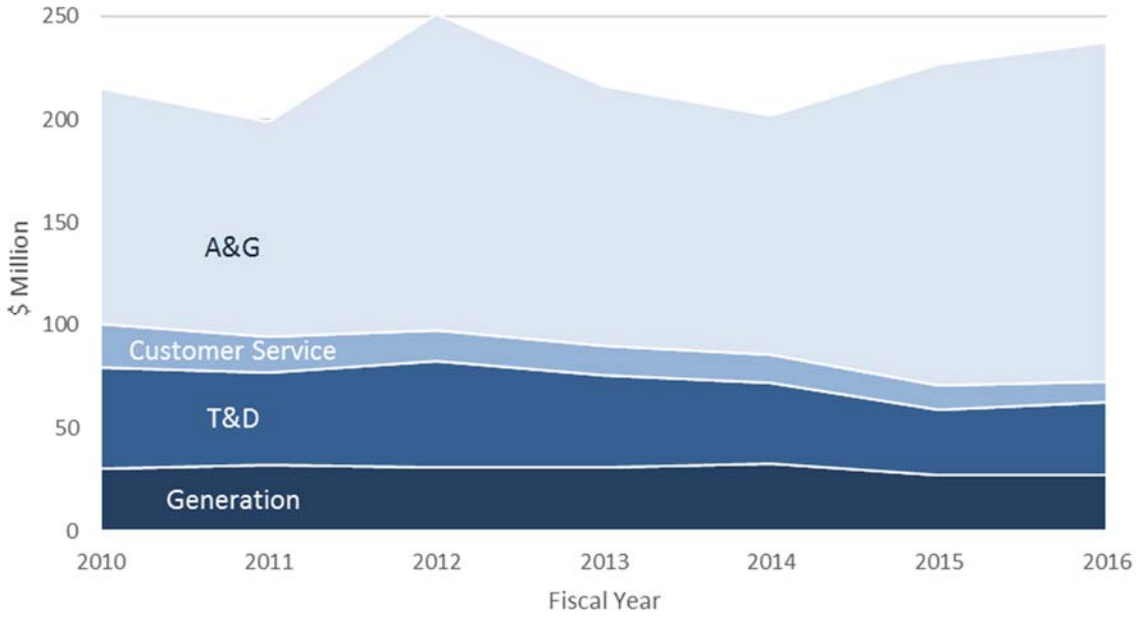
PREPA also cut the non-labor budget of its generation area, by approximately 27 percent between FYs 2010 and 2016 (amounting to a decrease in budget of nearly $13 million).[580] In the aggregate, PREPA's non-labor spending on everything except the A&G area has declined by 28 percent since FY2010, as we show in FIGURE below. Meanwhile, A&G non-labor spending increased by 44 percent—or a sum of $50 million—over the same period.[581]

[579] CEPR-AH-06-13 Attach 01.xslx.

[580] *Id.*

[581] *Id.*

Figure 32. PREPA's operational non-labor spending by functional area, FYs 2010-2016.[582]



These patterns indicate a change in priorities at PREPA. While PREPA has spent less and less on the materials and staff needed to operate its generating units and transmission and distribution infrastructure, it has chosen to devote more resources to its own internal corporate operations. This choice has had severe repercussions for the safety and reliability of PREPA's system, as we discuss further below.

b. Relationship between operational budgets and spending

The relationship between PREPA's operational budgets and its actual operational spending has also shifted over time. Prior to FY2014, PREPA routinely overspent its operational budgets. PREPA's underbudgeting was not evenly distributed among its functional areas: in general, PREPA met or slightly underspent its generation and customer service budgets while PREPA overspent its T&D budgets by approximately five percent on average and overspent its A&G budgets by 24 percent.[583]

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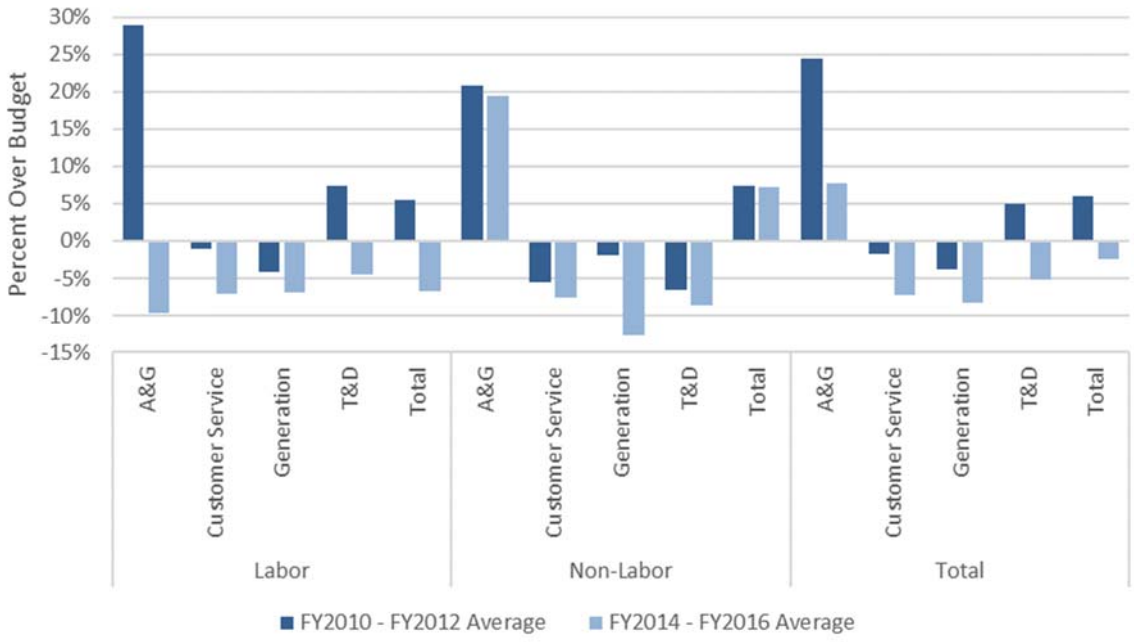
[582] *Id.*

[583] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xslx. Averages omit FY2013, which appears to be an outlier: PREPA exceeded every one of its operational sub-budgets except customer service- and generation-related labor expenses in that year, for unknown reasons. In particular, the extent to which PREPA overspent its generation non-labor budget is unusual: the budget was exceeded by 146 percent, primarily due to a $16 million overage on materials spending.

In FY2014 and thereafter, PREPA began to *underspend* its already-reduced budgets.[584] The average proportion of PREPA's generation expense budget that went unspent doubled from four to eight percent; the proportion of unspent customer service budget more than tripled over this period.[585] From having a yearly overrun, the T&D area began to underspend its budgets by five percent on average.[586] Only the A&G area continued to overspend, at a rate of eight percent per year on average.[587] These shifts are reflected in the figure below.

Figure 33. Percent by which PREPA under- or overspent its operational budgets in FYs 2010-2012 and FYs 2014-2016, by type of expense and functional area.[588]



The changes in PREPA's spending patterns are particularly notable with regards to labor spending. PREPA has been upfront about the fact that it is seeking to trim its labor force for the sake of greater efficiency.[589] However, we note that while these efforts would go some

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[584] *Id.* Note that the figures we presented above show for PREPA's actual spending rather than its budgeted spending. However, spending cutbacks are reflected in PREPA's budgets as well: the customer service, T&D, and generation budgets were cut by three, six, and twenty-five percent respectively in nominal terms from FY2010 to FY2016.

[585] *Id.*; averages cover FYs 2014 through 2016.

[586] *Id.*

[587] *Id.*

[588] *Id.*; author's calculation.

[589] As discussed further by Commission advisors Ralph Smith and Mark Dady.

way to explaining decreases in PREPA's budgeted labor spending, it is not clear how they relate to the deviation between PREPA's budgets and its actual expenditures. We are concerned by the possibility that this pattern indicates that either PREPA's budgets do not reflect its actual plans or that PREPA has been unable to retain desired employees over the past several years.

2. PREPA described its own budget formation process as one based on principles of austerity

The declines in PREPA's operational budget over time are concerning, but not surprising given PREPA's constrained financial situation and the manner in which it prepares its budgets. We emphasize here that the conceptual basis of the revenue requirement is that it represents *all* of the revenue needed by the utility to operate a safe and reliable electric system. Full return of a vertically-integrated utility's prudently-incurred costs is one of the basic premises of utility operations. However, as is well-known by the participants in this proceeding, PREPA's revenues have been insufficient to cover its costs for some time.

Perhaps as a result of situation, PREPA has adopted an attitude of austerity towards its own spending. When asked whether or not PREPA had historically capped its operational budgets in the same manner as its capital budgets,[590] PREPA responded that "of course," it had.[591] PREPA's Director of Finance proceeded to explain that PREPA's policy is to cap its' departments' operational budgets at the lower of the previous years' budget or actual spending, unless department heads make a compelling case for an increase in budget and present evidence that the increase is in line with PREPA's organizational goals.[592]

On the same call, PREPA claimed that this years' process of setting operational budgets differed somewhat from the past due and that budget caps for FY2017 were set to agree with "the revenue requirement." The intended meaning behind this statement is not clear, given that the FY2017 operational budget is based on the (restricted) FY2016 operational actual spending as discussed above. We are confident, however, that this statement does not imply that the FY2017 operational budget is in fact sufficient to cover PREPA's actual needs for the operation of a safe and reliable system.

3. Increases in Administrative and General spending

In stark contrast to the austerity described above, we noted above that PREPA's spending on Administrative and General operations has actually *increased* over the past several years, even as spending on its core generation and T&D operations has cratered. We investigated the source of this increase and found it to originate entirely due to additional non-labor

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[590] That is, at a level that has no *a priori* relationship to its actual needs

[591] October 20 Conference Call, 4:03:00.

[592] *Id.*, 4:06:00.

spending on the part of the A&G functional area. As mentioned above, PREPA's non-labor A&G spending has increased by approximately $50 million since FY2010.[593]

Concerningly, the bulk of this increase in spending is in an area described as "Gen Misc Exp Controlled by Resp."[594] We interpret this heading as "General Miscellaneous Expenses Controlled by Responsibility." PREPA's A&G spending in this area has increased from approximately $80 million in FY2010 to $122 million in FY2015 and a staggering $134 million in FY2016. In other words, PREPA's spending last year on miscellaneous A&G-related expenses was more than its *entire proposed budget for generation expenses* in FY2017. It is difficult for us to overstate how concerning this is. Moreover, we have absolutely no further information about what, exactly, PREPA spent these funds on, although we can make inferences. A separate discovery response indicates that they were likely spent by the "Corporate Responsibilities" directorate[595] but we do not find this to be particularly informative as to the nature of the expenses. We recommend that the Commission ask for more documentation from PREPA on this matter and require PREPA to justify these expenditures.

4. PREPA has explicitly stated that staff and budget restrictions have led to declines in safety and reliability

As we clearly establish in SECTION above, the reliability of PREPA's generation unit and transmission and distribution infrastructure has palpably declined as PREPA has cut back on its operational spending. PREPA itself has made a number of explicit statements acknowledging the effects of these cuts. In particular, PREPA's reduced staffing levels appear to be leading to severe consequences for system safety, reliability, and operability. For example, with regards to the "deteriorated" state of its transmission and distribution infrastructure, PREPA says:

> Due to the lack of adequate qualified personnel, the Distribution, like the Transmission System is deteriorated both from a structural/mechanical perspective and from an electrical perspective… This deterioration is the cause of continuous interruptions, no matter of weather conditions.[596]

In addition, PREPA cites that:

> …the lack of transportation or special equipment and the nonavailability of qualified human resources, are the major reasons that lead to long service

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[593] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xslx.

[594] CEPR-AH-06-13 Attach 01.xslx.

[595] CEPR-JF-01-24_Attach 05.xlsx. All spending in "Gen misc exp controlled by resp" expenses occurred under the directorate labeled "A14 - Responsabilidades Corporativas".

[596] CEPR-AH-02-01(e).

> interruptions (affecting SAIDI, SAIFI & CAIDI indexes) and impacted reliability.[597]

Finally, PREPA states baldly that:

> …the effects of T&D work force reduction (~22% from Jan 2014 to Jul 2016) have been significant on transmission and distribution system maintenance. These effects have been exacerbated by a shortage of funds necessary to execute a well-planned preventative maintenance program. One direct effect of the work force reduction has been the reassignment of multiple construction crews to focus on reactive maintenance instead of preventative maintenance and new construction…these effects have led to the steady decline in transmission and distribution system maintenance and performance across key performance indicators including CAIDI since 2014.[598]

We note here that the year identified by PREPA, 2014, is the same year we identified above as the turning point in spending patterns.

On a similar note, PREPA says the following with respect to the impact of reduced operational spending on its generation units:

> The effect of generation work force reduction (~23% from Jan 2014 to Jul 2016) on generation maintenance has been significant particularly when combined with shortage of funds to use third party labor to perform maintenance activities. The workforce reduction has affected not only the resources that performed maintenance planning/monitoring but also those that executed the maintenance. This resulted in a migration from preventive focused maintenance to a more basic/corrective focused maintenance to maintain units operating with limited resources and funding. That combined with the departure of critical operational experience from the power plants (not just in maintenance) increases the severity of the problem. Preventive maintenance in older units like PREPA's is particularly critical and if relaxed over a period of time leads to increased frequency and duration of forced outage events as have been noticed in recent times.[599]

As demonstrated above, we can confirm PREPA's assertion that forced outage events have occurred at increasing rates in the past two years. PREPA itself also cited "Loss of a

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[597] CEPR-AH-02-01(g).

[598] PREPA's response to CEPR-RS-03-03 of the Commission's Sixth ROI (August 22, 2016).

[599] *Id.*

significant number of experienced personnel," "insufficient staff to perform all the necessary maintenance work," and "deferments on paying vendor lead to delay in receiving materials" as key causes of its forced outages in an internal presentation.[600]

We note this presentation in particular as it was provided to the Commission only in discovery and not as a direct justification for PREPA's revenue requirement. One might easily interpret the quotes above as an attempt on PREPA's part to justify higher costs than it actually needs to operate a safe and reliable system. We do not believe this to be an accurate interpretation, for several reasons. First, PREPA's rates of forced outages and system interruptions have undeniably risen in the recent past—this is not a fiction or a misrepresentation on PREPA's part. Second, PREPA's proposed operational budget is not in fact substantially higher than the budgets of the recent past; in fact, it is substantially lower in some areas. Finally, PREPA would have no reason to dissemble on this topic in an internal presentation focused on analyzing its own forced outages and the causes of these outages. Explicitly, we do not believe that PREPA is misrepresenting the direness of its situation or the impacts of its reduced operational spending thereon in an attempt to artificially inflate the revenue requirement.

5. Implications for benchmarking study

As part of its filing, PREPA witness Larry Kaufmann presented the results of a study comparing PREPA's operational expenses (less fuel and purchased power spending) to those of several "peer" utilities. Dr. Kaufmann used this study to conclude the following:

> Overall, these findings lead me to conclude that PREPA's expenses are not being artificially inflated because of inefficient operations or excessive wage payments to PREPA employees. The evidence suggests that PREP A's internal cost management is not the primary factor in PREPA's financial difficulties. The PREPA figures, however, likely reflect downward pressures on spending due to its financial difficulties.[601]

In light of the above, we find this study to be completely immaterial to the task facing the Commission: deciding whether or not PREPA's revenue requirement and accompanying rates are just and reasonable, and whether or not they are sufficient but not excessive for the purposes of operating a safe and reliable electric system.

Dr. Kaufmann's analysis, based on data from years 2008 through 2014, is predicated on the assumption that PREPA's operational costs in these years are in fact fully representative of PREPA's needs for the operation of a safe and reliable system. Dr. Kaufmann's own statement

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[600] PREPA's response to CEPR-JF-01-16 of the Commission's Sixth ROI (PUBLIC; August 23, 2016). Refer to CEPR-JF-01-16 Attach 01 (PUBLIC).pdf

[601] PREPA's Petition for Rate Review, Exhibit 6.0, Direct Testimony of Larry Kaufmann, lines 532-536.

above, that PREPA's operational costs "likely reflect downward pressure on spending,"[602] contradict this baseline assumption. The many statements we quoted in the section above also belie Dr. Kaufmann's premise. Even if we assume that PREPA's spending through 2014 was *fully* sufficient for its needs (an assertion of which we have some doubt), it is clearly the case that PREPA's costs over the past two years and as presented in this rate case are not representative of the level of spending commensurate with operation of a safe and reliable system.

Moreover, it is simply not useful to compare PREPA's costs to those of other utilities when those other utilities manage to spend comparable amounts to PREPA and yet operate significantly more reliable systems, with superior reliability indices and lower forced outage rates. For example, Duke Florida—one of the "peer" utilities identified by Dr. Kaufmann[603]—reports an adjusted SAIDI goal of approximately 80 minutes per year for 2015.[604] PREPA's SAIDI in 2013 (a year comfortably within Dr. Kaufmann's period of analysis) was, on average, 51 minutes *per month.*[605] In other words, PREPA's system is approximately eight times less reliable (based on this metric alone) than Duke Florida's.

Due to the austerity built into PREPA's budgeting process, the Commission cannot be confident that PREPA's past spending or current revenue requirement represent the full amount that PREPA would require to maintain its system in as safe and reliable a state as practicable. Similarly, PREPA has never presented this Commission with an estimate of what PREPA's costs would be were it to improve its system to the point of having similar reliability to the mainland peer utilities discussed by Dr. Kaufmann. As such, we cannot consider this study to be of use and recommend that the Commission disregard it.

E. Calculation of adjustments to PREPA's operating budget

In light of the weight of evidence presented above, we found it useful to compare PREPA's operational labor and non-labor budgets to its average spending in the years in which its system was maintained in a passable (if not excellent) state of repair.[606] In doing so, we have arrived at several recommended adjustments that we assert will bring PREPA's operational budgets more in line with historical patterns and closer to what PREPA requires to run as

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[602] *Id.*, line 536.

[603] *Id.*, line 191.

[604] See Reliability Trends, Chapter III.B.1, Page 35 above.

[605] Author's calculation (simple average of values assumed to be monthly), based on values provided in PREPA's response to CEPR-MC-01-11 of the Commission's Fourteenth ROI (November 4, 2016). Refer to CEPR-MC-01-011 Attach 01.pdf.

[606] We base this statement on the unit availability analysis presented above and the statement from PREPA's external Consulting Engineers that its system was in "good repair and sound operating condition" as of the end of FY2013. Schedule I-1, Executive Summary p3.

safe and reliable a system as it ran in FY2014 and years prior. As mentioned above, our analysis here focuses on PREPA's budget before performance improvement savings are taken into account. We do not recommend any specific adjustments to PREPA's assumed performance savings.

We summarize our adjustments, and the methodology we used to arrive at them, below.

1. Reallocation of budgets based on expected labor and non-labor proportions of spending by area

As discussed above, we have observed that the percentages of PREPA's labor spending that fall under each functional area have historically been very different from the percentages of non-labor spending for which each functional area is responsible. Our first step in calculating an adjusted FY2017 operational budget was to reallocate the total labor and non-labor budgets proposed by PREPA to better realign them with this observation.

Our adjustment is based on the average percentages of labor and non-labor spending accounted for by each functional area for the period FY2010-FY2014. We chose this interval as it incorporates the largest amount of historical data available to us before the point at which PREPA's spending patterns shifted due to its financial constraints. Moreover, we observed that the breakdown of PREPA's labor and non-labor spending by functional area was fairly consistent during these years. The figures below show historical percentages of labor and non-labor spending by functional area, the FY2010-FY2014 averages we used to for budget reallocation purposes, and PREPA's proposed FY2017 allocation factors. We believe that our proposed reallocation factors more closely match PREPA's actual historical spending patterns during years in which it was running a nominally functional system, especially in the area of non-labor spending.

Figure 34. Percentage of labor spending by functional area, with proposed allocation factors.[607]

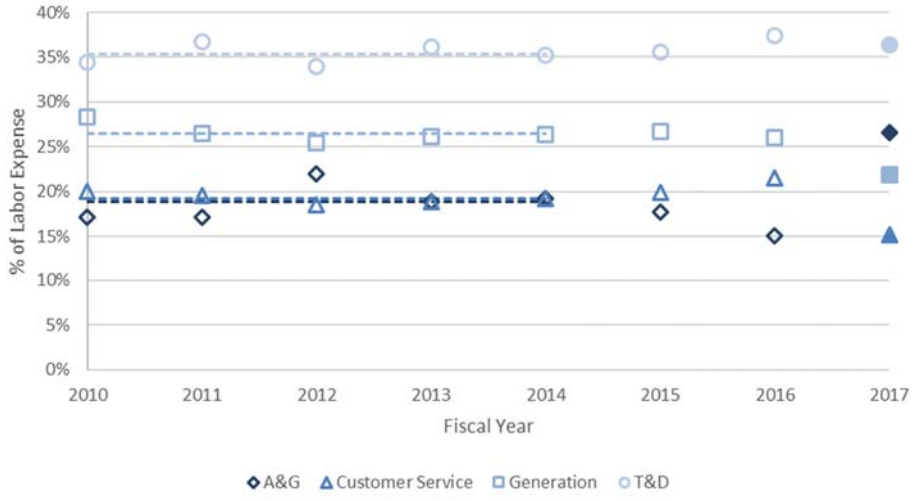
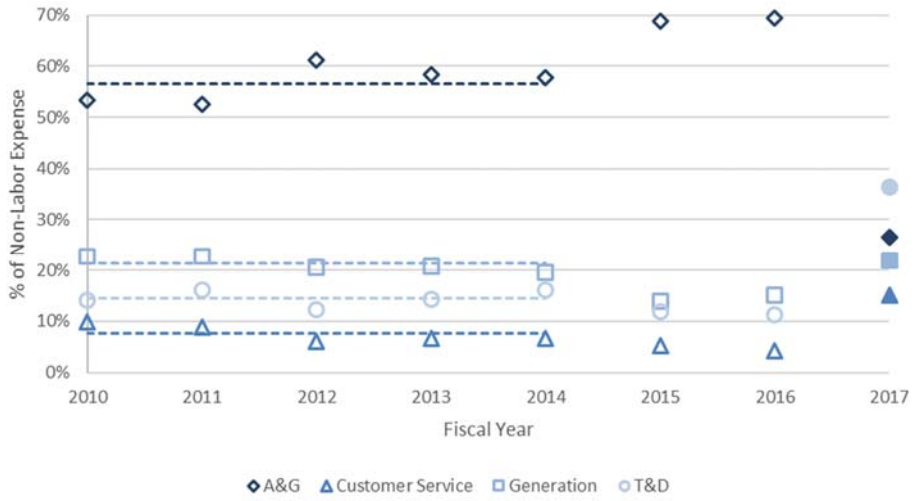


Figure 35. Percentage of non-labor spending by functional area, with proposed allocation factors[608]



[607] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xslx. Open symbols show historical values; closed symbols show PREPA's proposed allocation factors for the FY2017 revenue requirement; dashed lines show FY2010-FY2014 average percentages, as used for our reallocation analysis.

[608] Author's calculation based on values provided in CEPR-AH-06-13 Attach 01.xslx. Open symbols show historical values; closed symbols show PREPA's proposed allocation factors for the FY2017 revenue requirement; dashed lines show FY2010-FY2014 average percentages, as used for our reallocation analysis.

We observe that PREPA's proposed allocation factors are likely to be misleading if PREPA's actual spending on labor and non-labor expenses comports with historical patterns. In particular, PREPA's allocation likely overstates A&G labor expenses but vastly understates A&G non-labor expenses, while overstating non-labor spending in all other functional areas. PREPA's method also likely gives short shrift to generation-related labor expenses.

We describe our reallocations of PREPA's labor and non-labor expense budgets, based on FY2010-FY2014 average allocations, below. We emphasize here that these reallocations are not reflective of what we think PREPA *should* be spending on each functional area, based on a bottom-up evaluation of PREPA's actual needs. Rather, we present here our expectation of what PREPA would spend by functional area in FY2017 if its operational spending pattern conformed to historical trends.

a. Labor

We calculated a reallocated labor budget by multiplying our proposed reallocation factors by PREPA's total labor, as presented in the financial model. We also compared these values to an assumed labor budget by functional area, which we calculated using the allocation factors proposed by PREPA, to determine the adjustments (*i.e.*, additions or subtractions to PREPA's proposed budgets) indicated by our reallocation.

The table below shows a breakdown of labor spending by functional area using PREPA's allocation factors, a reallocated breakdown using our proposed allocation factors, and the adjustments that proceed from this reallocation.

Table 32. Reallocation of PREPA's FY2017 operational labor expense budget.

Functional Area	PREPA Allocation Factors*	Assumed FY2017 Labor Expense Allocation**	Reallocation Factors†	Reallocated FY2017 Labor Expense	Adjustment (Rounded)
A&G	27%	$115,697,810	19%	$82,180,802	-$33,517,000
Customer Service	15%	$66,001,814	19%	$83,777,704	$17,776,000
Generation	22%	$95,116,552	27%	$115,430,151	$20,314,000
T&D	36%	$158,121,645	35%	$153,549,163	-$4,572,000
Total	100%	$434,937,821	100%	$434,937,821	-

*PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 488-493, headed "FY2014 Allocation."
**Product of PREPA allocation factors and total FY2017 labor budget, PREPA Ex. 14.02.xslm, "Inputs" tab, line 60.
†Author's calculation, based on values provided in CEPR-AH-06-13 Attach 01.xlsx. Average percentage by functional area of total labor spending for years FY2010-FY2014.

As expected, this adjustment removes a significant amount of the funds assumed to be allocated to the A&G area for labor expenses and reallocates these funds to the generation and customer service areas. This reallocation also adjusts T&D labor expenses downwards slightly.

b. Non-Labor

While PREPA had labor expenses in every functional area since FY2010, the set of categories in which it expects to spend non-labor operational funds has expanded somewhat over time. In particular, there are two categories of spending in PREPA's non-labor operational budget that are new since FY2014: "Restructuring Fees" and "Additional Safety Upgrades." PREPA's budget for Restructuring Fees consists primarily of its payments to its restructuring consultant, AlixPartners, and other advisors in the restructuring process.[609] PREPA first engaged AlixPartners in FY2015.[610] PREPA's budget for Additional Safety Upgrades covers a number of safety initiatives that were identified by PREPA's consultant DuPont as a result of DuPont's audit of PREPA's safety record and practices.[611] Additional Safety Upgrades is a new category for FY2017, as indicated in the financial model.[612]

In order to perform a fair, apples-to-apples comparison of PREPA's non-labor operational budget with historical values from FYs 2010 through 2014, we first subtracted the funds in these two categories. This allows us to compare PREPA's planned versus historical spending over the same set of spending categories. The total amount of planned spending in the two new categories is $32,432,500,[613] leaving a total legacy-category non-labor operational budget of $195,131,755. Our reallocation of this budget sub-total according to the average FY2010-FY2014 allocation of non-labor operational spending is shown in the table below.

Table 33. Reallocation of PREPA's FY2017 operational non-labor expense budget.

Functional Area	PREPA Allocation Factors*	Assumed FY2017 Non-Labor Expense Allocation**	Reallocation Factors†	Reallocated FY2017 Non-Labor Expense	Rounded Adjustment
A&G	27%	$51,906,998	57%	$110,462,390	$58,555,000
Customer Service	15%	$29,611,244	8%	$14,836,592	-$14,775,000
Generation	22%	$42,673,364	21%	$41,468,897	-$1,204,000
T&D	36%	$70,940,150	15%	$28,363,877	-$42,576,000
Total (legacy)	100%	$195,131,755	100%	$195,131,755	0

*PREPA Ex. 14.02.xlsm, "RF_Schedules" tab, lines 488-493, headed "FY2014 Allocation."

**Product of PREPA allocation factors and FY2017 non-labor budget (PREPA Ex. 14.02.xslm, "Inputs" tab, line 79) less budgets for Restructuring Fees and Additional Safety Upgrades (*Id.*, lines 69 and 73).

†Author's calculation, based on values provided in CEPR-AH-06-13 Attach 01.xlsx. Average percentage by functional area of total non-labor spending for years FY2010-FY2014.

As expected from FIGURE, the impact of this reallocation is primarily to shift funds to the A&G area from all other functional areas. We repeat here the recommendation that the

609 PREPA's response to CEPR-RS-07-11(b) of the Commission's Sixteenth ROI (November 4, 2016).

610 PREPA entered into a professional services agreement with AlixPartners on September 15, 2014, according to its fifth contract amendment: http://www.aeepr.com/Documentos/Ley57/CONTRATOS%20GENERAL/2015-P00036E%20Alixpartners.pdf.

611 Schedule F-4, IV(C).

612 PREPA Ex. 14.02.xlsm, "Inputs" tab, line 69.

613 *Id.*, sum of lines 69 and 73.

Commission investigate PREPA's non-labor administrative and general spending, potentially as part of its pending investigation on PREPA's performance.

2. Corrective adjustments

The reallocation of PREPA's operational budget we performed allows for greater comparability between PREPA's FY2017 budget levels and its actual past spending. We used historical values to benchmark the reallocated budgets and as indicators (by inspection) of a need for corrective adjustments.[614] Our aim with these adjustments are to bring PREPA's generation- and T&D-related operational spending more in line with what it appeared to actually require to operate a nominally safe and reliable system, as it did in the period between FY2010 and FY2014. We balance this aim with a desire to avoid unduly increasing PREPA's revenue requirement.

a. Labor

Our benchmarking of PREPA's FY2017 labor budgets is summarized below.

Table 34. Benchmarking and correction of PREPA's FY2017 operational labor expense budget.

Functional Area	Reallocated FY2017 Labor Expense	Benchmarking Value	Difference from Benchmarking Value	Corrective Adjustment	Corrected FY2017 Labor Expense
A&G	$82,180,802	$65,124,014*	$17,056,788	-$17,057,000	$65,123,802
Customer Service	$83,777,704	$87,184,112*	-$3,406,408	0	$83,777,704
Generation	$115,430,151	$144,469,557**	-$29,039,405	$9,680,000	$125,110,151
T&D	$153,549,163	$192,438,980**	-$38,889,816	$19,445,000	$172,994,163
Total	$434,937,821	-	-	$12,068,000	$447,005,821

*Minimum spending level in years FY2010-FY2016, as based on values provided in CEPR-AH-06-13 Attach 01.xslx.
**Average of FY2010-FY2014 spending levels, as based on values provided in CEPR-AH-06-13 Attach 01.xslx.

We used average spending on generation and T&D labor expenses in years FY2010-FY2014 to benchmark our estimates of PREPA's FY2017 anticipated spending levels. This comparison reveals that PREPA's FY2017 budgets are significantly below its actual spending in prior years. Generation labor expenses are approximately $29 million below their historical levels, while T&D labor expenses are almost $39 million short compared to past spending. In light of our observations above regarding the impact of reduced spending on labor in these areas, we recommend increases to the labor budgets for generation and T&D.

Our recommended corrective adjustment for generation-related labor spending is one third of the shortfall between the FY2017 value and the historical average. Our recommended corrective adjustment for T&D-related labor spending is half the shortfall between the FY2017 value. Both values were rounded to the nearest thousand to avoid false precision.

[614] As mentioned above, all calculations, comparisons, and benchmarking are performed without correcting historical values for inflation.

We set these values on the basis of our judgment as they reduce the deviation between PREPA's FY2017 budgets and historical spending levels to approximately $20 million in each area, which we believe to be an appropriate compromise level given PREPA's constrained financial environment.

We chose to benchmark PREPA's A&G and Customer Service labor budgets to PREPA's minimum spending levels on these expenses in the period covered by historical records in our possession (FY2010 through FY2016). We benchmarked these values differently as we have seen no evidence that labor shortages in A&G or customer service have negatively impacted the safety or reliability of PREPA's system and therefore believe it is appropriate for PREPA to restrict spending in these areas considering its financial position. The FY2017 customer service labor allocation is already slightly below the benchmarked value (which corresponds to PREPA's spending on customer service labor expenses in FY2015[615]) and we therefore suggest no further adjustment to this value. The FY2017 A&G labor budget, by contrast, is approximately $17 million above the benchmarking value of FY2016 actual spending. We recommend that this budget be reduced to last year's actual spending level. This cut is not a matter of austerity per se; rather, we have seen no indication that a $17 million increase in PREPA's spending on its administration will increase the safety and reliability of PREPA's system in any way, and safety and reliability must be PREPA's first priorities.

b. Non-Labor

We performed a similar benchmarking analysis on PREPA's non-labor budgets in legacy categories. However, because we infer that PREPA has less direct control over its non-labor costs than over its labor costs, we benchmarked all categories to PREPA's average spending in FYs 2010 through 2014.[616] We tabulate the results below.

[615] CEPR-AH-06-13 Attach 01.xslx.

[616] This results in a more generous benchmarking for A&G and customer service non-labor expenses than for labor expenses in those areas. The FY2017 non-labor budget for A&G is approximately $6 million above PREPA's minimum spending on those expenses in the past several FYs (which occurred in FY2011), and the non-labor budget for customer service is approximately $4.8 million PREPA's minimum spending in that area (which occurred in FY2015). Author's calculation, based on values in CEPR-AH-06-13 Attach 01.xslx.

Table 35. Benchmarking and correction of PREPA's FY2017 operational non-labor expense budget.

Functional Area	Reallocated FY2017 Non-Labor Expense	Benchmarking Value*	Difference from Benchmarking Value	Corrective Adjustment	Corrected FY2017 Labor Expense
A&G	$110,462,390	$123,012,301	-$12,549,911	0	$110,462,390
Customer Service	$14,836,592	$16,328,449	-$1,491,858	0	$14,836,592
Generation	$41,468,897	$45,963,710	-$4,494,814	$4,495,000	$45,963,897
T&D	$28,363,877	$31,214,509	-$2,850,633	$2,851,000	$31,214,877
Total (legacy)	$195,131,755	-	-	$7,346,000	$202,477,755

*Average of FY2010-FY2014 spending levels, as based on values provided in CEPR-AH-06-13 Attach 01.xslx.

We observe that every functional area has a shortfall as compared to PREPA's historical spending levels. However, as above, we prioritize additions to the generation and T&D budgets. Because the non-labor operational budget is much smaller than the labor budget, correcting the entire budget shortfalls in these areas has a relatively small impact on PREPA's overall revenue requirement. Therefore, we recommend additions in the total amount of the deviations between PREPA's FY2017 budgets and historical actual non-labor spending on generation and T&D expenses—$4.495 and $2.851 million, respectively. We recommend no changes to the customer service and A&G non-labor budgets.

3. Other adjustments to PREPA's non-labor expenses budget

Apart from a reallocation and correction of PREPA's FY2017 operational budget to better match historical spending patterns from years in which PREPA's system was in a state of relatively good repair, we make two other sets of adjustments to PREPA's non-labor operational expense budget. The first set of adjustments adds back in planned spending on non-labor categories that did not exist in FY2014 or before. The second set of adjustments adds in the value of several maintenance contracts that PREPA appears to have improperly categorized as capital expenses. We present here a table summarizing these adjustments, with descriptions below.

Table 36. Other adjustments to PREPA's FY2017 non-labor operational expense budget.

Functional Area	Corrected FY2017 Non-Labor Expense	Assignment of New Non-Labor Expenses*	Recategorization of Maintenance Contracts**	Adjusted FY2017 Non-Labor Expense
A&G	$110,462,390	$28,000,000		$138,462,390
Customer Service	$14,836,592			$14,836,592
Generation	$45,963,897	$2,216,250	$16,000,000	$64,180,147
T&D	$31,214,877	$2,216,250		$33,431,127
Total	$202,477,755	$32,432,500		$250,910,255

*PREPA Ex. 14.02.xslm, "Inputs" tab, lines 69 and 73.
**Schedule F-3 REV, PIDs 15880, 16945, and 16946.

a. Assignment of non-labor spending in categories that are new since the test year

In order to complete our adjustments of PREPA's FY2017 non-labor operational budget, we were faced with the necessity of making an assumption regarding the appropriate allocation of PREPA's planned spending in categories that are new since FY2014. As discussed above, these categories are "Restructuring Fees" and "Additional Safety Upgrades."[617]

With regards to the "Additional Safety Upgrades" category, we consulted the safety assessment presentation prepared by DuPont.[618] This presentation describes necessary safety improvements both at PREPA's generating units and during its transmission and distribution maintenance activities. Therefore, we made a simple assumption that spending in this category would fall evenly between the generation and T&D functional areas.

We assumed that the entirety of PREPA's spending on restructuring fees is the responsibility of its administrative and general area.

b. Recategorization of maintenance contracts

As described in SECTIONS above, we have identified several line items that PREPA categorized as capital expenses but that we believe should actually be considered operational expenses. These line items are PREPA's planned spending on contracts for routine maintenance at its San Juan and Cambalache units.[619] We have recategorized these contracts as generation-related non-labor expenses and added them into the FY2017 budget estimate accordingly.

4. Separation of transmission and distribution budgets

PREPA's historical records group transmission and distribution into one functional area, but PREPA's filing treats these areas as separate. Therefore, it was necessary for us to perform the calculations above in terms of T&D collectively and then separate out transmission and distribution budgets individually in order to match the form of PREPA's filing. An analysis of historical values broken down into transmission and distribution labor and non-labor spending from a variety of sources[620] shows that transmission spending has historically accounted for approximately 17 percent of both labor and non-labor spending (with distribution spending accounting for the remaining 83 percent). We used separate average values for labor and non-labor spending (to allow greater precision than an assumed integer percentage value) to allocate total T&D labor and non-labor budgets into transmission and distribution expenses separately. We summarize these allocations in the table below.

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[617] PREPA Ex. 14.02.xlsm, "Inputs" tab, lines 69 and 73.

[618] PREPA's response to CEPR-TW-01-09 of the Commission's Tenth ROI (October 5, 2016). Refer to CEPR-TW-01-09 Attach 01.pdf.

[619] PREPA's Petition for Rate Review, Schedule F-3 REV, PIDs 15880, 16945, and 16946.

[620] Schedule I-1 Appendix III; Schedule E-6 REV; CEPR-AH-02-08(b); CEPR-AH-02-09(b).

Table 37. Allocation of T&D operational budget into transmission and distribution budgets.

Functional Area	PREPA Assumed Pre-Savings Operational Expense Budget	Labor %*	Labor Adjusted Budget	Non-Labor %**	Non-Labor Adjusted Budget	Total Adjusted Budget†
T&D total	$240,852,630	100%	$172,994,163	100%	$33,431,127	$206,425,630
Transmission	$40,503,828	17.1%	$29,622,092	16.8%	$5,615,067	$35,236,828
Distribution	$200,348,802	82.9%	$143,372,071	83.2%	$27,816,059	$171,187,802

*Author's calculation, based on values provided in CEPR-AH-02-08(b).
**Author's calculation, based on values provided in CEPR-AH-02-09(b).
†Total budgets based on rounded total adjustment values.

5. Summary of adjustments

The following table summarizes PREPA's pre-savings operational budgets by functional area as implied originally in the financial model, the sum total of the adjustments described above, and our final recommended operational budgets by functional area. Adjustments and recommended budgets have been rounded to the nearest thousand.

Table 38. Summary of FY2017 operational budget adjustments.

Functional Area	PREPA Assumed Pre-Savings Operational Expense Budget	Total Rounded Adjustment	Recommended FY2017 Operational Expense Budget
A&G	$176,232,177	$27,354,000	$203,586,177
Customer Service	$100,534,690	-$1,920,000	$98,614,690
Generation	$144,882,579	$44,408,000	$189,290,579
Transmission	$40,503,828	-$5,267,000	$35,236,828
Distribution	$200,348,802	-$29,161,000	$171,187,802
Total	$662,502,076	$35,414,000	$697,916,076

Although increased from PREPA's proposal, our adjusted budget remains $63.7 million below PREPA's average operational spending in FY2010-FY2014.[621] Our adjustments result in significant increases in generation expenses as well as A&G expenses (largely due to the reallocation of non-labor spending into the A&G area). PREPA's allocation of 36 percent of total operational spending to T&D was, in our observation, unprecedented in recent history. As such, our reallocation (being based on historical values) results in cuts to the transmission and distribution expense budgets as compared to the values presented by PREPA. However, given the *ad hoc* nature of PREPA's original breakdown, we are not concerned by this result.

We note here explicitly that we do not endorse this methodology for PREPA's future budgeting practices. As with our fuel adjustment, these calculations are meant to provide a back-of-the-envelope calculation of what reasonable spending levels at PREPA should look like. In the future, the Commission should expect to see well-documented and -supported,

[621] Author's calculation, based on values provided in CEPR-AH-06-13.xlsx.

bottom-up budgets for each functional area, detailing expected plans and spending. For the purposes of this rate case, however, we believe the adjusted budgets we present here will suffice.

6. Achievability of adjusted spending

Statements from PREPA and our analysis of PREPA's underspending on operations in the past three years both suggest that even if allocated additional funds, PREPA may not be able to actually spend them in FY2017. Indeed, with regards to its base labor budget as discussed above, PREPA stated:

> It is important to note that PREPA does not believe that it will (or should) achieve a workforce of 6,694[622] by the end of FY2017. This number was projected in FY2015 when the workforce was significantly larger in size.[623]

As PREPA expects its actual employee count to be lower than the number on which its pre-savings labor budget is based, we can infer that PREPA does not believe it will actually spend its entire labor budget in FY2017. PREPA does not appear to view this as problematic—in fact, PREPA believes it is sustainable to have several hundred fewer employees than are projected in the financial model.[624] PREPA believes this because of "the significant operational improvements that have been put in place as well as the workforce efficiency gains that have been achieved over the past two fiscal years."[625]

We find this statement odd in the face of PREPA's many explicit claims that it has insufficient employees available to perform basic maintenance. While it is entirely possible that PREPA *has* achieved improved workforce efficiency, we find it impossible to deconvolute any gains in workforce efficiency from the severe cuts in staff that have allowed PREPA's forced outage and service interruption rates to rise. As we have established clearly, PREPA's system requires significant maintenance. Therefore, unlike PREPA, we do find it concerning that PREPA believes it will not have—or need—the number of employees it set forth in the financial model.

Ultimately, the Commission must judge whether or not PREPA's revenue requirement is sufficient to allow it to operate its system safely and reliably. We believe that, as stated by PREPA, its operational budget is not sufficient for these purposes. Regardless of whether or not PREPA achieves this level of spending in FY2017, the record must show what PREPA actually needs to operate its system, or the closest available estimate of that value. If PREPA

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[622] Matches value for "Headcount" in the financial model. PREPA Ex. 14.02.xlsm, "Inputs" tab, line 61.

[623] PREPA's response to CEPR-RS-07-07(b) of the Commission's Sixteenth ROI (November 10, 2016).

[624] PREPA's response to CEPR-RS-07-02(d) of the Commission's Sixteenth ROI (November 10, 2016).

[625] *Id.*

underspends its budgets, excess value will likely be returned to ratepayers through some form of reconciliation mechanism.

In light of PREPA's statements on this issue, we recommend that the Commission maintain active oversight of PREPA's budget and spending. We further recommend that these questions, regarding PREPA's plans and its actual needs, be considered in the Commission's pending investigation on PREPA's performance.

F. Recommendation

1. Addition of funds to operations budget

As described above, we recommend a series of adjustments to PREPA's operational expense budget. These adjustments result in an addition of $35,414,000 to PREPA's budget for operational expenses, of which $16 million is a recategorization of funds from PREPA's capital budget. As such, our suggested adjustments add a total of $19,414,000 to PREPA's revenue requirement.

2. Increased budget oversight

In addition to the adjustments we describe above, our analysis of PREPA's operational expense budget has emphasized the importance of increased oversight of PREPA's budgeting process and actual spending. To enable greater visibility on these matters, we recommend that the Commission require PREPA to adjust its monthly report format to list monthly and year-to-date actual spending and budgeted values by labor and non-labor expenses in the same functional areas used herein. We recommend that the Commission also require PREPA to include its total annual budgets and percent of budgets spent in the past month and year-to-date to enable easier tracking of PREPA's spend-downs of budgets.

VIII. CERTIFICATION

By filing this report, I certified that the information, facts, schedules, exhibits and analysis provided here is my direct testimony and, to the best of my knowledge, true and correct.

Jeremy I. Fisher

November 21, 2016

By filing this report, I certified that the information, facts, schedules, exhibits and analysis provided here is my direct testimony and, to the best of my knowledge, true and correct.

Ariel I. Horowitz

November 21, 2016