

# Asuntos que Requieren Atención en torno al Sistema Eléctrico de Puerto Rico, Medidas y Recomendaciones

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A continuación, presento alternativas para atender la reestructuración del sistema eléctrico de Puerto Rico. Estas propuestas se presentan con el fin de atenuar el impacto económico de la reestructuración de la deuda y proveer un marco legal a tenor con las mejores prácticas regulatorias en Estados Unidos y en el mundo desarrollado. Estas medidas, deben ser implantadas por el Gobierno de Puerto Rico, para evitar un impacto negativo mayor en la economía y para facilitar los procesos de transformación.

Dado mi experiencia de sobre 30 años en el campo de la ingeniería, como planificador, miembro de la Junta de Planificación de Puerto Rico y como director del Instituto de Competitividad y Sostenibilidad Económica, entiendo que los asuntos que requieren atención con respecto al sistema eléctrico de Puerto Rico son los siguientes:

- Transparencia
- Participación Ciudadana
- Costos del sistema eléctrico
- Poderes del Negociado de Energía
- Transformación del Sistema Eléctrico

## 1. Transparencia

Lograr un fiel cumplimiento de la Ley 159 de 2013 y leyes relacionadas a la transparencia y disponibilidad de información.

La Ley 159 establece en su Artículo 3:

“Se ordena a toda Corporación Pública del Estado Libre Asociado de Puerto Rico a transmitir vía Internet, con audio e imagen simultánea a la reunión física, todas las reuniones de sus respectivas Juntas donde se deliberen los asuntos de la Corporación Pública que no estén expresamente excluidos en esta Ley. Se velará porque el costo de la transmisión simultánea sea el menor posible, salvaguardando los requerimientos de audio e imagen de video establecidos por esta Ley.”

Las excepciones a la ley son limitadas:

“Artículo 5.- Excepciones

No será requerida la transmisión vía Internet dispuesta en el inciso (a) del Artículo 3 de esta Ley cuando:

- a) Se trate de una Reunión de Emergencia, según definida por esta Ley.
- b) Se trate una Acción Judicial, según definido por esta Ley.
- c) Se discutan asuntos relativos a procedimientos instemos de Recursos Humanos. Esta excepción será aplicable únicamente cuando se discutan asuntos de empleados particulares

e identificables, luego del procedimiento ordinario establecido de sanciones, penalidades y/o bonificaciones; y solo cuando haya un riesgo razonable de lacerar la expectativa razonable de intimidad del empleado. **No aplicará esta excepción y deberá transmitirse por Internet toda deliberación sobre una reestructuración de la Corporación Pública**, cesantías o bonificaciones a empleados en general, así como la deliberación sobre bonificaciones por concepto de productividad.

d) Se discutan asuntos protegidos por la Health Insurance Portability and Accountability Act (HIPAA), cobijados por la Regia 506 de las Reglas de las de Evidencia de 2009, según enmendadas, sobre la relación médico-paciente o por la Regla 508 de las mismas sobre la relación psicoterapeuta y paciente.

e) Se trate de un secreto comercial o de negocios conforme lo dispuesto en la Regla 513 de las Reglas de Evidencia de Puerto Rico.

f) Se discuta información sobre investigaciones internas de la Corporación Pública mientras dicha investigación no haya concluido. Esta excepción no incluirá la discusión del informe final y hallazgos de la investigación.

g) Se discuta información relacionada con las estrategias de la negociación de convenios colectivos o disputas obrero-patronales.

h) Se discutan asuntos sobre la propiedad intelectual de terceros.

i) Se discutan asuntos de seguridad publica si estos están relacionados con amenazas contra la Corporación Pública, sus bienes o sus empleados."

Le Ley también define el orden en el cual se llevarán a cabo dicho proceso:

"Artículo 6.- Orden de los asuntos

a) **En caso de que en alguna reunión se fueran a discutir asuntos cobijados por una o más de las excepciones dispuestas por esta Ley, la Junta realizara la reunión, y transmitirá la misma vía Internet, atendiendo en primera instancia los asuntos no exceptuados.** Una vez culmine la discusión de estos asuntos, la Junta procederá a notificar a viva voz que se culmina en esos momentos la transmisión para dar paso a la discusión de asuntos cobijados por el Artículo 5 de esta Ley, identificando el inciso en particular que le aplique.

Una vez termine la transmisión de la reunión no podrá discutirse asunto alguno, a menos que este cobijado por alguna de las excepciones dispuestas. **Será nula toda determinación que se tome una vez culminada la transmisión vía Internet de la reunión."**

En cuanto a la publicación de documentos de la Junta de Gobierno de la AEE, la Ley 83 de 1941 indica:

"Se publicarán, además, las actas de los trabajos de las reuniones ordinarias y extraordinarias de la Junta en el portal de Internet de la Autoridad, una vez sean aprobadas por la Junta en una reunión subsiguiente."

La información producida durante las reuniones de la Junta es pública y debe publicarse. Esto incluye, información de apoyo los temas discutidos durante las reuniones, opiniones disidentes y todo documento relacionado a dichas reuniones, los cuales deben incluirse como anejos a el acta de la reunión.

## 2. Participación Ciudadana

Se debe de enmendar la Ley 57 de 2014 para establecer procesos para la selección de comisionados del Negociado de Energía de manera independiente, con participación ciudadana.

Al menos dos (2) de los cinco (5) comisionados del Negociado de Energía de Puerto Rico deben ser elegidos de manera independiente. Esto se puede llevar a cabo mediante la directa participación de la ciudadanía o por cualquier método alternativo que envuelva participación pública.

## 3. Costos del Sistema Eléctrico

Reconozco la necesidad de una reestructuración de la deuda de la AEE, igualmente la necesidad de transformar la AEE. Los planteamientos y recomendaciones hechas son para que ambos pasos se den protegiendo al máximo la economía de Puerto Rico y a los consumidores de energía eléctrica. Se acompaña copia del estudio hecho por el Dr. Ramón Cao en torno a los efectos de los aumentos propuestos en el acuerdo de reestructuración y en el Plan Fiscal de la AEE. Entiendo que es el único estudio económico que se ha hecho sobre la reestructuración. Espero se evalúe, se reaccione al mismo y se genere un dialogo serio de altura sobre su contenido.

Como parte de esa discusión recomiendo enmiendas a la Ley 57 de 2014, Ley 4 de 2016 y Ley 17 de 2019 para integrar al Negociado de Energía en el proceso de Reestructuración de Deuda de la AEE.

Al Negociado de Energía se le debe otorgar la capacidad para poder ajustar los Cargos de Transición incluidos en el acuerdo de reestructuración (RSA) como consecuencia de variaciones en la demanda de electricidad, y determinar la forma más efectiva, en beneficio a los consumidores, para el pago de los bonos de reestructuración, una vez el tribunal determine la cantidad a ser pagada a los tenedores de bonos. La determinación de la cuantía a pagar se determina y aprueba en el tribunal. Lo que señalo es con respecto a la implantación del pago de dicha cuantía.

Actualmente la Ley 4 de 2016 lee:

“la revisión de la Comisión (ahora Negociado de Energía) de los Cargos de Transición iniciales o cualquier ajuste de los Cargos de Transición **se limitará a verificar la corrección matemática**

**del cálculo de dichos Cargos de Transición** iniciales o ajustes de los Cargos de Transición subsecuentes que resulten de la aplicación del Mecanismo de Ajuste (según sea el caso),”

El acuerdo actual supone un aumento de 64.5% de los Cargos de Transición, en un término de 24 años, manteniendo el mismo fijo luego de dicho periodo. Esto implica una disminución en la demanda en la misma proporción. Por lo tanto, dado que no es técnicamente viable calcular una demanda a un término de 24 o 40 años, y el Cargo de Transición varía en factor de la demanda, las variaciones en el Cargo de Transición por cambios en la demanda deben ser evaluados y determinados periódicamente por el Negociado de Energía.

Además, el Negociado de Energía debe de determinar la forma más efectiva, en beneficio a los consumidores, para el pago de los bonos de reestructuración, una vez el tribunal determine la cantidad a ser pagada a los tenedores de bonos. Actualmente, el RSA determina dos “Tranches” para el repago de la deuda. El “Tranche” A, por la cantidad del 67.5% del principal de la deuda, con una madurez a 40 años y un cupón de 5.25%. El “Tranche” B, por la cantidad del 10% de la deuda, con una madurez de 47 años, a un interés de 7.00% de considerarse bonos exentos y de 8.75% de considerarse no exentos; estos se comienzan a pagar después de haber pagado el “Tranche” A. La manera en que se construye el acuerdo de reestructuración puede resultar excesivamente oneroso para los consumidores. Por ejemplo, según se propone en el RSA, el recaudo anual promedio de los Cargos de Transición, para los años 2 al 5 es de \$615 millones, pero el pago anual estimado para el servicio de la deuda es de \$367.93 millones. ¿Por qué esta diferencia? Además, los intereses del “Tranche” B se capitalizan a través del tiempo, hasta que se hayan pagado los bonos del “Tranche” A. El valor inicial del principal de estos bonos puede crecer hasta convertirse en una cantidad considerable. Esto supone una forma no solo incierta, sino perjudicial para los consumidores, más allá de la cantidad a ser determinada en el tribunal a ser pagada a los tenedores de bonos. Por lo tanto, el Negociado de Energía debe de determinar la forma para el pago de los bonos de reestructuración.

#### **4. Poderes del Negociado de Energía**

Se debe de enmendar la Ley 120 de 2018, Ley para Transformar el Sistema Eléctrico de Puerto Rico.

En términos generales, la planificación del sistema eléctrico, incluyendo la aprobación de venta y /o concesión de activos de la utilidad pública, se debe desarrollar dentro de los procesos ordinarios del Negociado de Energía. La Ley 120 establece unos procesos especiales que limitan el rol del regulador, contrario a la forma que se hace en Estados Unidos.

Actualmente la Ley 120, como enmendada por la Ley 17-2019, limita el rol del Negociado de Energía a emitir un Certificado de Cumplimiento en lo relacionado todo Contrato de Alianza y Venta de Activos de la AEE. Los procesos normales del Negociado de Energía incluyen la autoridad del Negociado para otorgar o negar la aprobación. Para lograr esto, el Negociado de Energía, al igual que todo ente regulatorio, establece unos procesos para realizar su

función. La Ley 120, establece el término de para emitir el Certificado de Cumplimiento en 30 días. Esto no solamente conlleva la evaluación de proyectos específicos fuera de los procesos ordinarios, sino que impone una limitación de tiempo en la gestión del regulador. El trato especial a los contratos de alianza puede levantar suspicacia dentro del ámbito del inversionista. Por lo tanto, todo contrato con relación a la transformación de la AEE debe de ser visto dentro de los procesos ordinarios del Negociado de Energía y si necesario, proveer un término razonable para que terminen dichos procesos.

En otras palabras, toda gestión de la Autoridad para las Alianzas Público Privadas relacionada a la venta de centrales generatrices, concesión del sistema eléctrico y venta de activos de la AEE debe de formar parte de los procesos ordinarios del Negociado de Energía, como establecido en el Ley 57.


## 5. Transformación del Sistema Eléctrico

Se debe de enmendar al Reglamento para la Compra, Evaluación, Selección, Negociación y Otorgamiento de Contratos de Alianzas y Contratos de Venta para la Transformación del Sistema Eléctrico bajo la Ley 120 de 2018, con fecha de 8 de marzo de 2019. Se debe de eliminar de este reglamento referencia a:

- i. Destituir a cualquier miembro del Comité de Alianzas, a la entera y absoluta discreción (“sole and absolute discretion”) de la Autoridad. P. 9 del reglamento.
- ii. Permitir a los proponentes que no presenten toda la información solicitada por el “RFP” someter, bajo entera y absoluta discreción de la Autoridad, la información que falte. P. 17 del reglamento.
- iii. Aceptar, bajo entera y absoluta discreción de la Autoridad, propuestas que no cumplan con los requisitos establecidos (“non-compliant proposals”). P. 19 del reglamento.

Estas medidas son necesarias de manera inmediata para generar la confianza y transparencia necesaria para la adecuada culminación de la reconstrucción y transformación del sistema eléctrico de Puerto Rico.

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AN INDEPENDENT ECONOMIC EVALUATION OF THE  
DEFINITIVE RESTRUCTURING SUPPORT AGREEMENT  
FOR OUTSTANDING PREPA'S DEBT, OF PREPA FISCAL  
PLAN AND A MODEST PROPOSAL

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Table of Contents

I. Introduction ..... 3

II. Strategy for the Analysis ..... 4

III. The Proposed Debt Restructuring Agreement (RSA) ..... 4

IV. An Alternative Approach to Restructure PREPA Debt..... 6

V. Possible Increases in Electricity Tariff Rates ..... 8

VI. Economic Impacts by Major Industrial Sectors..... 14

VII. Impact on the Consumers Price Index (Inflation)..... 16

VIII. Expected impacts on production and income ..... 18

IX. Employment effects ..... 21

X. Demand for Electricity ..... 24

    Residential Demand for Electricity ..... 26

    Commercial Demand for Electricity ..... 27

    Industrial Demand for Electricity..... 29

    Total Demand for Electricity..... 31

XI. Conclusions ..... 33

Appendix A: Evaluation of the RSA ..... 36

A Preliminary Evaluation of Proposed PREPA Debt Restructuring Agreement..... 37

    Description and implications of the proposed PREPA Debt Restructuring Agreement ..... 37

    Evaluation of the outlined Alternative Debt Restructuring Agreement..... 40

Electricity Consumption.....	40
Expected consequences on general economic activity .....	41
Expected consequences over employment.....	42
Summary and conclusions .....	43
Appendix B: Puerto Rico 2013 Input/Output Matrix Condensed to Eight Sectors .....	46
Appendix C: Relevant Weights Used to Compute the Consumer Price Index.....	47
Appendix D: Regression Equation Used to Forecast GNP at constant prices .....	48
Appendix E: Demand Equation for PREPA’s Residential Customers .....	50
Appendix F: Demand Equation for PREPA’s Commercial Customers .....	52
Appendix G: Demand Equation for PREPA’s Industrial Customers.....	54
Appendix H: General Assumptions Used in Estimating Demand Equations for Electricity and Forecasting Consumption .....	56



# AN INDEPENDENT ECONOMIC EVALUATION OF THE DEFINITIVE RESTRUCTURING SUPPORT AGREEMENT FOR OUTSTANDING PREPA'S DEBT, OF PREPA FISCAL PLAN AND A MODEST PROPOSAL

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## I. Introduction

In this report it is considered that, as a principle, we should repay as much of PREPA's debt as it is possible. The question is: how much is possible without compromising future operation of the Authority? This question must be answered because it is the core for avoiding future financial and operational crisis in PREPA. Also, electric power is a necessity for consumers, as well in all production processes, i.e., it is essential for the economy to work. Then, the question of how much of the outstanding debt PREPA can afford to repay, must take into account the consequences of debt restructuration over the economy.

Both the Debt Restructuring Agreement (RSA)<sup>1</sup> and PREPA Fiscal Plan of June 2019<sup>2</sup> (Fiscal Plan) propose increases in electricity tariff rates for all PREPA's customers. Justifications for those rate increases are not only superficial and based on unjustified, and sometimes rather unrealistic assumptions, but also, they do not take into account their expected consequences on the Puerto Rican economy. This report attempts to make up for some of these limitations in RSA and the Fiscal Plan.

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<sup>1</sup> Financial Oversight and Management Board for Puerto Rico, *Definite Restructuring Support Agreement*, executed on May 3, 2019.

<sup>2</sup> *2019 Fiscal Plan for the Puerto Rico Electric Power Authority*, as certified by the Financial Oversight and Management Board for Puerto Rico on June 2019.

## II. Strategy for the Analysis

The analysis in this report begins by describing the rate increases proposed in both documents (RSA and Fiscal Plan), and proposing an alternative. Then, some economic consequences of all considered increases in rates are evaluated. The economic effects, over a five years period,<sup>3</sup> taken into account are:

1. Computation of the effects of proposed rate increases and the alternative rate increase on production costs of major industrial sectors over a five years period.
2. Expected impact of proposed rates on the inflation rate.
3. Expected economic effects of the proposals on production, and employment.
4. Expected effects on the quantity of electricity consumed or demanded.

## III. The Proposed Debt Restructuring Agreement (RSA)<sup>4</sup>

The RSA contains some key elements, which are:

1. The restructured debt is going to be issued in the form of Securitized Bonds, secured by a Transition Charge (TC) to be imposed on PREPA's electricity sales.
2. Prior to the TC, a Settlement Charge of 1.00 c/kwh was implemented. Afterwards, the TC begins at 2.768 c/kwh at the first year of validity of RSA, and it is going to be periodically increased up to 4.552 c/kwh at year 24 and thereafter. The TC can be increased up to a maximum of 25% to compensate for Contributions In Lieu of Taxes and Subsidies granted by PREPA.<sup>5</sup>
3. The TC is going to be unavoidable to all users of electricity. Since it will be charged before the meter, if a customer decides to generate his own electricity, he still will have to pay the TC.

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<sup>3</sup> The RSA is expected to occur over a 47 years period. It considers periodic increases in the RSA surcharge (defined as Transition Charge) over the years. Given the state of the sciences, it is unreasonable and unrealistic to attempt to predict consequences over a two generations period of time. In consequence the analysis in this report is limited to a 5 years span.

<sup>4</sup> For a more detailed evaluation of the RSA and of an alternative proposal, See Appendix A to this report.

<sup>5</sup> After 2019, the Settlement Charge evolves to become the RSA Transition Charge (TC) over the length of the agreement, i.e., 47 years.

4. Two kinds of bonds will be issued:

- a. Tranche A Bonds: In the amount of 67.5% of principal amount of outstanding bonds. These bonds will be tax exempt, with 40 years maturity and a 5.25% coupon.
- b. Tranche B Bonds: In the amount of 10% of principal amount of outstanding bonds. These bonds may or may not be tax exempt, with 47 years maturity and a 7.00% accretion coupon for tax exempted bonds, and 8.75% accretion coupon for non-tax exempted bonds. Tranche B Bonds will begin to be paid after Tranche A Bonds are paid in full. Also, any amounts on such Tranche B Bonds not paid with Transition Charge Revenues imposed prior to the stated final maturity of the Tranche B Bonds shall not be recoverable by Bondholders.<sup>6</sup>

It should be noted that there is no rationale to justify Tranche A and Tranche B principal ratios to outstanding debt. Indeed, the resulting Debt to Total Assets of PREPA, after restructuring the debt is much higher than the corresponding ratios shown by electric power companies in almost all jurisdictions in the US.<sup>7</sup>

As previously mentioned, the proposed RSA establishes that PREPA's restructured debt will be securitized. This includes the implementation of a Transition Charge that will be billed to all PREPA's customers as a specific charge in their monthly bill. The proposed TC in the RSA is going to increase by 64.5% over the maturity life of the securitized bonds. This means that the RSA assumes that PREPA's annual sales (in Gwh) are going to decrease by 64.5% over time.<sup>8</sup> This assumption is totally unfounded. Nobody can forecast electricity consumption in any location over a 40 years period. In consequence, assumptions with regard to electricity demand over a 40 years period will surely result in flawed sales and income estimates. For that reason, it is much more reasonable for the Puerto Rico Energy Bureau to periodically review (every year or every two years) the amount to be imposed as TC.

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<sup>6</sup> It should be noted that, as proposed in the RSA, the interest in Tranche B Bonds is going to be accrued over time, until Tranche A Bonds are paid in full. If it is assumed that they are going to earn an average interest rate of 7.85% [7.85% is the midpoint between the proposed coupon of 7.00% for tax-exempted Tranche B Bonds and 8.75% for non-tax exempted Tranche B Bonds], then the initial principal of \$904.2 for Tranche B Bonds, will grow to become a principal of \$20,226 million (for Tranche B Bonds) by the 40<sup>th</sup> year of the RSA Tranche A Bonds.

<sup>7</sup> See American Public Power Association, *Financial and Operating Ratios of Public Utilities*, Arlington, VA, December 2018.

<sup>8</sup> It should be noted that it would be very difficult for PREPA to engage in its planned privatization of electricity generation, if the outlook is that electricity consumption is going to shrink by 64.5% over the next 40 years, as implicitly assumed in RSA.

As proposed by the RSA, average annual collections from the TC over years 2 to 5 would be \$615.40 million, but estimated annual debt service for the restructured debt is \$367.93 million.<sup>9</sup> There is no explanation for this apparent discrepancy.

#### IV. An Alternative Approach to Restructure PREPA Debt

The RSA does not explain the reasons for restructuring debt in their two kinds of securitized bonds, Tranche A and Tranche B Bonds. It neither provides an explanation for the proportion of outstanding debt to be restructured, nor for the rationality for the amount and structure of the TC. In consequence it is relevant to evaluate these issues and, if necessary, to propose a more sensible alternative.

As a starting point for this analysis, let us begin by evaluating the debt to total assets ratios shown by electric power companies in the United States.<sup>10</sup>

**Debt to Total Assets Ratios (median values)**

Power Generation Class (p.3)			
No Generation	More than 0 and less than 10%	10% to 50%	50% to 100%
0.230	0.366	0.439	0.489

**Debt to Total Assets Ratios (median value) (p.17)**

More than 100,000 Customers	0.563
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**Debt to Total Assets Ratios (median value) (p.7)**

National Average	0.321
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At present time, in its power generation category, PREPA could be considered in the range of 50% to 100% generation, were the median debt to total assets ratio (D/A ratio) is 0.489. However, PREPA is in the process of privatizing electricity generation, which implies that the utility’s goal is to generate no electricity, where the median value for the D/A ratio is 0.230. On the other hand, PREPA is in the category of companies having more than 100,000 customers, where the D/A ratio is 0.563. Given that information, it is reasonable to consider, in a conservative approach, that an affordable D/A ratio for

<sup>9</sup> Estimated using the financial formula in Excel for periodic payments of principal and interest of Tranche A Bonds over a 40 years period (life span of Tranche A Bonds) with zero residual debt.

<sup>10</sup> American Public Power Association, *Financial and Operating Ratios of Public Utilities*, Arlington, VA, December 2018.

PREPA should be 0.563, i.e., the maximum amount of debt that PREPA should pay without compromising its financial and operational position.

The latest available PREPA's Financial Statement is for the year ending June 30, 2016.<sup>11</sup> On such statements, it is stated that PREPA had total assets in the amount of \$8,291.6 million,<sup>12</sup> and that its outstanding long-term debt was \$9,118.2 million.<sup>13</sup> This implies that PREPA's D/A ratio is 1.10.<sup>14</sup> If an affordable D/A ratio of 0.563 is applied to PREPA's total assets, as previously discussed, it can be concluded that PREPA can afford to pay up to \$4,668 million in restructured debt, without compromising its finances and operations. In consequence, a sensible debt restructuring agreement should be to issue securitized bonds equivalent to 51.2% of principal amount of outstanding bonds.<sup>15</sup> These bonds, as proposed in RSA, will be tax exempt, with 40 years maturity and a 5.25% coupon. Annual debt service, under this proposal, will be in the order of \$281.4 million, and an Alternative Transition Charge (ATC) will amount to 1.91 c/kwh. Because it is impossible to predict how electricity consumption will behave over a 40 years period, the Puerto Rico Energy Bureau should periodically – i.e., every year or every two years – revise the amount of the ATC to assure compliance with the debt service. However, it should be noted that PREPA's asset values used for the computation of the ATC are based on the utility 2016 Financial Statements, which are prior to the 2017 hurricanes. Thus, the final value for restructured debt and the ATC should be calculated based on actual asset values, after the occurrence of the two 2017 hurricanes. Hence, the final values for restructured debt and the ATC would be even lower than the ones computed in this report.

Before reaching any conclusion regarding the social and institutional convenience of this report, its economic consequences should be evaluated. This is done in subsequent sections of this report, which also includes economic evaluations of expected consequences of the proposed TC in the RSA, as well as of the rate increases included in PREPA's Fiscal Plan.

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<sup>11</sup> BDO Puerto Rico, P.S.C., *PREPA Independent Auditors' Report, Independent Auditors' Financial Statements, Required Supplementary Information and Supplemental Schedules for the year ending June 30, 2016*, San Juan, PR, December 18, 2018.

<sup>12</sup> *Ibid.* p. 4. It also states that, at June 30, 2016, PREPA had fixed assets valued at \$6,574.0 million.

<sup>13</sup> *Ibid.*, p. 10.

<sup>14</sup> The D/A ratio with respect to total fixed assets is 1.387 at June 30, 2016.

<sup>15</sup> \$4,668 million (the amount of debt that PREPA could afford to pay), divided by \$9,118 million, the amount of outstanding debt as of June 30, 2016, is equal to 0.511954, or 51.2%.

## V. Possible Increases in Electricity Tariff Rates

Up to this moment, two possible increases in electricity tariff rates have been mentioned in this report at some detail: (1) the Transition Charge (TC) proposed in the RSA, and (2) an Alternative Transition Charge (ATC) discussed in the previous section of this report. However, PREPA Fiscal Plan also proposed increases in electricity tariff rates. Increases proposed in the Fiscal Plan can be grouped in two categories: (1) those based on optimistic assumptions, and (2) increases that include optimistic assumption plus some risks, that under close consideration are very likely to happen.

In the case of the ATC, tariff increment in FY2020 is 1.00 c/kwh already enacted in 2019<sup>16</sup> as RSA Settlement Charge, and from FY2021 it is 1.91 c/kwh over the forecasting period.

The TC is specified in the RSA.<sup>17</sup> The amounts established for the TC for FY 2021 to 2024 are reproduced on Table 1, which also includes the maximum Subsidy Charge, which is up to 25% of the TC.<sup>18</sup> Since the TC changes over the life of the RSA, the dollar amount for Subsidy Charge is also subject to periodic increases.

**Table 1**  
**Additional Electricity Tariff Charges from RSA (c/kwh)**

Fiscal Year	Basic Transition Charge (TC)	Subsidy Charge (25% of TC)	Total TC
FY20	1.00		<b>1.00</b>
FY21	2.77	0.69	<b>3.46</b>
FY22	2.77	0.69	<b>3.46</b>
FY23	2.77	0.69	<b>3.46</b>
FY24	2.96	0.74	<b>3.70</b>

The Fiscal Plan also includes some rate increases in electricity tariffs. These increases are supposed to be applied to all categories of customers. The Fiscal Plan considers two

<sup>16</sup> In all cases it will be assumed that the RSA Settlement Charge is in effect over fiscal year 2020. After that year, it evolves to be the RSA Transition Charge.

<sup>17</sup> RSA, Recovery Plan Term Sheet, III Transition Charge.

<sup>18</sup> RSA, Schedule I-A, pp. I-A-4 and I-A-5.

scenarios, one considered risk free, and another with some operational or administrative risks. The main differences among these scenarios are:

1. The risk-free scenario assumes that FEMA is going to fund 90% of the costs of PREPA's grid modernization. The risk scenario assumes that PREPA will only fund 45% of these costs and customers will pay the remainder.
2. Also, the risk-free scenario assumes an ideal dispatch curve for conventional fuel and purchase power. The risk scenario assumes that dispatch continues at present rates.
3. With regard to renewables PPOA, the risk-free scenario assumes a cost of new solar PPO starting in FY21 at  $\approx$  \$63/Mwh. The risk scenario assumes PREPA to be unable to procure solar power below \$100/Mwh PPOA for the period of the fiscal plan.
4. Both scenarios, No-Risk and Risk, assume a surcharge to cover for PREPA Pension Funds, estimated between 1.6 c/kwh for year 2021 and 1.7 c/kwh for year 2022 to 2024

Table 2 summarizes the rates increases proposed in the Fiscal Plan.

**Table 2**

**Additional Electricity Tariff Charges from PREPA Fiscal Plan (c/kwh)**

	Fiscal Plan: No Risks <sup>a</sup>		Fiscal Plan: Additional Risks Charges <sup>b</sup>				
Fiscal Year	PREPA Pension Fund Surcharge	<b>Total Charges: No Risks</b>	PREPA Pension Fund Surcharge	Federal Funding	Conventional Fuel & Power Purchase	Renovable Energy PPOAs	<b>Total Charges: Addition of Risks</b>
2020				0.69	1.26		1.95
2021	1.6	1.6	1.6	1.20	1.28	0.28	4.36
2022	1.6	1.6	1.6	1.74	1.12	0.58	5.04
2023	1.7	1.7	1.7	2.28	1.13	0.83	5.94
2024	1.7	1.7	1.7	2.82	1.08	0.97	6.57

<sup>a</sup>PREPA, Fiscal Plan 2019, As certified by the Financial Oversight and Management Board for Puerto Rico on June 27, 2019, p. 62.

<sup>b</sup>*Ibid.*, pp. 62 and 66.

It should be noted that PREPA's tariff rates vary among different categories of its customers. Industrial, commercial and residential customers are responsible for 98% of total electricity consumption. Thus, it is convenient to determine how tariff rates

would result under possible scenarios.<sup>19</sup> Annual expected rates, under each scenario, are computed adding additional charges corresponding to each scenario to the average tariff paid by each customer category in Fiscal Year 2019.<sup>20 21</sup> In the following pages, tables inform the resulting annual tariffs corresponding to each scenario by customers categories, and the annual per cent change with respect to average tariff paid in FY2019 by each customer category.<sup>22</sup>

<sup>19</sup> Possible scenarios considered are:

1. ATC
2. TC
3. TC + Fiscal Plan with no risks
4. TC + Fiscal Plan including risks

It must be pointed out that PREPA Fiscal Plan indicates, on page 63, indicates that:

“ PREPA’s current rate structure is composed of three primary components – Base Rate, Fuel Adjustment and Purchased Power Adjustment Charges, and CILT & Subsidy rate riders. A fourth component includes RSA settlement charges, which is still pending of approval by the Puerto Rico Energy Board.

- Three primary categories of customers make up 98% of PREPA’s revenue from electricity sales: Commercial (53%), Residential (34%) and Industrial (11%)
- PREPA approved a permanent rate structure in FY2017 and implemented it in FY2019. This new rate structure eliminated the 11% gross-up of fuel and purchased power adjustment charges, and created direct cost recovery/pass through rate riders in customer’s bills to cover Contributions in lieu of taxes (CILT) and subsidies.
- As a new O&M operator comes into place, the rate structure may potentially need to be revised from time to time to reflect changes in operating cost structure as well as incorporate developing trends in rate design.”

<sup>20</sup> Average tariff paid in Fiscal Year 2019 is computed as the 10 months average from July 2018 to April 2019, as estimated as the proportion of Total Revenues in the category to Total Consumption in the corresponding category. Data was obtained from PREPA’s *ae-meta(1) data*, May 2019.

<sup>21</sup> It should be pointed out that the Fiscal Plan, p. 62, says that average electricity tariff for all consumers in FY2019 was 18.8 c/kwh. Computations made for this report results in an average tariff of 21.99 c/kwh for the same fiscal year.

<sup>22</sup> In the next pages, electricity rates increases are considered by PREPA’s principal customers categories. Average rate increases for all customers are presented in the table below, where the average electricity rate paid in FY 2019 was 21.99 c/kwh.

**Table A-1**  
**Required Electricity Tariff Rates Under Different Scenarios**  
**All Customers Average: c/kwh**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA+ Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	22.99	22.99	22.99	24.94
FY21	23.98	25.45	27.05	29.81
FY22	23.98	25.45	27.05	30.49
FY23	23.98	25.45	27.15	31.39
FY24	23.98	25.69	27.39	32.26



Average electricity tariff rate paid by industrial customers in FY2019 = 19.56 c/kwh

**Table 3**  
**Required Electricity Tariff Rates Under Different Scenarios**  
**Industrial Customers: c/kwh**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	20.56	20.56	20.56	22.51
FY21	21.47	23.02	24.62	27.38
FY22	21.47	23.02	24.62	28.06
FY23	21.47	23.02	24.72	28.96
FY24	21.47	23.26	24.96	29.83

**Table 4**  
**Change in Electricity Tariff Rates Under Different Scenarios**  
**Industrial Customers (%)**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	5.11%	5.11%	5.11%	15.08%
FY21	9.76%	17.69%	25.87%	39.98%
FY22	9.76%	17.69%	25.87%	43.46%
FY23	9.76%	17.69%	26.38%	48.06%
FY24	9.76%	18.90%	27.59%	52.49%

And the rates increases for all customers, in the four scenarios, are estimated to be as follows:

**Table A-2**  
**Change in Electricity Tariff Rates Under Different Scenarios**  
**All Customers Average (%)**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA+ Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	4.55%	4.55%	4.55%	13.42%
FY21	9.05%	15.73%	23.01%	35.56%
FY22	9.05%	15.73%	23.01%	38.65%
FY23	9.05%	15.73%	23.47%	42.75%
FY24	9.05%	16.81%	24.54%	46.69%

Average electricity tariff rate paid by commercial customers in FY2019 = 22.83 c/kwh

**Table 5**  
**Required Electricity Tariff Rates Under Different Scenarios**  
**Commercial Customers: c/kwh**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	23.83	23.83	23.83	25.78
FY21	24.74	26.29	27.89	30.65
FY22	24.74	26.29	27.89	31.33
FY23	24.74	26.29	27.99	32.23
FY24	24.74	26.53	28.23	33.10

**Table 6**  
**Change in Electricity Tariff Rates Under Different Scenarios**  
**Commercial Customers (%)**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	4.37%	4.38%	4.38%	12.92%
FY21	8.37%	15.16%	22.16%	34.25%
FY22	8.37%	15.16%	22.16%	37.23%
FY23	8.37%	15.16%	22.60%	41.17%
FY24	8.37%	16.19%	23.64%	44.97%

Average electricity tariff rate paid by residential in FY2019 = 21.09 c/kwh

**Table 7**  
**Required Electricity Tariff Rates Under Different Scenarios**  
**Residential Customers: c/kwh**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	22.09	22.09	22.09	24.04
FY21	23.00	24.55	26.15	28.91
FY22	23.00	24.55	26.15	29.59
FY23	23.00	24.55	26.25	30.49
FY24	23.00	24.79	26.49	31.36

**Table 8**  
**Change in Electricity Tariff Rates Under Different Scenarios**  
**Residential Customers (%)**

Fiscal Year	Alternative TC (ATC)	TC (RSA)	RSA + Fiscal	
			Plan: No Risks	RSA + Fiscal Plan w/Risks
FY20	4.74%	4.74%	4.74%	13.99%
FY21	9.06%	16.41%	23.99%	37.08%
FY22	9.06%	16.41%	23.99%	40.30%
FY23	9.06%	16.41%	24.47%	44.57%
FY24	9.06%	17.53%	25.59%	48.68%

From the tables it can be seen that there are significant differences in resulting rates among different scenarios. For example, in the case of residential customers, rate increases go from 4.74% in FY 2020 to 9.06% in FY 2024 in the ATC scenario. In the RSA-TC the rates increase go from 4.74% in FY 2020 to 17.53% in Fiscal Year 2024. When the rate increases proposed in the Fiscal Plan, under the no-risks optimistic assumption, are added to the RSA-TC the rates increase from 4.74% in Fiscal Year 2020 to 25.59% in Fiscal Year 2024. When the rates proposed in the Fiscal Plan with the operational risks assumptions in addition to the RSA-TC, are considered, electricity rates increase from 13.99% in Fiscal Year 2020 48.68% in Fiscal Year 2024. Such an increase in the electricity bill, cannot be taken slightly. A residential electricity rate that increases in almost 50% in four years could seriously promote inequity, worsen the situation of the poor and stimulate increased emigration.

In the case of industrial customers, rate increases go from 5.11% in FY2020 to 9.76% in FY 2024 in the ATC scenario, In the RSA-TC scenario the rates increase go from 5.11% in FY 2020 to 18.90% in FY 2024. Under the Fiscal Plan no-risks optimistic assumption in FY 2020 to 27.59% in FY 2024. In the worst scenario, where operational risks pointed out in the Fiscal Plan are included and added to the RSA-TC scheduled rates,<sup>23</sup> electricity rates increase from 15.08% in FY 2020 to a whopping 52.4% in FY 2024. Such an increase in the electricity bill cannot go unnoticed to manufacturers in Puerto Rico, who probably will review their investment and operation plans, and even the permanence of their manufacturing plants in Puerto Rico.

For that reason, among others, it is pertinent to evaluate and estimate expected economic consequences of proposed electricity rate changes under the different scenarios. That analysis is done in the next sections of this report, beginning with

<sup>23</sup> This worst scenario appears to be a highly probable one.

estimating expected consequences of each scenario on input costs along some relevant industrial sectors.

## VI. Economic Impacts by Major Industrial Sectors

This section of the report informs results of expected economic consequences from proposed electricity rate increases resulting from the previously proposed Alternative Transition Charge, the Puerto Rico Electric Power Authority Debt Restructuring Agreement (RSA), and from related scenarios included in last approved PREPA Fiscal Plan.<sup>24</sup> The analysis is focused on eight major industrial sectors:

- Agriculture
- Mining & Construction
- Manufacturing
- Wholesale & Retail Trade
- Hospitals & Health Serv.
- Electricity & Irrigation Serv.
- Other Services
- Government

To compute effects of rates changes, as presented in the four scenarios under consideration, on the cost of intermediate inputs, the 2013 Input-Output Matrix (I/O Matrix) for Puerto Rico was aggregated into eight sectors. The resulting I/O Matrix is reported on Appendix B. Electricity rate increases were computed in the vector electricity and irrigation services for all sectors, except PREPA's vector, under the assumption that PREPA does not actually pay for the electricity it consumes. The estimates are made for fiscal years 2022 and 2024 in the four scenarios that are considered in this report. Its effects were estimated only for fiscal years 2022 and 2024, because the most relevant rate changes in all scenarios do not take effect until fiscal year 2021.

Table 9 summarizes estimated consequences of the different scenarios analyzed on the costs of intermediate inputs, by industrial sectors, in fiscal years 2022 and 2024. Some important considerations can be inferred from the results in the table.

In the first place, it can be seen that, in all scenarios, the most affected sectors by increases in electricity rates are:

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<sup>24</sup> PREPA Fiscal Plan includes electricity rates increases proposed in RSA, and also other rate increases related to other operational and administrative measures included in the plan.

1. Wholesale and retail trade
2. Government
3. Manufacturing

It should be noted that these sectors are particularly critical for its consequences upon the local economy.

1. Increases in the operating costs in the commerce sector are usually translated to customers, reducing the purchasing power of the general population, and increasing incentives for emigration.
2. In the case of government, it should be remembered that it faces a serious fiscal crisis, with serious restrictions on its spending capacity. An increase in operation costs is going to aggravate its present fiscal crisis.
3. Manufacturing is critical for local economic performance. The Puerto Rican economy is predicated on exporting manufactured goods, and increases in operation costs reduced its (already diminished) capacity to compete in world markets. It should be remembered that employment in manufacturing has been declining for more than a decade.

Construction is another sector that has been stagnant in Puerto Rico for over a decade, with declining employment. Expected increases in input costs are going to promote further adverse effects over the real estate sector of the economy, with the aggravation that electricity rates increase also adversely affects everyday home maintenance and use.

**Table 9**  
**Percent Change in Cost of Intermediate Inputs by Industrial Categories under Considered Scenarios**

Industrial Sectors	Alternative TC		TC (RSA)		RSA TC + Fiscal Plan (No Risks)		RSA TC + Fiscal Plan (Risks Included)	
	FY	FY	FY	FY	FY	FY	FY	FY
	2022	2024	2022	2024	2022	2024	2022	2024
Agriculture	0.05%	0.05%	0.09%	0.09%	0.13%	0.09%	0.43%	0.26%
Mining & Construction	0.09%	0.09%	0.17%	0.18%	0.25%	0.28%	0.42%	0.51%
Manufacturing	0.19%	0.19%	0.35%	0.37%	0.51%	0.54%	0.85%	1.03%
Wholesale & Retail Trade	0.22%	0.22%	0.91%	0.98%	1.34%	1.48%	2.25%	2.71%
Hospitals & Health Serv.	0.04%	0.04%	0.17%	0.18%	0.25%	0.28%	0.42%	0.51%
Electricity & Irrigation Serv.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other Services	0.06%	0.06%	0.26%	0.28%	0.38%	0.42%	0.64%	0.78%
Government	0.15%	0.15%	0.62%	0.66%	0.90%	1.00%	1.51%	1.83%
<b>Overall Average</b>	<b>0.13%</b>	<b>0.13%</b>	<b>0.35%</b>	<b>0.38%</b>	<b>0.52%</b>	<b>0.56%</b>	<b>0.87%</b>	<b>1.05%</b>

Identified increases in inputs costs reduces the ability for local firms to compete, both in the export markets, as well as with imports. This could result in a negative effect on the economy's ability to generate income and employment, that should be carefully considered before making any decision on electricity rates increase, particularly when they are so significant in most of the scenarios considered in this report.

It is also important to observe that all scenarios, except the one that considers the effects of the Alternative Transition Charge proposed in this report, result in a higher proportional increase in input costs in FY2024 than in FY2022. This implies that all considered rate schedules – except the ATC – have the potential to promote a cost push inflation over the local economy. Disruptive effects of inflation on economy and society are well known. Inflation distorts resource allocation in production, creates adverse incentives to investment and saving, tends to increase inequality in income distribution, (making particularly worse-off the persons with fixed income, such as retirees,) and promotes instability in the labor market (promoting labor strikes and unrest) as well as in society.

## VII. Impact on the Consumers Price Index (Inflation)

The next topic on consideration, examined in this section of the report, is the consequences of possible electricity rates increases on inflation. For this analysis, it was used the expenditure weights computed by the Puerto Rico Department of Labor and Human Resources to estimate the Consumer Price Index (CPI).<sup>25</sup> Table 10 reports expected increases in CPI for fiscal years 2022 and 2024 under each of the rate increase scenarios under consideration.

Expected price increases range from a minimum of 0.36% in the case of the ATC for years 2022 and 2024, to a maximum of 2.47% in 2024 in the case of the rates for the RSA TC coupled with the additional rates increases in the Fiscal Plan, including highly probable operational risks. These increases in CPI are additional to normal inflation.

It should be noted that, except in the case of the ATC, in all scenarios expected increases in CPI are higher in FY2024, than in FY2022; i.e., they tend to induce cost push inflation.

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<sup>25</sup> These weights refer to consumers expenses by consumptions categories in year 2006, the latest available information. The weights were computed by the Puerto Rico Department of Labor and Human Resources, with the assistance of the US Bureau of Labor Statistics. Appendix C reproduces the values of the weights used in this report.

**Table 10**

**EXPECTED CHANGE IN THE CONSUMER PRICE INDEX**

EXPENDITURE CATEGORIES	Alternative TC		TC (RSA)		TC (RSA) + Fiscal Plan (No Risks)		TC (RSA) + Fiscal Plan (Risks Included)	
	FY 2022	FY 2024	FY 2022	FY 2024	FY 2022	FY 2024	FY 2022	FY 2024
Apparel	0.01%	0.01%	0.04%	0.04%	0.06%	0.06%	0.10%	0.11%
Education & communications	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%	0.03%	0.04%
Foods & beverages	0.05%	0.05%	0.21%	0.22%	0.30%	0.34%	0.51%	0.62%
Other goods and services	0.02%	0.02%	0.03%	0.03%	0.04%	0.04%	0.06%	0.08%
Housing & housing services								
Electricity	0.26%	0.26%	0.47%	0.50%	0.68%	0.73%	1.14%	1.38%
Health services	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%	0.03%
Entertainment	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.02%	0.03%
Transportation	0.02%	0.02%	0.06%	0.07%	0.09%	0.10%	0.16%	0.19%
<b>Total</b>	<b>0.36%</b>	<b>0.36%</b>	<b>0.83%</b>	<b>0.89%</b>	<b>1.22%</b>	<b>1.32%</b>	<b>2.05%</b>	<b>2.47%</b>

According to published statistics, the Puerto Rican has shown fairly price stability over the past 10 years, exhibiting an average inflation rate of 1.11% from fiscal years 2009 to 2018.<sup>26</sup> This situation could change if proposed electricity rate increases are enacted.

Table 11 informs the expected increase in CPI under each scenario as a percentage of historic inflation rate in PR over the last ten years. It can be seen from the table that in all scenarios, except with the ATC, expected increases in inflation caused by proposed electricity rate increases would accelerate inflation in a significant way. In consequence, the only electricity price increase that the economy appears to be able to afford, without significantly accelerating inflation, is the Alternative Transition Charge proposed in this report.

<sup>26</sup> PR Planning Board, *Statistical Appendix to the Economic Report to the Governor 2018*, Table 1.

**Table 11**

**Expected Increase in CPI in Each Scenario as a Percentage of Local Inflation Rate**

Expected Increase in CPI in Each Scenario, as a percentage of Local Inflation Rate	Alternative TC		TC (RSA)		TC (RSA) + Fiscal Plan (No Risks)		TC (RSA) + Fiscal Plan (Risks Included)	
	FY 2022	FY20 24	FY 2022	FY 2024	FY 2022	FY 2024	FY 2022	FY 2024
	33%	33%	75%	80%	110%	119%	184%	223%

### VIII. Expected impacts on production and income

This section of the report examines expected economic impacts of proposed electricity tariff rate increases on Puerto Rico Gross National Product at constant prices (i.e., without inflation). Any increase in rates on electricity is expected to have negative consequences on production and income. All production processes use electricity, so any increase in rates increases the costs of companies and their ability to compete with foreign producers.<sup>27</sup> This impairs the ability of the local economy to export, as well as the capacity of the enterprises that produce for the domestic market to compete with imported products. To evaluate the expected effects of the increases in electricity rates, an equation was estimated for projecting the gross national product at constant prices. The computed parameters and characteristics of this equation are presented in Appendix D to this report.<sup>28</sup>

<sup>27</sup> See Section VI of this report.

<sup>28</sup> The forecasting equation was specified as;

$$GNP_t^{PR} = \beta_0 + \beta_1 PKWH_t + \beta_2 GDP_t^{US} + \beta_3 N_t + \beta_4 r_t u_t$$

Where:

$GNP_t^{PR}$  Gross National Product at constant prices of Puerto Rico in year t, t = 2008 to 2017. Variable Name: GNPR\_PR.

$\beta_i$  Estimated coefficient for the i-th independent variable.

$PKWH_t$  Unit price of electricity for all PREPA consumers in \$/kwh in year t.

$DPI_t$  National Income in Commerce and Services in millions of dollars in year t. t = 2008 to 2017. Variable Name: YN\_COM\_SERV.

$N_t$  Total population in thousands of persons. t = 2000 to 2017. Variable Name: POP.

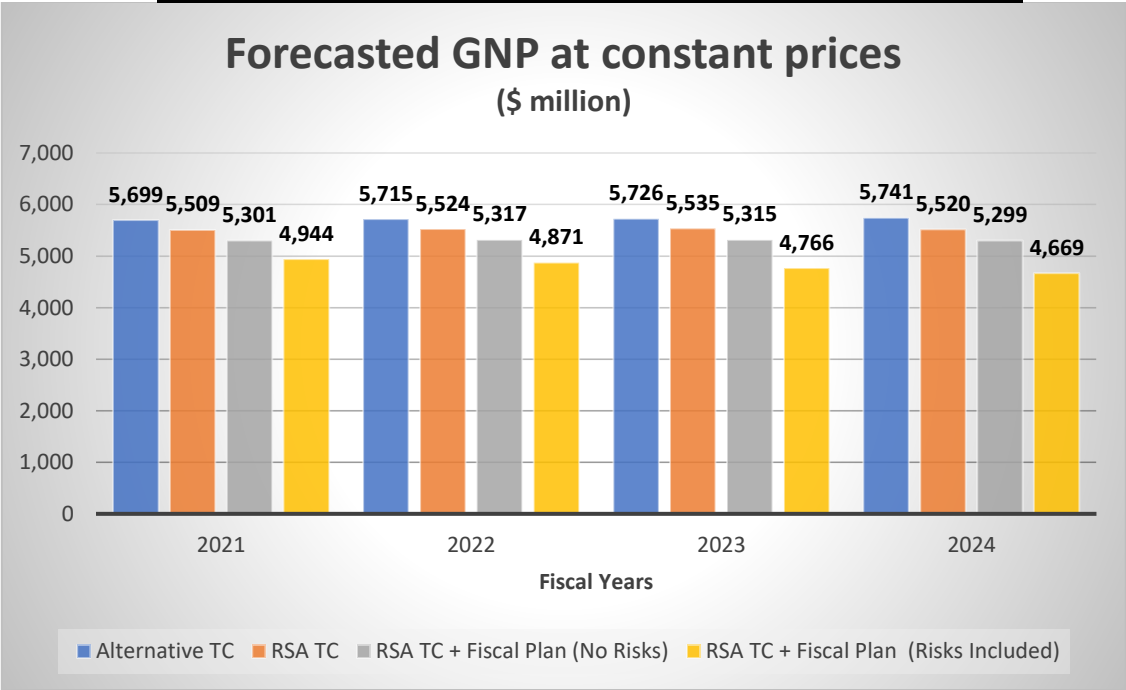


Table 12 and Diagram 1 reports forecasted values for GNP at constant prices for each electricity rates increase scenario considered in this report.

**Table 12**

**Forecasted GNP at constant prices (\$ million)**

Fiscal Year	Alternative TC	TC (RSA)	TC (RSA) + Fiscal Plan (No Risks)	TC (RSA) + Fiscal Plan (Risks Included)
2021	5,699	5,509	5,301	4,944
2022	5,715	5,524	5,317	4,871
2023	5,726	5,535	5,315	4,766
2024	5,741	5,520	5,299	4,669



**Diagram 1**

This result, when viewed in context of the 2017 GNP value of \$6,006.8 million, show the real impact of the proposed electricity rate increases on the Puerto Rico economy.

$GDP^{US}$  Gross Domestic Product of the US, at constant prices, in year t. t = 2000 to 2017. Variable Name: GDPR\_US.

$r_t$  Prime interest rate in year t, t = 2000 to 2017. Variable Name: R.

The equation was estimated using the Robust Least Squares procedure (Yohai method).

As it can be seen from Table 12 and Diagram 1,<sup>29</sup> the scenario with the lower negative impact on economic performance (i.e., on GNP at constant prices) is the Alternative Transition Charge (ATC) previously developed in this report. Moreover, it is the only scenario where, all other things constant, some economic growth is registered to happen over time. This is crucial in the case of the Puerto Rican economy, where the local economy has been under a situation of structural contraction, where its performance has been shrinking for more than a decade. All other scenarios not only result in lower values for forecasted GNP at constant prices, but they also show trends for declining GNP over the forecasting period.

**Table 13**  
**Percent Difference Between Forecasted GNP and Historic**  
**FY2017 GNP at constant prices**

Fiscal Year	Alternative TC	TC (RSA)	TC (RSA) + Fiscal Plan (No Risks)	TC (RSA) + Fiscal Plan (Risks Included)
2021	-5.12%	-8.29%	-11.74%	-17.70%
2022	-4.86%	-8.03%	-11.48%	-18.90%
2023	-4.68%	-7.85%	-11.51%	-20.66%
2024	-4.43%	-8.11%	-11.78%	-22.28%

The argument in the previous paragraph can be better appreciated with the help of Table 13. There forecasted values for GNP in each scenario are compared with historic values in fiscal year 2017. FY2017 is the last normal economic year, i.e., before the Island was hit by hurricanes Irma and María. Even in the case of the ATC, which is the scenario with the lowest adverse effect on economic activity and allows for some growth over the forecasting period, forecasted GNP at constant prices for FY 2024 is 4.43% lower than historic GNP at constant prices in FY2017. The situation becomes more negative in the case of the RSA TC, where forecasted GNP at constant prices for FY 2024 is 8.11% less than actual GNP at constant prices in FY 2017. This adverse effect is 83.1% worse than the one forecasted for the ATC scenario. If Fiscal Plan rate increases, under optimistic no risk assumptions, are added to RSA TC, negative effects of proposed rates increases are stronger. In this scenario, forecasted GNP at constant prices for FY 2024 is 11.78% less than the historic value in FY 2017, and 165.8% worse than in the case of ATC for FY 2024. Finally, the scenario where Fiscal Plan with

<sup>29</sup> It should be noted that forecasted values in each scenario for all fiscal years are lower than those assumed on page 59 of the Fiscal Plan. The Fiscal Plan does not explain how its forecasted were computed.

probable risks rate increases are added to the ARS TC, predicts real disaster. In this case, forecasted GNP at constant prices for FY 2024 is 22.28% lower than the historical value in FY 2017, and 402.9% worse than the forecast in the case of the ATC. This analysis strongly suggests that the only electricity rate increase that the local economy can afford is the proposed ATC.

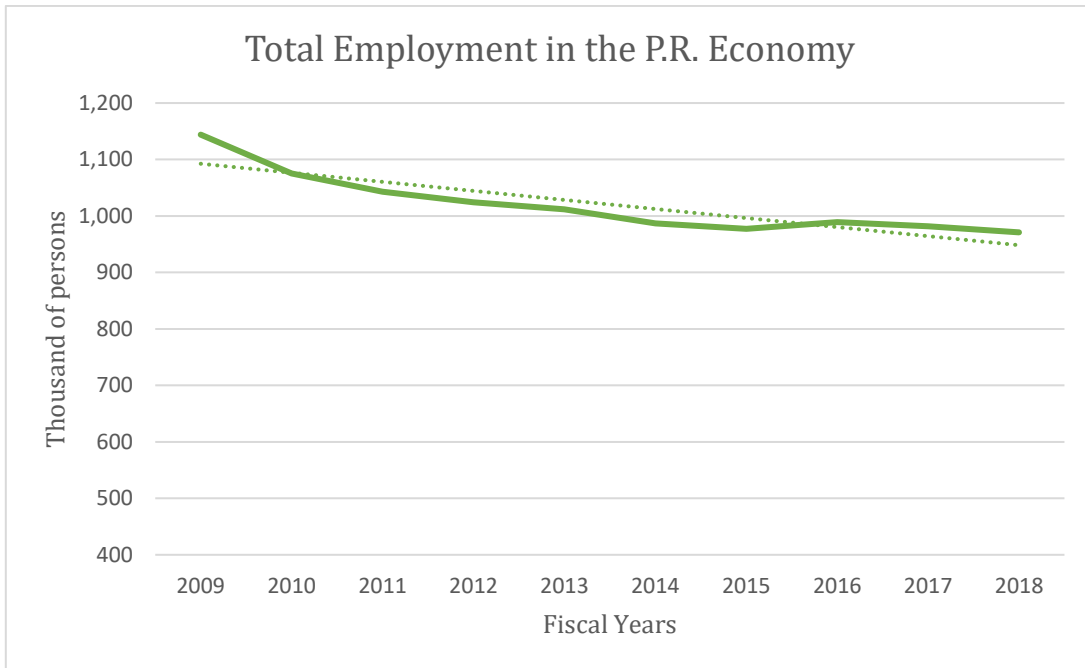
## IX. Employment effects

Once examined the expected effects of tariff rates increases, considered in the different scenarios, on the level of economic activity, it is worth to consider the expected effects of these changes on the level of employment in Puerto Rico. It has been repeatedly reported by the Government, that the rate of unemployment in Puerto Rico has been declining consistently over the past years. This is true, but the reduction in the unemployment rate does not occur as a result of improved economic activity and increased job creation, but by the combined effects of population aging and emigration. In fact, as shown in table 14, the number of persons employed and the size of the labor force have recorded clear reduction trends over the last decade.

**Table 14**  
**Labor Force, Employment, Unemployment and Unemployment Rate (Thousands of persons)**

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Labor Force	1,326	1,284	1,245	1,207	1,177	1,153	1,121	1,121	1,109	1,082
Employed	1,144	1,075	1,043	1,024	1,012	987	977	989	982	971
Unemployed	182	209	202	183	165	166	144	132	127	111
Unemployment Rate (%)	13.7	16.3	16.2	15.2	14.0	14.4	12.8	11.8	11.5	10.3

Source: *Statistical Appendix to the Economic Report to the Governor 2018*, Table 32.



Source: *Statistical Appendix to the Economic Report to the Governor 2018*, Table 32.

**Diagram 2**

Given this situation, additional contractions expected in the level of economic activity, resulting from electricity rates increases, must have adverse impacts on job creation and permanence. Those expected consequences are hereby analyzed for each of the scenarios under consideration.

The first step to estimate the expected effects of the alternative increases in electricity rates on the level of employment, is to estimate the direct requirements of employment per million dollars of GNP at constant prices. Table 15 reports that calculation. The table shows that, on average, between fiscal 2009 to 2018, 161.4 employments were needed for each million dollars of actual production.

Table 16 present the difference, in million of dollar, between actual GNP at constant prices registered in fiscal year 2018 and the value of this variable forecasted for each of the electricity rate increase scenarios under consideration, for fiscal years 2021 to 2024.

**Table 15****Direct Employment Requirements per Million Dollars of Real GNP**

Fiscal Year	Real GNP (Millions of \$)	Total Employment (Thousands)	Direct Employment Requirements (per \$ million of Real GNP)
2009	6,784.2	1,144	168.6
2010	6,541.8	1,075	164.3
2011	6,431.7	1,043	162.2
2012	6,466.2	1,024	158.4
2013	6,457.6	1,012	156.7
2014	6,343.9	987	155.6
2015	6,292.2	977	155.3
2016r	6,191.5	989	159.7
2017r	6,006.8	982	163.5
2018p	5,726.5	971	169.6
Mean			161.4

Source: *Statistical Appendix to the Economic Report to the Governor 2018*, Table 1 and author's computations.

**Table 16****Difference Between Forecasted GNP and Historic FY2018 GNP at constant prices (\$ million)**

Fiscal Year	Alternative TC	RSA TC	RSA TC + Fiscal Plan (No Risks)	RSA TC + Fiscal Plan (Risks Included)
2021	-27.35	-217.79	-425.07	-782.62
2022	-11.86	-202.29	-409.57	-855.22
2023	-0.66	-191.09	-411.33	-960.62
2024	14.21	-206.83	-427.06	-1,057.97

In Table 17, the direct employment requirement per million dollars in Gross National Product at constant prices is applied to the expected changes in GNP forecasted for each scenario under consideration, to estimate expected effects on the level of employment in the island.

**Table 17**

**Expected Employment Consequences for Each Rate Increase Scenario  
(Number of persons)**

Fiscal Year	Alternative TC	RSA TC	RSA TC + Fiscal Plan (No Risks)	RSA TC + Fiscal Plan (Risks Included)
2021	-4,414	-35,151	-68,606	-126,315
2022	-1,914	-32,650	-66,105	-138,033
2023	-106	-30,843	-66,388	-155,043
2024	2,294	-33,382	-68,928	-170,756

From Table 17 it can be seen that, in the case of the ATC, the economy seems to absorb the increase in electricity rates, and by FY 2024 it is able to generate 2,294 additional jobs, over the employment level of FY 2018. For its part, in the case of the RSA TC, the economy begins to slowly absorbing the effects of the initial rate increase, but, since the RSA TC includes an additional rate increase for FY 2024, total employment again declines in FY 2024, with a total loss of 33,382 jobs in FY 2024, which is equivalent to 3.4% of total employment in FY 2018. If the electricity rate increases proposed by the RSA is compounded with the rate increases proposed in the Fiscal Plan with optimistic assumptions, by FY 2024 the economy is expected to have a net loss of 68,928 jobs, an amount that is equivalent to 7.1% of total employment in FY 2018. In the last scenario, where electricity rate increases in the RSA TC are added to those proposed in the Fiscal Plan, including more realistic risk assumptions, the losses in employment are really significant; by fiscal year 2024, is expected that total employment in the economy is going to be reduced by 170,756 jobs, or 17.6% of total jobs in FY 2018.

The Puerto Rican economy has shown a downward trend in total employment over more than a decade. As a consequence of the structural contraction that has been happening in the local economy, it has been unable to create enough jobs for the population, a situation that has resulted in increased emigration of productive persons and in promoting a more inequitable income distribution. From an economic and social point of view, Puerto Rico must be very careful in adopting measures that have additional adverse effects on employment. Of the four scenarios considered in this report, the ATC is the only one that result in moderate employment loss in the short run and has the capacity to be absorbed by the markets and allow for the economy to be able to generate jobs in the not so long run.

## **X. Demand for Electricity**

Since the Transition Charges included in the RSA are based on expected PREPA’s total sales of electricity, it is pertinent to estimate the demand for electricity, because it determines PREPA’s annual sales and, in consequence, the need to adjust, and how

much to adjust, the amounts proposed for the TC and other proposed new charges in the electricity bill. In fact, scheduled increases in Transition Charges are predicated on reductions in electricity sales (and, hence, in paid consumption). To assume that electricity consumption is going to be reduced is reasonable, since it already shows a downward tendency since fiscal 2007, and multiple factors operate for such shrinkage to happen.<sup>30</sup> The issue is to determine which is the reasonable magnitude to be expected for the level of consumption of electricity from PREPA customers over the forecasting period.<sup>31</sup>

To forecast electricity consumption in Puerto Rico, demand equations were estimated for the three most relevant customer categories: (1) residential, (2) commercial, and (3) industrial.<sup>32</sup> These three categories add up to the 98% of total electricity consumption on the island.<sup>33</sup> To forecast total electricity consumption for each fiscal year over the forecasting period, it was aggregated the estimated electricity demand in each category for each fiscal year, and 2% was added to the total obtained to include the consumption of customers categories left out. This procedure implicitly assumes that the main customer categories will continue to be responsible for 98% of total electricity consumption.

Next subsections in the report inform the results obtained from estimated demand equations, as well as the aggregate demand for electricity.

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<sup>30</sup> Among the factors that tend to promote reduction in the consumption of electricity, it can be mentioned, among others:

1. The secular contraction in the economy of Puerto Rico.
2. Emigration.
3. Increases in electricity rates.
4. The availability of more efficient electrical equipment.
5. Private solar power generation.

<sup>31</sup> It must, again, be pointed out that it is not reasonable to attempt to forecast quantities demanded of electricity for a 47 years period. It is simply impossible to try to predict how economic conditions affecting electricity (or any other good or service) consumption will behave over a two generations period of time. This report is limited to, the already indicated, more modest and reasonable forecasting period.

<sup>32</sup> Each demand equation was estimated using the following methods;

1. OLS
2. Stepwise regression
3. If the Durbin-Watson statistic in the OLS showed autoregressive errors, or indetermination, the equation was also estimated through the Durbin-Watson method.
4. Robust Least Squares (Yohai method)
5. Robust Least Squares, adjusted for autoregressive errors through the Cochran-Orcutt method.
6. 2SLS

Results obtained from the six estimation methods were compared, and, the equation with the best statistical fit was selected to be used for the analysis.

<sup>33</sup> *Fiscal Plan, op. cit.*, p. 63.

## Residential Demand for Electricity

The residential demand equation for electricity was specified as:

$$Q_t^{DER} = \beta_0 + \beta_1 PKWH_t + \beta_2 DPI_t + \beta_3 N_t + u_t$$

Where:

$Q_t^{DER}$  Quantity of electricity in Gwh demanded by residential consumers of PREPA at year t, t = 2000 to 2017. Variable Name: C\_ELECT\_RES.

$\beta_i$  Estimated coefficient for the i-th independent variable.

$PKWH_t$  Unit price of electricity for residential consumers in \$/kwh in year t.

$DPI_t$  Disposable Personal Income in millions of dollars in year t. t = 2000 to 2017. Variable Name: YPD.

$N_t$  Total population in thousands of persons. t = 2000 to 2017. Variable Name: POP.

The equation was estimated by the Robust Least Squares Method (Yohai method), and the results, including the statistics and information to evaluate the statistical fit of the equation, are informed in Appendix E, at the end of this report. The selected demand equation for PREPA residential customers was used to forecast consumption under the different scenarios under consideration. Forecasted residential consumption is reported in Table 18.

**Table 18**  
**Quantity of Electricity Demanded by Residential Consumers (Gwh)**

Fiscal Year	ATC	RSA TC	RSA TC +	
			Fiscal Plan: No Risks	RSA TC + Fiscal Plan: w/ Risks
2021	5,230	5,065	4,894	4,599
2022	5,202	5,036	4,865	4,497
2023	5,176	5,010	4,828	4,375
2024	5,191	5,000	4,818	4,298

Table 19 informs the relative difference between each forecasted value and actual consumption registered for residential PREPA customers in Fiscal Year 2017, the last “normal” year, before hurricanes Irma and María.



**Table 19**  
**Quantity of Electricity Demanded by Residential Consumers**  
**Percent Variation with Regard to Quantity Consumed in FY 2017**

Fiscal Year	ATC	RSA TC	RSA TC + Fiscal Plan: No Risks	RSA TC + Fiscal Plan: w/ Risks
2021	-18.17%	-20.77%	-23.44%	-28.06%
2022	-18.62%	-21.21%	-23.89%	-29.64%
2023	-19.03%	-21.62%	-24.46%	-31.56%
2024	-18.79%	-21.78%	-24.62%	-32.77%

From Table 19 it can be seen that all forecasts are consistent with the downward trend registered in electricity consumption in Puerto Rico. It can also be seen that the quantity of electricity demanded varies in a significant way among the various scenarios. The scenario with the smallest reduction in electricity consumption is the one with the ATC proposed in this report, which also shows a slight increase in electricity consumption by FY 2024. All other scenarios show larger decline in the quantity of electricity demanded by residential customers and no improvement by FY 2024. This is an important issue to be taken into account by policy markets, particularly because PREPA has plans to privatize electricity generation, and it will be very difficult to privatize electric generation if it is expected that electricity consumption is going to continue diminishing over time in a significant and consistent way.

### Commercial Demand for Electricity

The commercial demand equation for electricity was specified as:

$$Q_t^{DEC} = \beta_0 + \beta_1 PKWH_t + \beta_2 NI_t^{C+S} + \beta_3 N_t + u_t$$

Where:

$Q_t^{DEC}$  Quantity of electricity in Gwh demanded by commercial consumers of PREPA at year t, t = 2008 to 2017. Variable Name: C\_ELECT\_C.

$\beta_i$  Estimated coefficient for the i-th independent variable.

$PKWH_t$  Unit price of electricity for commercial consumers in \$/kwh in year t.

$DPI_t$  National Income in Commerce and Services in millions of dollars in year t. t = 2008 to 2017. Variable Name: YN\_COM\_SERV.

$N_t$  Total population in thousands of persons. t = 2008 to 2017. Variable Name: POP.

The equation was estimated by the Two Stages Least Squares procedure, and the results, including the statistics and information to evaluate the statistical fit of the equation, are informed in Appendix F to this report. The selected demand equation for PREPA commercial customers was used to forecast consumption under the different scenarios under consideration. Forecasted commercial consumption is reported in Table 20.

**Table 20**  
**Quantity of Electricity Demanded by Commercial Consumers**  
**(Gwh)**

Fiscal Year	ATC	RSA TC	RSA TC + Fiscal Plan: No Risks	RSA TC + Fiscal Plan: w/ Risks
2021	7,544.19	7,539.07	7,533.78	7,524.66
2022	7,481.95	7,476.83	7,471.54	7,460.17
2023	7,419.72	7,414.59	7,408.97	7,394.96
2024	7,373.04	7,367.12	7,361.50	7,345.41

Consistent with what done in the case of residential customer, Table 21 informs the relative difference between each forecasted value and actual consumption registered for commercial PREPA customers in Fiscal Year 2017.

**Table 21**  
**Quantity of Electricity Demanded by Commercial Consumers**  
**Percent Variation with Regard to Quantity Consumed in FY 2017**

Fiscal Year	ATC	RSA TC	RSA TC + Fiscal Plan: No Risks	RSA TC + Fiscal Plan: w/ Risks
2021	-5.62%	-5.68%	-5.75%	-5.86%
2022	-6.39%	-6.46%	-6.52%	-6.67%
2023	-7.17%	-7.24%	-7.31%	-7.48%
2024	-7.76%	-7.83%	-7.90%	-8.10%

As expected, the price elasticity of demand for commercial customers is more inelastic than for other customer categories. In consequence, the variation of forecasted values for commercial electricity consumption are much lower than in other cases, both with regard to quantity consumed in fiscal year 2017, as well as among the different scenarios considered. It should be noted that, for this equation, the only independent

variable that shows statistical significance is population; hence, as long as the population continues declining on the island, the lower the quantity electricity consumed by commercial customers.<sup>34</sup>

## Industrial Demand for Electricity

The industrial demand equation for electricity was specified as:

$$Q_t^{DEC} = \beta_0 + \beta_1 PKWH_t + \beta_2 NI_t^{C+S} + \beta_3 N_t + u_t$$

Where:

$Q_t^{DEC}$  Quantity of electricity in Gwh demanded by commercial consumers of PREPA at year t, t = 2008 to 2017. Variable Name: C\_ELECT\_C.

$\beta_i$  Estimated coefficient for the i-th independent variable.

$PKWH_t$  Unit price of electricity for commercial consumers in \$/kwh in year t.

$DPI_t$  National Income in Commerce and Services in millions of dollars in year t. t = 2008 to 2017. Variable Name: YN\_COM\_SERV.

$N_t$  Total population in thousands of persons. t = 2008 to 2017. Variable Name: POP.

The equation was estimated by the Robust Least Squares Method (Yohai method), and the results, including the statistics and information to evaluate the statistical fit of the equation, are informed in Appendix F, at the end of this report. The selected demand equation for PREPA industrial customers was used to forecast consumption under the different scenarios under consideration. Forecasted residential consumption is reported in Table 22.

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<sup>34</sup> It should be remembered that population decline is largely caused by emigration, which, in turn depends on the level of economic activity. Thus, to reverse the migration trend it is necessary to reverse the structural economic contraction that Puerto Rico has been suffering for over a decade.

**Table 22****Quantity Demanded of Electricity by Industrial Customers under Different Scenarios (Gwh)**

Fiscal Year	ATC	RSA TC	RSA + Fiscal Plan (No Risks)	RSA + Fiscal Plan (Risks Included)
2021	1,785	1,739	1,691	1,609
2022	1,693	1,647	1,600	1,497
2023	1,597	1,551	1,500	1,374
2024	1,492	1,439	1,388	1,243

As done in the two previous cases, here again it is computed the variation between forecasted values and actual consumption of industrial customers in FY 2017, before the island was hit by hurricanes Irma and María. Resulting estimates are reported in Table 23.

**Table 23****Quantity of Electricity Demanded by Industrial Consumers Percent Variation with Regard to Quantity Consumed in FY 2017**

Fiscal Year	ATC	RSA TC	RSA TC + Fiscal Plan: No Risks	RSA TC + Fiscal Plan: w/ Risks
2021	-18.40%	-20.50%	-22.68%	-26.43%
2022	-22.58%	-24.68%	-26.85%	-31.53%
2023	-26.98%	-29.08%	-31.39%	-37.15%
2024	-31.79%	-34.22%	-36.53%	-43.14%

Industrial customers show the highest response to considered electricity rate increases, among the three categories of customers under consideration. This appears to happen for two reasons: (1) industrial customers have a higher price-elasticity of demand than other categories of consumers,<sup>35</sup> and (2) many of them also have the choice to relocate their productive activities out of Puerto Rico, and electricity rate increases provide an incentive to relocation. It should also be noted that, for industrial

<sup>35</sup> Price-elasticity of demand depends, among other things to the ability of the consumer to substitute goods or services subject to price increases. Industrial customers tend to have a higher capacity to substitute PREPA's electricity for electricity generated in their own facilities than other customer categories.

customer, the ratio between electricity tariff rates in Puerto Rico, as compared to US corresponding rates, results in the highest increase, under all scenarios considered.<sup>36</sup>

## Total Demand for Electricity

Residential, commercial and industrial customers consume 98% of total energy consumed on the island. To estimate total demand, under the different scenarios, total consumption of these three customers categories was adjusted by 98%.<sup>37</sup> The resulting estimates of total electricity consumption, for each scenario, are reported in Table 24.

36

**Table A-3**

**Ratios Between Electricity Tariff Rates in Each Scenario by Customer Categories to Median Tariff Rates in US for Electric Power Utilities with More than 100,000 Customers**

Fiscal Year	Alternative TC (ATC)	RSA-TC	RSA+ Fiscal Plan: No Risks	RSA + Fiscal Plan w/Risks
<b>RESIDENTIAL CUSTOMERS</b>				
FY21	2.0	2.2	2.3	2.5
FY22	2.0	2.2	2.3	2.6
FY23	2.0	2.2	2.3	2.7
FY24	2.0	2.2	2.3	2.8
<b>COMMERCIAL CUSTOMERS</b>				
FY21	2.6	2.7	2.9	3.2
FY22	2.6	2.7	2.9	3.2
FY23	2.6	2.7	2.9	3.3
FY24	2.6	2.7	2.9	3.4
<b>INDUSTRIAL CUSTOMERS</b>				
FY21	2.8	2.8	2.8	3.0
FY22	2.9	3.1	3.3	3.7
FY23	2.9	3.1	3.3	3.8
FY24	2.9	3.1	3.3	3.9

Source: American Public Power Association, *Financial and Public Utility Ratios of Public Power Utilities*, Arlington, VA, December 2018, pp. 15 and 16; and computations by the author.

Tables 5.6.A and 5.6.B. of U.S. Energy Information Administration, *Electric Power Monthly with Data for April 2019*, June 2019 were considered for the analysis. Data from the American Public Power Association was preferred to maintain information source consistency in the report.

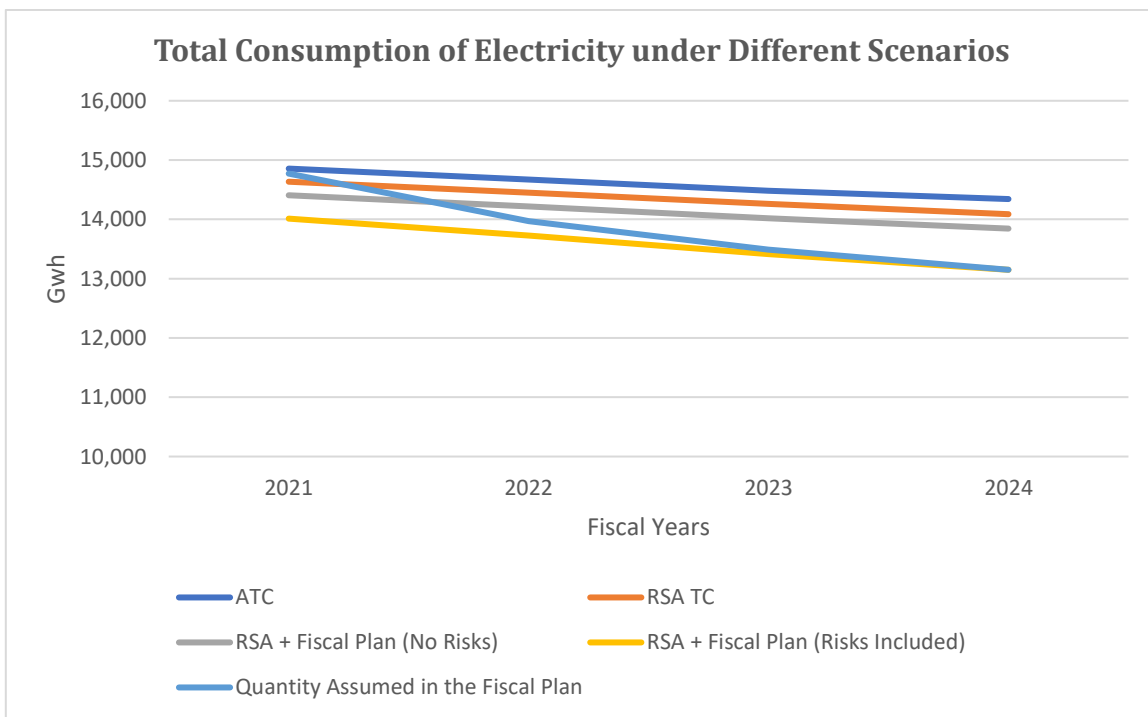
<sup>37</sup> On page 23 of this report it was explained that to forecast total electricity consumption for each fiscal year over the forecasting period, it was aggregated the estimated electricity demand in each category for each fiscal year, and 2% was added to the total obtained to include the consumption of customers categories left out. This procedure implicitly assumes that the main customer categories will continue to be responsible for 98% of total electricity consumption.

**Table 24**

**Total Consumption of Electricity Demanded under Different Scenarios (Gwh)**

Fiscal Year	ATC	RSA TC	RSA + Fiscal Plan (No Risks)	RSA + Fiscal Plan (Risks Included)	Quantity Assumed in the Fiscal Plan
2021	14,856	14,635	14,407	14,013	14,772
2022	14,670	14,449	14,221	13,730	13,972
2023	14,482	14,261	14,018	13,413	13,491
2024	14,343	14,087	13,845	13,149	13,150

The table shows that the expected electricity consumption, over the forecasted period, is higher in the ATC scenario, while the scenario that results with the lowest electricity consumption is the one that includes the TC in the RSA plus Fiscal Plan risks. As indicated earlier, the proposed TC in the RSA is going to increase by 64.5% over the maturity life of securitized bonds. This means that the RSA assumes that PREPA’s annual sales (in Gwh) are going to decrease by 64.5%.



**Diagram 3**

Estimates in Table 24 tend to indicate that future electricity consumption could be underestimated by the RSA and the Fiscal Plan. The consequences that arises from the underestimating expected future demand for electricity are important. Two serious probable consequences are:

1. The Transition Charge schedule in the RSA depends upon expected future consumption of electricity over a very long period of time. As stated before, it is unreasonable to try forecast electricity consumption over such an extended period of time – as well as a TC schedule. But if there is a tendency to underestimate future consumption, then the TC rates in the RSA schedule will be overestimated. For these reasons, it is of outmost importance that, instead of defining a 40 years schedule of Transition Charges, to provide for periodic reviews of the TC. The Puerto Rico Energy Bureau is the most competent institution to undergo the task of these periodic TC reviews.
2. PREPA is in the process of privatizing generation of electric power. If consumption of electricity is not properly forecasted, it will be very difficult for PREPA and the private enterprises to be involved in the process to negotiate a reasonable privatization process. If future electricity consumption is underestimated, private companies may not be interested to negotiate privatization accords, or may want rates and clauses in their contracts to provide for minimum revenues to guarantee their profitability. If electricity consumption is under forecasted, such clauses can result in windfall gains for the companies and losses for PREPA.

## XI. Conclusions

From the analysis developed in this report, the following conclusions can be derived:

1. The RSA devotes a lot of effort to describe in detail its scope and content, as well as to develop detailed measures to assure that bondholders will get the payments agreed under it. But the RSA never justifies its rationale, i.e., why the proposed ratio of restructured debt to outstanding debt, which is the reason to have the two proposed tranches for the bonds to be issued under the restructured debt, and why the interest payments of Tranche B Bonds will be accrued over time, in a way where at the end of 40 years the nominal value of Tranche B Bonds is going to be in the neighborhood of \$20,226 million.
2. There is no any justification for the proposed schedule of the volumetric Transition Charge, included in the RSA. Moreover, this schedule has the implicit assumption that PREPA's electricity are going to decline by 64.5% over time, which completely speculative.
3. Furthermore, the RSA does not devote a single line to consider the impacts that it is expected to have on the Puerto Rico's economy, nor it considers how negative impacts can be mitigated.

4. This report shows that, when the TC in the RSA is added to additional surcharges proposed in the last PREPA's Fiscal Plan, the overall rate increases are significant and very problematic for the economy to afford.
5. An Alternative proposal to restructure PREPA's outstanding debt is developed in this report, with a corresponding Alternative Transition Charge (ATC).
6. When economic consequences of electricity tariff rates increases are evaluated for the different scenarios included in this report, it was found that the most affected sectors on the costs of intermediate inputs are:
  - a. Wholesale and retail trade
  - b. Government
  - c. Manufacturing

Such results tend to imply that proposed rate changes could have serious negative consequences on the economy.

7. When the consequences of the proposed rate increases on the general price level were analyzed, it was found that in all scenarios considered, except in the case of the proposed Alternative Transition Charge, there is a real possibility of cost-push inflation in the economy, with the disruptions it usually causes on resource allocation, diminished production, increased inequality in the distribution of income, and social instability.
8. It was also found that all proposed rate increases tend to significantly reduce the levels of economic activity over time, a much serious outlook for an economy that has been suffering from continuous economic contraction over more than a decade. The only scenario where the economy appears to be able to absorb the rate increase and begins to recover by fiscal year 2024, is the one that considers the Alternative Transition Charge.
9. Consequently, all rate increase scenarios result in substantial reductions in employment levels. It should be noted that, notwithstanding optimistic government statements, official statistics document that total employment shrinkage that has been occurring on the island for over a decade continues. In this respect, again, the only scenario where the economy appears to be able to absorb the rate increase and begins to recover by fiscal year 2024, is the one where the only rate increase is the proposed Alternative Transition Charge.
10. This report also forecasts electricity consumption for all the four scenarios and compares the outcomes with consumption assumed in the Fiscal Plan. The main conclusion is that the RSA and the Fiscal Plan appear to underestimate expected future consumption of electricity. If this happen, it posits serious problems:
  - a. The Transition Charge schedule in the RSA depends upon expected future consumption of electricity. If such consumption is underestimated, then



the scheduled TC is going to overcharge electricity customers. In consequence, instead of providing a TC schedule in an RSA, what should be done is to provide for periodic reviews of the TC by a competent and independent entity, such as the Puerto Rico Energy Bureau.

- b. PREPA is in the process of privatizing generation of electric power. If consumption of electricity is not properly forecasted, it will be very difficult for PREPA and private enterprises to be involved in the process to negotiate sensible privatization accords.

To summarize, the Puerto Rican economy does not appear to be able to afford electricity tariff rates increases proposed in the RSA, much less when these increases are coupled with those proposed in PREPA Fiscal Plan. Instead, the RSA should be carefully reviewed and justified; and PREPA's operations and management must be profoundly reformed to end situations of inefficiency, waste, and other undesirable events, as they have been frequently denounced by local media, as well as in many audit reports issued by the Puerto Rico Comptroller Office over more than two decades.



## Appendix A: Evaluation of the RSA

### A Preliminary Evaluation of Proposed PREPA Debt Restructuring Agreement

RAMÓN J. CAO GARCÍA PH.D.

# A Preliminary Evaluation of Proposed PREPA Debt Restructuring Agreement

Ramón J. Cao García, Ph.D.  
August 17, 2019

## Description and implications of the proposed PREPA Debt Restructuring Agreement

It is pertinent to evaluate the proposed PREPA Debt Restructuring Agreement (RSA) in some detail. As a principle, we should repay as much of PREPA's debt as it is possible. The question is: how much is possible without compromising future operation of the Authority? This question must be answered because it is the core for avoiding future financial and operational crisis in PREPA.

The RSA contains some key elements that should be evaluated. They are:

5. The restructured debt is going to be issued in the form of Securitization Bonds, secured by a Transition Charge (TC).
6. The TC will begin at 2.768 c/kwh at the first year of validity of RSA, and it is going to be periodically increased up to 4.552 c/kwh at year 24 and thereafter. The TC can be increased up to a maximum of 25% to compensate for Contributions In Lieu of Taxes and Subsidies granted by PREPA.
7. Two kinds of bonds will be issued:
  - a. Tranche A Bonds: In the amount of 67.5% of principal amount of outstanding bonds. These bonds will be tax exempt, with 40 years maturity and a 5.25% coupon.
  - b. Tranche B Bonds: In the amount of 10% of principal amount of outstanding bonds. These bonds may or may not be tax exempt, with 47 years maturity and a 7.00% accretion coupon for tax exempted bonds, and 8.75% accretion coupon for non-tax exempted bonds. Tranche B Bonds will begin to be paid after Tranche A Bonds are paid in full. Also, any amounts on such Tranche B Bonds not paid with Transition Charge Revenues imposed prior to the stated final maturity of the Tranche B Bonds shall not be recoverable by Bondholders.

When RSA is evaluated, it is clearly reasonable that restructured debt to be issued in the form of Securitization Bonds, just to give bondholders assurances for payment of the restructured debt. But the structure proposed for the TC it is not justified, and some important questions arise:

1. The proposed TC is going to increase by 64.5% over the maturity life of the securitized bonds. Since the yearly amount of the debt service is not going to increase over that period of time, it implies an assumption that PREPA's annual sales (in Gwh) are going to decrease by 64.5% over time. This is a totally unfounded assumption. Nobody can forecast electricity consumption in Puerto Rico – or, by that matter, in any other jurisdiction – over a 40 years period. It is true that electricity consumption has been showing a downward trend over recent years, but nobody can predict for how long this trend will continue, or how it will change over an extended period of time. For that reason, it is much more reasonable for the Puerto Rico Energy Bureau to periodically review (every year or every two years) the amount to be imposed as TC.
2. As proposed by RSA, average annual collections from the TC over years 2 to 5 of RSA would be \$615.40 million, but estimated annual debt service for the restructured debt is \$367.93 million.<sup>38</sup> It appears to be that proposed TC over that period is excessive. This is another reason for allowing the Energy Bureau to periodically review and decide the proper amount to be charged to electricity consumers as TC.
3. The RSA proposes to restructure PREPA outstanding debt into 67.5% of Tranche A Bonds, plus 10.0% in Tranche B Bonds. There is no explanation about how the RSA came to those percentages, or how the restructured debt compares to the situation in similar public utilities, or how the RSA is going to impact PREPA finances and operation; furthermore, no analysis is provided with regard of how it will impact the local economy. These are relevant issues that should also be addressed.

Let us consider the Debt to Total Asset Ratios for electric utilities, as reported by the American Public Power Association.<sup>39</sup>

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<sup>38</sup> Value computed through Excel financial formula.

<sup>39</sup> American Public Power Association, *Financial and Operating Ratios of Public Utilities*, Arlington, VA, December 2018.

### Debt to Total Assets Ratios (median values)

Power Generation Class (p.3)			
No Generation	More than 0 and less than 10%	10% to 50%	50% to 100%
0.230	0.366	0.439	0.489

### Debt to Total Assets Ratios (median value) (p.17)

More than 100,000 Customers	0.563
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### Debt to Total Assets Ratios (median value) (p.7)

National Average	0.321
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At this moment, PREPA is in the power generation category of 50% to 100%, where the median debt to total assets ratio (D/A ratio) is 0.489, but PREPA is in the process of privatizing electricity generation, which implies that at the utility's goal is to generate no electricity, where the median value for the D/A ratio is 0.230. On the other hand, PREPA is in the category of companies having more than 100,000 customers, where the D/A ratio is 0.563. Given that information, it is reasonable to consider that an affordable D/A ratio for PREPA is 0.563, i.e., the maximum amount of debt that PREPA should pay without compromising its financial and operational position.

The latest available PREPA's Financial Statement is for the year ending June 30, 2016.<sup>40</sup> There it is stated that PREPA had total assets in the amount of \$8,291.6 million at June 30, 2016,<sup>41</sup> and that its outstanding long-term debt was \$9,118.2 million.<sup>42</sup> This implies that PREPA's D/A ratio is 1.10.<sup>43</sup> If an affordable D/A ratio of 0.563 is applied to PREPA's total assets, it can be concluded that PREPA can afford to pay up to \$4,668 million in restructured debt, without compromising its finances and operations. In consequence, a sensible debt restructuring agreement should be to issue securitized bonds equivalent to 51.2% of principal

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<sup>40</sup> BDO Puerto Rico, P.S.C., *PREPA Independent Auditors' Report, Independent Auditors' Financial Statements, Required Supplementary Information and Supplemental Schedules for the year ending June 30, 2018*, San Juan, PR, December 18, 2018.

<sup>41</sup> *Ibid.* p. 4. It also states that, at June 30, 2016, PREPA had fixed assets valued at \$6,574.0 million.

<sup>42</sup> *Ibid.*, p. 10.

<sup>43</sup> The D/A ratio with respect to total fixed assets is 1.387 at June 30, 2016.

amount of outstanding bonds.<sup>44</sup> These bonds, as proposed in RSA, will be tax exempt, with 40 years maturity and a 5.25% coupon. Annual debt service, under this proposal, will be in the order of \$281.4 million, and an Alternative Transition Charge (ATC) will amount to 1.91 c/kwh. Because it is impossible to predict how electricity consumption will behave over a 40 years period, the Puerto Rico Energy Board should periodically – i.e., every year or every two years – revise the amount of the ATC to assure compliance with the debt service. However, it should be noted that PREPA’s asset values used for the computation of the ATC are based on the utility 2016 Financial Statements, which are prior to the 2017 hurricanes. Thus, the final value for restructured debt and the ATC should be calculated based on actual asset values, after passing of the 2017 hurricanes. Hence, the final values for restructured debt and the ATC would be even lower than the ones computed in this report.

4. Under this proposal, there is no need for Tranche B Bonds.
5. It should be noted that, as proposed, the interest in Tranche B Bonds is going to be accrued over time, until Tranche A Bonds are paid in full. If it is assumed that they are going to earn an average interest rate of 7.85%,<sup>45</sup> then the initial principal of \$904.2 for Tranche B Bonds, will grow to become a Tranche B Bonds principal of \$20,226 million by the 40<sup>th</sup> year of the RSA.

## Evaluation of the outlined Alternative Debt Restructuring Agreement

### Electricity Consumption

Since the proposed ATC is lower than the TC proposed in the RSA, it should be expected that the ATC is going to have a smaller impact on electricity consumption than the TC proposed in the RSA. To validate this hypothesis, demand equations for electricity were estimated for PREPA’s main customers categories, and total quantity demanded for fiscal years 2020 to 2024 were forecasted. The table below compares the resulting forecasts with those reported in PREPA’s Fiscal Plan, for the same fiscal years.<sup>46</sup>

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<sup>44</sup> \$4,668 million (the amount of debt that PREPA could afford to pay), divided by \$9,118 million, the amount of outstanding debt as of June 30, 2016, is equal to 0.511954, or 51.2%.

<sup>45</sup> 7.85% is the midpoint between the proposed coupon of 7.00% for tax-exempted Tranche B Bonds and 8.75% for non-tax exempted Tranche B Bonds.

<sup>46</sup> 2019 Fiscal Plan for the Puerto Rico Electric Power Authority As certified by the Financial Oversight and Management Board for Puerto Rico on June 27, 2019, p. 54.

**Forecasted PREPA Electricity  
Sales: Fiscal Plan and Alternative  
TC**

Fiscal Year	PREPA Sales (Fiscal Plan) Gwh	PREPA Sales Alternative TC Gwh
2020	15,832	15,277
2021	14,772	14,959
2022	13,972	14,815
2023	13,491	14,667
2024	13,150	14,565

From the table, it can be seen that electricity consumption tends to be higher under the ATC than what is forecasted in the Fiscal Plan, except in the case of FY2020. For example, in FY2024 it is expected that electricity consumption under ATC is going to be 10.8% higher than the value forecasted in the Fiscal Plan. Higher electricity consumption not only results in higher sales revenues, but it also provides better financial and operational stability to the Utility.<sup>47</sup>

Expected consequences on general economic activity

Electricity consumption is an indicator of the general level of economic activity. All production and market activities use electricity; normally, if other factors remain unchanged and electricity consumption declines, it is because of reduced general economic activity. To evaluate expected consequences of the ATC and the TC proposed in the RSA, an equation to forecast Gross National Product (GNP) at constant prices (i.e., without inflation) was estimated and used to forecast expected GNP at constant prices under the ATC and the TC proposed in the RSA.<sup>48</sup> The table below compares the results obtained.

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<sup>47</sup> Also, it would be very difficult for PREPA to engage in its planned privatization of electricity generation, if the outlook is that electricity consumption is going to shrink by 64.5% over the next 40 years, as implicitly assumed in RSA.

<sup>48</sup> Assumptions in the forecast include:

1. Total population is expected to continue declining, as assumed on page 59 of PREPA Fiscal Plan.
2. Extraordinary federal transfers for reconstruction after hurricanes Irma and María are not included. This because there is uncertainty about how much, when and under what conditions

**Comparison of ATC and TC in RSA on the Level of Economic Activity**

Forecasted Real GNP (\$million)			Change from Real GNP at FY2018 (\$million)		Change from Real GNP at FY2018 (%)	
Fiscal Year	GNP - AT C	GNP - TC in RSA	GNP - ATC	GNP - TC in RSA	GNP - ATC	GNP - TC in RSA
2020	5,948	5,819	222	92	3.9%	1.6%
2021	5,957	5,301	230	-425	4.0%	-7.4%
2022	5,972	5,524	246	-202	4.3%	-3.5%
2023	5,984	5,535	257	-191	4.5%	-3.3%
2024	5,999	5,519	272	-207	4.8%	-3.6%

As shown in the table, adopting the ATC is expected to do not have a significant impact on GNP at constant prices, while the TC proposed in RSA tends to further contract the level of economic activity, which has been steadily declining for over a decade.

**Expected consequences over employment**

The number of persons employed is determined by the level of economic activity. From fiscal years 2009 to 2018, on the average, it was required to employ 161.4 persons per million dollars of GNP at constant prices. Since, from the table on the previous page, it was seen that the ATC does not have any negative material effect on the level of economic activity, it neither is expected to have a negative effect on total employment. The TC proposed by the RSA, on the other hand, does have an expected significant impact on GNP at constant prices, and, in consequence, is expected to also have a negative effect on total employment. The table below quantifies the expected consequences of the TC in the RSA over employment for fiscal years 2012 to 2024.

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these transfers are going to happen. It should also be noted that, two years after the hurricanes, extraordinary transfers do not show any economic impact on the performance of local economy.

- Fuel prices at assumed to level over the forecasting period.



**Expected Employment Loss from  
Implementing the TC in RSA**

Fiscal Year	Employment Loss (persons)	Percent Loss of Employment with regard to FY2018
2021	-68,606	-7.1%
2022	-32,650	-3.4%
2023	-30,843	-3.2%
2024	-33,461	-3.4%

From the table it can be seen that implementing the proposed TC in the RSA, would result in a serious loss of employment, with serious adverse socioeconomic consequences:

1. Increased emigration of person in productive ages and with labor skills in demand.
2. Proportional increase in the old age population, further modifying the structure of aggregate demand for goods and services.
3. Increased pauperization in society.
4. Increased demand for social welfare services to a government that continues facing a fiscal crisis.
5. Shortages of professional in some specialized areas. This creates bottlenecks that generates adverse incentives to investment.

### Summary and conclusions

As a principle, we should repay as much of PREPA's debt as it is possible. The questions are: how much is possible without compromising future operation of the Authority?, and how the proposed Debt Restructuring Agreement impacts PREPA's future operational capacity and the local economy. These questions must be answered because it is the core for avoiding future financial and operational crisis in PREPA. This paper addresses these questions.

As stated earlier in this report, the TC proposed in the RSA is going to increase by 64.5% over the maturity life of the securitized bonds. The RSA assumes that PREPA's annual

sales (in Gwh) are going to decrease by 64.5% over time. This assumption is totally unfounded. Nobody can forecast electricity consumption in Puerto Rico – or, by that matter, in any other jurisdiction – over a 40 years period. In consequence, assumptions with regard to electricity demand over a 40 years period will surely result in flawed sales and income estimates. For that reason, it is much more reasonable for the Puerto Rico Energy Bureau to periodically review (every year or every two years) the amount to be imposed as TC.

As proposed by RSA, average annual collections from the TC over years 2 to 5 of RSA would be \$615.40 million, but estimated annual debt service for the restructured debt is \$367.93 million.

The RSA proposes that PREPA outstanding debt to be restructured to 67.5% in Tranche A Bonds, plus 10.0% in Tranche B Bonds. There is no explanation about how the RSA came to those percentages, or how the restructured debt compares to the situation in similar public utilities, or how the RSA is going to impact PREPA finances and operation. Additionally, no analysis is provided with regard of how the restructured debt payment will impact the local economy. These are relevant issues that should also be addressed.

When the financial data from electric power utilities in the USA is analyzed, it is reasonable to consider that an affordable D/A ratio for PREPA is 0.563. Given that PREPA had total assets in the amount of \$8,291.6 million at June 30, 2016, and that its outstanding long-term debt was \$9,118.2 million; then, applying the D/A ratio of 0.563, a sensible debt restructuring agreement should be to issue securitized bonds equivalent to 51.2% of principal amount of outstanding bonds. These bonds, as proposed in RSA, will be tax exempt, with 40 years maturity and a 5.25% coupon. Annual debt service, under this proposal, will be in the order of \$281.4 million, and an Alternative Transition Charge (ATC) will amount to 1.91 c/kwh. Because it is impossible to predict how electricity consumption will behave over a 40 years period, the Puerto Rico Energy Board should periodically – i.e., every year or every two years – revise the amount of the ATC to assure compliance with the debt service.

It should be noted that PREPA's asset values used for the computation of the ATC are based on the utility 2016 Financial Statements, which are prior to the 2017 hurricanes. Thus, the final value for restructured debt and the ATC should be calculated based on actual asset values, after passing of the 2017 hurricanes. Hence, the final values for restructured debt and the ATC would be even lower than the ones computed in this report.

Under this proposal, there is no need for Tranche B Bonds.

When expected consequences of ATC are compared with those of the TC proposed in the RSA, it was found that electricity consumption tends to be higher under the ATC than what is forecasted in the Fiscal Plan, except in the case of FY2020. For example, in

FY2024 it is expected that electricity consumption under ATC is going to be 10.8% higher than the value forecasted in the Fiscal Plan. Higher electricity consumption not only results in higher sales revenues, but it also provides better financial and operational stability to the Utility. Also, adopting the ATC is expected to do not have a significant impact on GNP at constant prices, while the TC proposed in RSA tends to further contract the level of economic activity, which has been steadily declining for over a decade. Also, since the ATC does not have any negative material effect on the level of economic activity, it neither is expected to have a negative effect on total employment. The TC proposed by the RSA, on the other hand, does have an expected significant impact on GNP at constant prices, and, in consequence, is expected to also have a negative effect on total employment. It is estimated that implementing the TC proposed in the RSA would reduce total employment in Puerto Rico by 17.1% over fiscal years 2021 to 2024.

Before concluding this report, it is important to point out that PREPA's Fiscal Plan of June 2019 proposes additional charges to electricity tariffs. The Fiscal Plan provides very limited justifications for such proposals, advances unjustified assumptions and does not provide any analysis of the impacts of such proposals upon the demand for electricity and their expected economic. A research is in progress to consider some key issues not taken into account by the Fiscal Plan.

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## Appendix B: Puerto Rico 2013 Input/Output Matrix Condensed to Eight Sectors

PUERTO RICO 2013 INPUT-OUTPUT MATRIX  
 Eight Sectors Transaction Matrix  
 (\$ thousands)

	Agriculture	Mining & Construction	Manufacture	Wholesale & Retail Trade	Hospitals & Health Serv	Electricity & Irrigation Serv	Other Services	Government	Total Intermediate
Agriculture	357805	41461	918559	51857	4200	61	203026	40624	1617593
Mining & Construction	7196	80702	716221	307442	64383	0	1433170	73292	2682406
Manufacturing	340202	1591546	19722328	801313	1137327	312320	4520069	1606847	30031952
Wholesale & Retail Trade	153090	194928	5201743	0	268781	1053	1362585	306350	7488530
Hospitals & Health Serv.	0	4	1	8	384304	605	9052	337663	731637
Electricity & Irrigation Serv.	4935	34253	563710	369360	33155	218094	490493	144920	1858920
Other Services	26173	1014027	1554122	4539432	1026312	51487	20054734	976664	29242951
Government	589	74772	109184	55006	4562	0	374472	80688	699273
Intermediate Inputs	889990	3031693	28785868	6124418	2923024	583620	28447601	3567048	74353262
Output	2128681	6656157	92152048	14915553	6993656	2354114	56935704	13746171	
I/O Ratio	0.4181	0.4555	0.3124	0.4106	0.4180	0.2479	0.4996	0.2595	

Source: PR Planning Board and computations by the author.

## Appendix C: Relevant Weights Used to Compute the Consumer Price Index

### EXPENDITURE WEIGHTS IN CPI

	Weights (Dec. 2006)
Apparel	4.24%
Education & communications	5.10%
Foods & beverages	22.78%
Other goods and services	9.79%
Housing & housing services	25.09%
Electricity	2.84%
Health services	5.47%
Entertainment	3.27%
Transportation	24.25%

## Appendix D: Regression Equation Used to Forecast GNP at constant prices

Dependent Variable: GNPR\_PR  
 Method: Robust Least Squares  
 Date: 07/27/19 Time: 07:51  
 Sample: 2000 2017  
 Included observations: 18  
 Method: MM-estimation  
 S settings: tuning=1.547645, breakdown=0.5, trials=200, subsmpl=5,  
 refine=2, compare=5  
 M settings: weight=Bisquare, tuning=4.684  
 Random number generator: rng=kn, seed=78871573  
 Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4254.805	2458.985	1.730309	0.0836
GDPR_US	0.121369	0.042667	2.844606	0.0044
POP	0.571799	0.483347	1.182999	0.2368
PWKH_REV	-12954.93	3022.620	-4.285993	0.0000
R	67.80919	23.26501	2.914643	0.0036

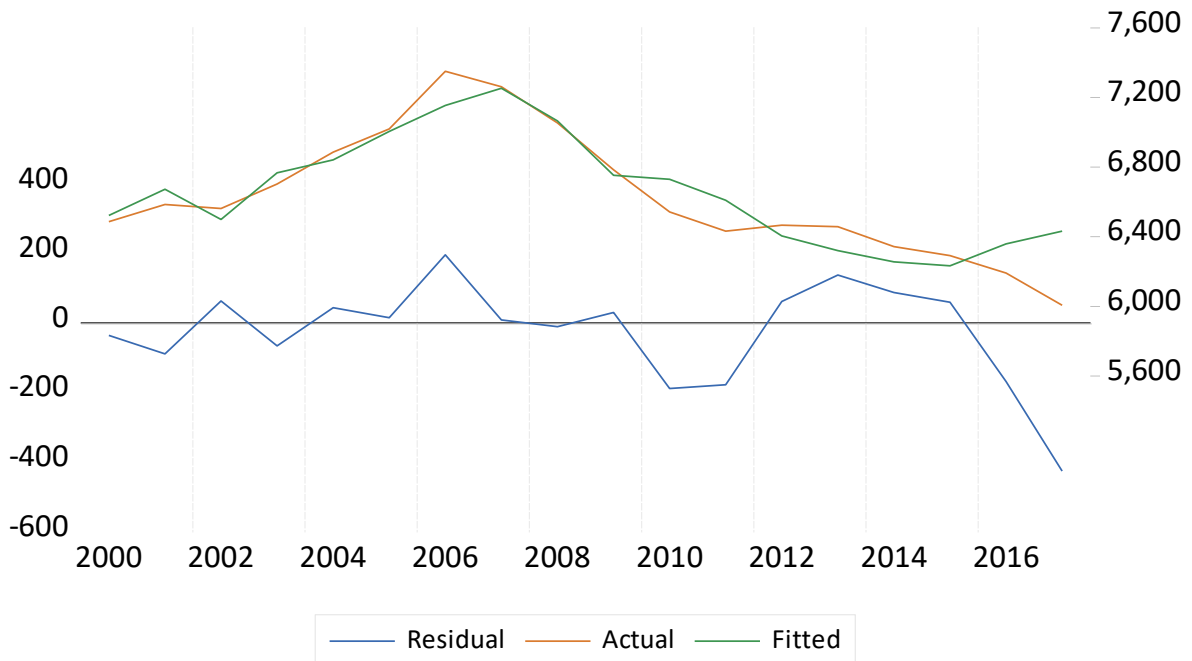
### Robust Statistics

R-squared	0.646910	Adjusted R-squared	0.538267
Rw-squared	0.903572	Adjust Rw-squared	0.903572
Akaike info criterion	32.30184	Schwarz criterion	37.47129
Deviance	243797.2	Scale	102.9122
Rn-squared statistic	64.11395	Prob(Rn-squared stat.)	0.000000

### Non-robust Statistics

Mean dependent var	6634.756	S.D. dependent var	363.9220
S.E. of regression	168.3897	Sum squared resid	368616.2

obs	Actual	Fitted	Residual	Residual Plot
2000	6487.10	6522.44	-35.3379	*.
2001	6585.10	6673.40	-88.3030	*.
2002	6562.60	6499.70	62.8995	.*
2003	6702.70	6768.10	-65.3976	*.
2004	6886.20	6842.32	43.8789	.*
2005	7019.60	7004.56	15.0376	*
2006	7350.60	7154.93	195.666	. *
2007	7261.60	7253.03	8.57402	*
2008	7054.20	7064.74	-10.5399	*
2009	6784.20	6753.74	30.4615	.*
2010	6541.80	6730.09	-188.286	*.
2011	6431.70	6609.23	-177.533	*.
2012	6466.20	6404.61	61.5895	.*
2013	6457.60	6320.07	137.532	. *
2014	6343.90	6256.57	87.3285	.*
2015	6292.20	6232.40	59.7954	.*
2016	6191.50	6359.59	-168.090	*.
2017	6006.80	6431.83	-425.034	*.



# Appendix E: Demand Equation for PREPA's Residential Customers

Dependent Variable: C\_ELECT\_RES  
 Method: Robust Least Squares  
 Date: 08/08/19 Time: 09:35  
 Sample: 2000 2017  
 Included observations: 18  
 Method: MM-estimation  
 S settings: tuning=1.547645, breakdown=0.5, trials=200, subsmpl=4,  
 refine=2, compare=5  
 M settings: weight=Bisquare, tuning=4.684  
 Random number generator: rng=kn, seed=765258960  
 Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-10699.11	2210.875	-4.839311	0.0000
PKWH	-10689.75	2557.885	-4.179137	0.0000
YPD	0.095363	0.018656	5.111700	0.0000
POP	3.910486	0.473498	8.258721	0.0000

### Robust Statistics

R-squared	0.566199	Adjusted R-squared	0.473242
Rw-squared	0.830297	Adjust Rw-squared	0.830297
Akaike info criterion	23.16494	Schwarz criterion	30.91312
Deviance	908863.8	Scale	216.7158
Rn-squared statistic	71.41569	Prob(Rn-squared stat.)	0.000000

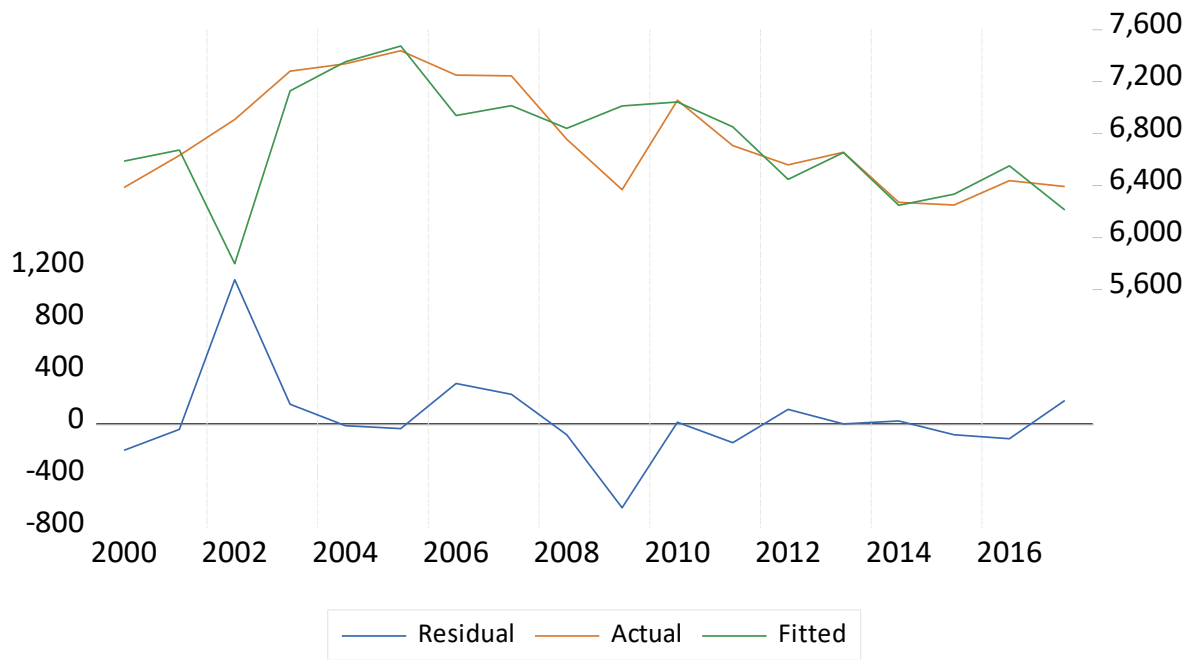
### Non-robust Statistics

Mean dependent var	6774.022	S.D. dependent var	402.1188
S.E. of regression	374.0134	Sum squared resid	1958404.

obs	Actual	Fitted	Residual	Residual Plot
2000	6385.00	6587.82	-202.815	* .
2001	6631.70	6672.64	-40.9408	*
2002	6909.50	5799.43	1110.07	. *
2003	7280.50	7128.29	152.207	. *
2004	7338.10	7351.61	-13.5115	*
2005	7437.90	7474.44	-36.5387	*
2006	7250.30	6938.25	312.045	. *
2007	7243.60	7015.67	227.929	. *
2008	6757.10	6840.81	-83.7119	* .
2009	6367.50	7012.42	-644.917	* .
2010	7056.80	7043.08	13.7236	*
2011	6707.50	6851.90	-144.403	* .
2012	6559.60	6447.28	112.323	. *
2013	6655.70	6655.44	0.25521	*
2014	6270.80	6247.95	22.8530	*
2015	6249.70	6333.57	-83.8740	* .
2016	6439.00	6552.63	-113.633	* .



2017 6392.10 6212.46 179.641 || . \* |

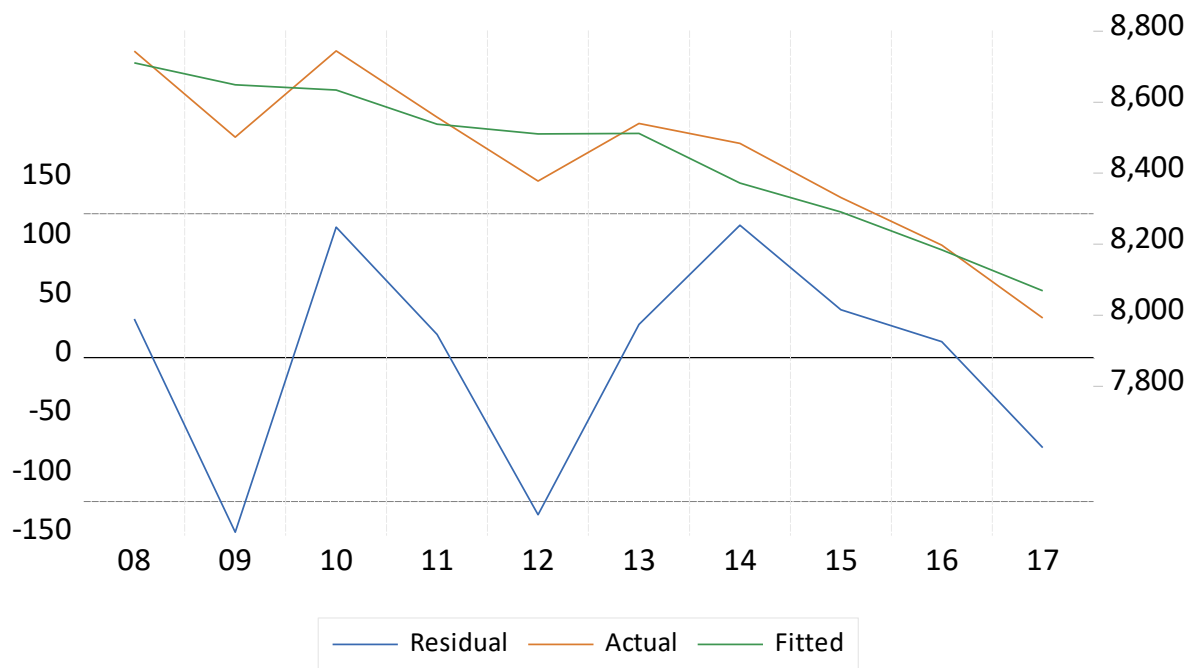


## Appendix F: Demand Equation for PREPA's Commercial Customers

Dependent Variable: C\_ELECT\_C  
 Method: Two-Stage Least Squares  
 Date: 08/08/19 Time: 13:03  
 Sample: 2008 2017  
 Included observations: 10  
 Convergence achieved after 12 iterations  
 Instrument specification: GNPR\_PR GDPR\_US INFLACION  
 Constant added to instrument list  
 Lagged dependent variable & regressors added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2214.728	1912.499	1.158028	0.2992
PKWH	-330.5224	1124.040	-0.294049	0.7805
YN_COM_SERV	0.032966	0.052484	0.628120	0.5575
POP	1.555937	0.298206	5.217654	0.0034
AR(1)	-0.250861	0.454331	-0.552155	0.6046
R-squared	0.848789	Mean dependent var		8447.070
Adjusted R-squared	0.727820	S.D. dependent var		232.9500
S.E. of regression	121.5321	Sum squared resid		73850.22
Durbin-Watson stat	2.396170	J-statistic		1.572128
Instrument rank	8	Prob(J-statistic)		0.665726
Inverted AR Roots	-0.25			

obs	Actual	Fitted	Residual	Residual Plot
2008	8743.70	8711.00	32.7001	.   *   .
2009	8501.30	8648.77	-147.473	*.     .
2010	8744.20	8634.07	110.129	.     *.
2011	8557.90	8538.28	19.6225	.     *   .
2012	8378.10	8510.88	-132.784	*.     .
2013	8540.10	8512.09	28.0093	.     *   .
2014	8483.80	8371.94	111.857	.     *   .
2015	8331.30	8290.86	40.4389	.     *   .
2016	8197.70	8184.21	13.4854	.     *   .
2017	7992.60	8068.59	-75.9859	.   *   .



# Appendix G: Demand Equation for PREPA's Industrial Customers

Dependent Variable: CELECT\_M  
 Method: Robust Least Squares  
 Date: 08/12/19 Time: 12:47  
 Sample: 2000 2017  
 Included observations: 18  
 Method: MM-estimation  
 S settings: tuning=1.547645, breakdown=0.5, trials=200, subsmpl=4,  
 refine=2, compare=5  
 M settings: weight=Bisquare, tuning=4.684  
 Random number generator: rng=kn, seed=2069320706  
 Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	8123.459	1378.982	5.890911	0.0000
PKWH_M	-2971.362	4569.783	-0.650220	0.5156
GDPR_US	-0.220162	0.170870	-1.288475	0.1976
YN_MANUF	-0.029515	0.050646	-0.582760	0.5601

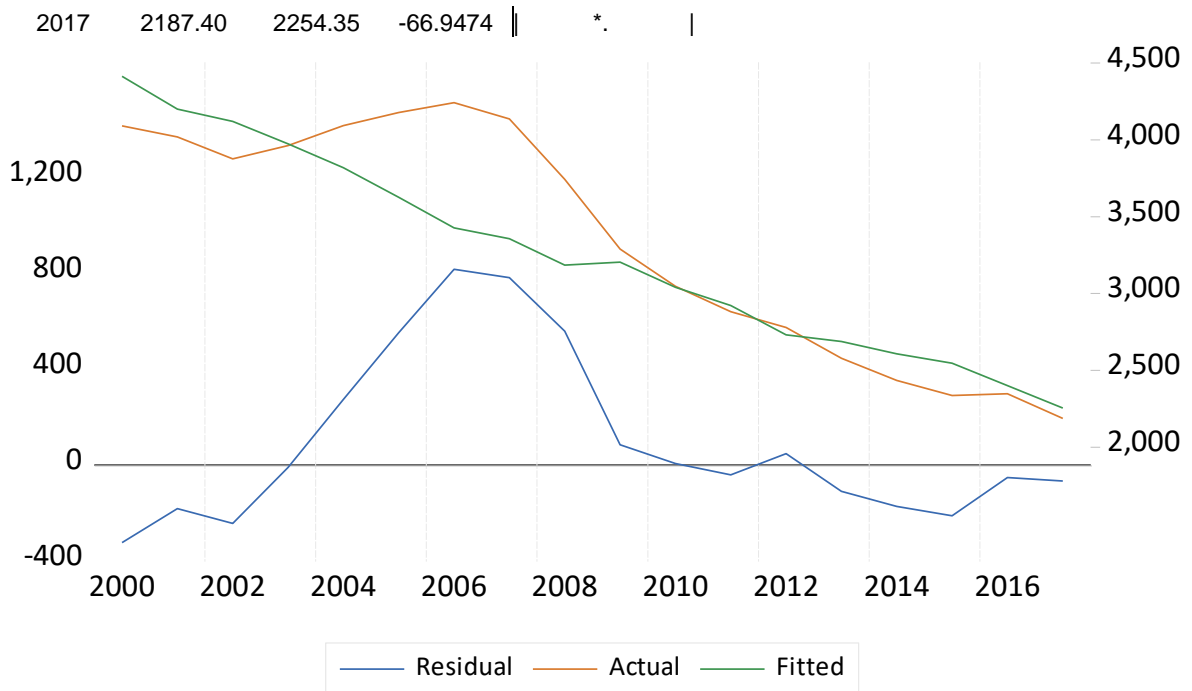
### Robust Statistics

R-squared	0.576868	Adjusted R-squared	0.486197
Rw-squared	0.880527	Adjust Rw-squared	0.880527
Akaike info criterion	36.87444	Schwarz criterion	40.43760
Deviance	1520756.	Scale	229.4882
Rn-squared statistic	37.84651	Prob(Rn-squared stat.)	0.000000

### Non-robust Statistics

Mean dependent var	3345.428	S.D. dependent var	763.6260
S.E. of regression	402.0701	Sum squared resid	2263245.

obs	Actual	Fitted	Residual	Residual Plot
2000	4090.60	4414.01	-323.414	* .
2001	4018.70	4200.32	-181.621	* .
2002	3876.40	4119.19	-242.788	* .
2003	3963.40	3973.70	-10.3015	* .
2004	4092.10	3819.14	272.955	. *
2005	4177.40	3626.57	550.828	. *
2006	4241.80	3426.48	815.323	. *
2007	4136.30	3356.26	780.044	. *
2008	3742.60	3185.15	557.451	. *
2009	3288.40	3204.18	84.2192	. *
2010	3047.20	3041.02	6.18385	* .
2011	2881.10	2922.12	-41.0164	* .
2012	2778.60	2731.75	46.8546	. *
2013	2578.20	2688.24	-110.043	* .
2014	2434.30	2606.92	-172.618	* .
2015	2335.70	2546.79	-211.093	* .
2016	2347.50	2400.07	-52.5726	* .



## Appendix H: General Assumptions Used in Estimating Demand Equations for Electricity and Forecasting Consumption

1. Electricity prices: Actual prices until FY 2019 were obtained by dividing PREPA's Total Revenues by Total Consumption in each tariff category (residential, commercial and industrial). Expected future prices were estimated by tariff category adding the corresponding increase in price for each scenario to the average price in FY 2019.
2. Population: For FY 2000 to 2018 it was used actual population values as reported by PR Planning Board, *Statistical Appendix to the Economic Report to the Governor, 2018, and previous issues of the report*. For years after FY 2018, Population estimated were taken from PREPA's Fiscal Plan, p. 59.
3. Disposable Personal Income: For FY 2000 to 2018 it was used the actual Disposable Personal Income values as reported by PR Planning Board, *Statistical Appendix to the Economic Report to the Governor, 2018, and previous issues of the report*. For years after FY 2018, annual values were estimated by adding the average growth rate registered from fiscal years 2008 to 2018.
4. National Income of Commerce and Services: For FY 2000 to 2018 there were added actual values of National Income (or Net Income) for all categories in commerce and services, as reported by PR Planning Board, *Statistical Appendix to the Economic Report to the Governor, 2018, and previous issues of the report*. For years after FY 2018, annual values were estimated by adding the average growth rate registered from fiscal years 2008 to 2018.
5. National Income of Manufacturing: For FY 2000 to 2018 it was used the actual values of National Income (or Net Income) in manufacturing, as reported by PR Planning Board, *Statistical Appendix to the Economic Report to the Governor, 2018, and previous issues of the report*. For years after FY 2018, annual values were estimated by adding the average growth rate registered from fiscal years 2008 to 2018.
6. Gross Domestic Product in the US: For years 2000 to 2018 it was used actual values of Gross Domestic Product in the US, as reported by the Federal Reserve Bank of Saint Louis in its website FRED. For years after 2018, the forecasts of the Congress Budget Office were used.